

Uneven geographies of low-carbon transition: exploring energy
vulnerabilities in peripheral communities

By Kate O'Sullivan

Thesis submitted for the degree of Doctor of Philosophy

School of Geography and Planning

Cardiff University

September 2019

Abstract

The ongoing transition of the energy system are altering the way energy is produced, distributed and consumed. It has the promise of increased energy democracy and more distributed decentralised developments and benefits. Yet, not everyone or every place has equal access to these transition opportunities. Access to energy is already precarious for some households leading to what is conceptualised in literature as energy vulnerabilities and energy injustice. However, little explored remains how the nature of place – in its interplays with social, economic and political factors – impacts upon energy vulnerabilities and energy transition.

This thesis fills this gap by exploring energy transition experiences in sub-regional peripheries of South Wales, illuminating the interplay between vulnerability, peripherality and transition. It does so by adopting an energy justice and spatial justice framework, a qualitative case study methodology and mixed research methods including interviews, personal observations, document and secondary data analysis. The research demonstrates how drivers of energy vulnerabilities (such as difficulty in affording and accessing energy) are place-specific and defined by factors associated with peripheralization: lack of agglomerative advantage, political peripheralization, sparse and shrinking population, poor energy infrastructure, high energy costs, high costs of living, dependence on external investment, limited employment opportunities and low incomes. Peripheralization is a self-reinforcing circular process, driven by disadvantageous political, symbolic, economic processes manifest spatially. The mutually reinforcing circles of peripheralization and energy vulnerabilities limit economic, political and social capacity to transition and restrain transition benefits.

Research findings overall elucidate the production of spatially contingent energy vulnerabilities, thus also making contribution to the advancement of energy vulnerability and transition literature. It is also shown that geographic processes influence transition mode, trajectory and outcomes. Policy implications are identified, including the importance of recognising that energy vulnerability is influenced by place-specific factors currently unaccounted for in fuel poverty policy.

Acknowledgements

I would like to thank the numerous people who have volunteered their time and knowledge to participate in this research. Thank you for opening your homes, community and workspaces and taking time out of your day to sit and talk with me. Each interview provided new and invaluable perspectives without which this research would not have been possible.

I am indebted to the support of my supervisory team, Dr Oleg Golubchikov and Dr Abid Mehmood. I am extremely lucky to have experienced such mentorship. Your patience, direction and knowledge while invaluable in completing this research, has also given me the tools to continue on my research journey; I also owe thanks to Clare Parsons, Brecon Beacons National Park Authority, your in-depth understanding of the Parks communities, landscapes and the Authority itself proved invaluable in this research. I am also grateful to my reviewer Professor Gill Bristow for her time and extremely valuable advice at every stage of this study.

I would like to thank my colleagues and friends who have supported me on this journey. My fellow PhD Students, Andy, Justyna and Christina, I owe you all thanks for your reassurances and comradery, it was so good to know we have been in this together!

I would like to express my gratitude to my friends and family for their constant support, and encouragement. I would not have been able to undertake this research without you all. Particularly, I want to thank my daughter Bonnie for forcing me to have some fun along the way.

Parts of this thesis have been presented at the Royal Geographic Society Annual Conference; I am appreciative of the input on my ideas received at this event. Portions of this thesis have also been published as journal articles co-authored with my supervisory team. I am grateful again to my supervisors for helping me adjust to the publishing process and also for the feedback of editors and peer-reviewers in refining my thoughts.

This thesis was facilitated by an Economic and Social Research Council studentship and the Brecon Beacons National Park Sustainable Development Fund. I am thankful for the financial assistance provided by this which enabled me to pursue my research.

Contents

Chapter 1. Introduction.....	9
Chapter 2. Energy Vulnerability: Linking energy justice, social justice and vulnerability	19
2.1 Introduction	19
2.2 Fuel Poverty: Initial understandings of domestic energy deprivation	21
2.3 Energy justice: A lens for understanding domestic energy deprivation	29
2.4 Energy vulnerability: An alternative conceptualisation?.....	33
2.5 Conclusion.....	40
Chapter 3. Low-carbon energy transition: Implications for energy and spatial justice	43
3.1 Introduction	43
3.2 Low-carbon energy transition in the UK: A spatially uneven process	45
3.3 Towards a ‘just’ socio-technical transition process.....	54
3.4 Accounting for geographies: A spatial justice framework	63
3.5 Conclusion.....	70
Chapter 4. Energy peripheries: Spatial injustice and energy vulnerability.....	72
4.1 Introduction	72
4.2 Spatial differentiation: Core-periphery development	74
4.3 Spatial injustice and peripheralization: The case of Wales	80
4.4 Spatialized energy vulnerability	92
4.5 Conclusion.....	98
Chapter 5. Methodology	101
5.1 Introduction	101
5.2 Methodology: A qualitative case study	103
5.3 Getting to know the case: Pilot studies.....	113
5.4 Data collection methods	114
5.5 Data collection considerations.....	117
5.6 Sampling and recruitment.....	121
5.7 Ethical considerations.....	134
5.8 Thematic data analysis.....	135
5.9 Evaluating the research: A critique of qualitative inquiry	140
5.10 Conclusion.....	143
Chapter 6. Peripheral energy and spatial injustice: Representation, recognition, energy vulnerabilities and transition	145
6.1 Introduction	145
6.2 National political peripheralization	146
6.3 Regional and sub-regional political peripheralization.....	151
6.4 The Brecon Beacons National Park: Further political peripheralization.....	165
6.5 Conclusion.....	174

Chapter 7. Peripheral economies, infrastructures and living costs: Embedded energy vulnerabilities and disparate transition opportunities	176
7.1 Introduction.....	176
7.2 Peripheral economy and income: Unaffordable energy and transition?	178
7.3 The necessity of personal transport: A peripheral specific energy need.....	188
7.4 Peripheral energy infrastructure: Precarious energy access, affordability and security of supply.....	193
7.5 Peripheral housing stock & tenure: Inescapable inefficiencies.....	205
7.6 Conclusion	212
Chapter 8. Discussion & Conclusions: Energy Periphery, place-based energy injustices and transitions.....	216
8.1 Introduction.....	216
8.2 Experiences of peripherality: Interplaying spatial and energy injustices.....	218
8.3 Energy Peripheries: Energy vulnerable places.....	223
8.4 Energy Periphery in transition	231
8.5 Implications for justice.....	247
8.6 Recommendations to harness energy transition and reduce peripheral vulnerabilities	254
8.7 Research limitations & further research.....	256
References	259
Appendix 1. UK Government Fuel Poverty Policy 1991-2018	308
Appendix 2. UK Government Climate Change Policy 1994-2019.....	311
Appendix 3. Interview Protocols	315
Appendix 4. List of events attended for context building, observation and potential interview recruitment	320
Appendix 5. Research Poster	321
Appendix 6. Ethical Approval	322

List of Figures

Figure 2.1. Conceptualization of energy vulnerability.....	37
Figure 3.1. UK energy use by source 1970-17.....	48
Figure 3.2. Electricity production in the UK 1996-17.....	49
Figure 3.3. UK energy consumption by sector 1970-17.....	50
Figure 3.4. Renewable energy capacity per UK country.....	52
Figure 3.5. Devolved administration GHG emissions by sector.....	53
Figure 3.6. Multi-level perspective on transitions.....	58
Figure 4.1. Conceptualization of regional peripheral disadvantage.....	78
Figure 4.2. UK constituent countries.....	82
Figure 4.3. GVA per head of population.....	84
Figure 4.4. Income estimated 2011/12.....	84
Figure 4.5. Elements of peripheral formation combined with associated energy vulnerabilities.....	96
Figure 5.1. BBNP and Local Authorities.....	108
Figure 5.2. Settlement distribution in and around the BBNP.....	109
Figure 5.3. Conceptualization of interview group embeddedness.....	122
Figure 5.4. Wales built up areas (BUA), largest cities (population), national parks and locations of household, community and SMI interviews.....	123
Figure 6.1. Renewable electricity production in the UK (2000-2017).....	148
Figure 6.2. Local Authority urban and rural classifications and population density.....	153
Figure 6.3. Access to service deprivation in Wales.....	154
Figure 6.4. Income deprivation and employment deprivation in Wales.....	158
Figure 6.5. Areas in receipt of Arbed Years 1, 2 and 3.....	159
Figure 6.6. Location of renewable energy developments (1 MW and above), areas of deprivation and Strategic Search Areas (SSAs).....	161
Figure 6.7. Community based low-carbon transition.....	172
Figure 7.1. Welsh gross value added (GVA) per head for NUTS3 local areas, 1998 to 2016.....	178
Figure 7.2. Percentage of jobs lower than the applicable Living Wage Foundation living wage.....	182
Figure 7.3. Low-carbon measures as a means of securing supply and increasing business viability.....	185

Figure 7.4. Farm based micro-hydro offering security of supply and security of income..	186
Figure 7.5. Low-carbon installation financial risk and cost for an SME.....	187
Figure 7.6. UK & Wales travel distances achievable within 1 hour (by car).....	189
Figure 7.7. Index of UK retail prices and cost of transport in Wales.....	189
Figure 7.8. Household vehicle expenditure to income.....	192
Figure 7.9. Main gas and electricity network structure of the UK.....	193
Figure 7.10. Annual domestic bill for gas and electricity in 2018 across UK regions.....	194
Figure 7.11. Welsh Electricity sub-station location and capacity.....	195
Figure 7.12. Off-gas areas in Wales.....	195
Figure 7.13. Outdoor tank used for oil storage.....	196
Figure 7.14. Solid fuel Rayburn.....	200
Figure 7.15. Household solution to energy vulnerability (access and affordability)	
installing wood-burner.....	202
Figure 7.16. Domestic Ground Source Heat Pump (GSHP) Condenser and necessary	
plumbing.....	203
Figure 7.17. Row of stone-built terrace cottages (circa 1890s), most with external wall	
insulation cladding (mix of privately funded and Arbed).....	206
Figure 7.18. Row of stone-built terrace houses (circa 1890s).....	206
Figure 7.19. Semi-detached stone and brick-built houses (circa 1900) with external	
rendering.....	206
Figure 7.20. Percentage domestic EPC Bands F or G.....	207
Figure 7.21. Roof-mounted solar-PV.....	209
Figure 8.1. Interplay of peripheralization elements and energy vulnerability drivers.....	227
Figure 8.2. Interplay of peripheralization elements and energy vulnerability with ‘upstream’	
energy processes in the periphery.....	228

List of Tables

Table 3.1. Devolution of energy related powers in the UK.....	51
Table 3.2. Devolved Administrations GHG reduction targets and progress.....	52
Table 4.1. UK transport policy devolution levels.....	87
Table 4.2. Energy vulnerability drivers linked to peripheralization elements.....	97
Table 5.1. Local Authorities within the BBNP boundary.....	108
Table 5.2. Criteria used to select case study area.....	111
Table 5.3. Case study participants.....	126
Table 5.4. Household interview group breakdown.....	129
Table 5.5. Percentage gender in interview sample and Wales.....	132
Table 5.6. Percentage age groups in interview sample and Wales and BBNP.....	132
Table 5.7. Household composition (number of residents per home) in interview sample and Wales and BBNP.....	132
Table 5.8. Percentage of different housing tenure in interview sample and Wales.....	132
Table 5.9. Building attachment and age, interview sample and Wales and BBNP.....	133
Table 5.10. Percentage building material, interview sample only.....	133
Table 5.11. Percentage building material and mains gas access, interview sample, Wales and UK.....	133
Table 5.12. Example of codes applied to a Community Perspective text extract.....	137
Table 5.13. Final themes and example codes for each interview group.....	139
Table 6.1. Breakdown of urban and rural Local Authorities in Wales.....	153
Table 6.2. Local Authority staff size and area covered.....	156
Table 6.3. Average house price in BBNP compared to weighted average of Local Authorities within its boundaries.....	166
Table 6.4. Domestic insulation types, economic cost and savings.....	169
Table 7.1. Local Authorities within the BBNP boundary GVA and relative rank in Wales.....	179
Table 7.2. Additional weekly rural costs for 4 illustrative household types, compared with UK urban Minimum Income Standard.....	197
Table 8.1. Peripheral low-carbon transition energy vulnerability opportunities and injustices	246

Chapter 1. Introduction

Energy justice calls for the fair and equitable distribution of costs and benefits for all throughout the energy system. Yet energy systems all over the world are misaligned with this concept leaving many people deprived of the energy they need, unable to take advantage of opportunities for benefits, and/or more likely to incur other costs. In the UK it is estimated that there are approximately 3.65 million households that are currently fuel poor (Department for Business Energy and Industrial Strategy [BEIS] 2018a), living without the energy they need to access fundamental services such as heat, light, cooked food and transportation. Consequently, they are at higher risk of poor physical and mental health, poor educational attainment, and social exclusion.

Fuel poverty is now a political concern (Hills et al. 2013; Boardman 2015). However, despite illuminating the risks associated with energy deprivation and enabling formal assistance to many households in fuel poverty, the concept is narrow, focusing on causes of deprivation at the point of energy consumption, or ‘end-use’. In this way, policy interventions have enjoyed limited success and unfortunately while recognising many people at risk, still overlook many others. Similarly, the concept of ‘energy poverty’ used mostly to conceptualise energy deprivation in the global south due to mainly infrastructural limitations has been critiqued for its narrowness (Bouzarovski 2013). Energy vulnerability is a more comprehensive concept, combining elements of fuel poverty and energy poverty (Day & Walker 2013; Bouzarovski et al. 2014). It is conceptualized as “the propensity of an individual to become incapable of securing a materially and socially needed level of energy service in the home” (Bouzarovski et al. 2014, p.10). In this way it differs from fuel poverty and energy poverty, which are outcomes of precarious energy contexts, instead, exploring and highlighting the multiple factors that create such precarious contexts. Energy vulnerability comprises six drivers; access, affordability, flexibility, energy efficiency, needs and practices (Simcock & Petrova 2017). As such, energy vulnerability expands fuel poverty considerations to be able to include more nuanced factors such as climate, energy networks and socio-cultural practices while still including factors accounted for in fuel poverty, such as building structures and energy price.

However, while energy vulnerability accounts for multiple socio-economic structures that make accessing energy precarious, it does not necessarily address the differential

influence of place and space – in other words, the geography of vulnerability. It is important that this aspect of energy vulnerability is understood as people, communities or places may be more or less energy vulnerable depending on their spatial position. For example, places spatially differentiated by hierarchical socio-spatial structures such as core or periphery, where the periphery is economically, culturally and politically disadvantaged relative to the core. Spatial hierarchies work at multiple scales, evident between countries, between regions within countries and also inter-regionally between differently defined areas, such as urban and rural. Hierarchies are formed and continuously reinforced by the agglomeration of social, political and economic power within cores but reduced within peripheries. In weaker social, economic and political positions peripheries are likely to experience social, economic and political marginalization. Thus, peripheralization is considered “a spatially organized inequity of power relations and access to material and symbolic goods that constructs and perpetuates the precedents of the centre over the marginalized” (Fischer-Tahir & Nauman 2013, p. 18). Peripheralization in this way can be considered a spatial injustice.

The development and sustainment of core and periphery are theorised as influenced by virtuous or vicious circles (Myrdal 1957; Krugman 1991; Fujita et al. 1999; Copus 2001) whereby once a process of growth or decline commences it becomes self-perpetuating and difficult to intercede. Energy is implicated within these processes of spatial development and differentiation in several ways. In requiring natural resource extraction for its production, then during its distribution and consumption, energy is physical (or material) and consequently is bound to space in different ways at different points within the “whole system” (Healy et al. 2019, p. 219). Furthermore, existing spatial hierarchies influence how and where the costs and benefits within each stage of the whole energy system are distributed across space. This can, for example, influence locations of intrusive energy development, who can access the energy produced, at what cost, or where energy waste is disposed of. Peripheries more likely to experience social, economic and political marginalization, hold less power to influence decisions over energy resource access and allocation, this includes over natural resources, produced goods and public spending, including that on essential energy services. It also limits peripheral ability to utilize indigenous resources, including those required for energy, in ways that maximize the benefit to the periphery instead of or in addition to the core. In this way, the spatial injustice experienced by peripheries can lead to energy injustice, but energy injustice also feeds into processes of spatial injustice.

Within this existing landscape of core and periphery with already embedded energy injustices and vulnerabilities, the energy system is transitioning from high-carbon to low-carbon. This transition is driven by recognition at multiple scales that global energy demand is predicted to increase (Chalvatzis & Ioannidis 2017), and if met using current energy sources where fossil fuel remain dominant, hold direct implications for climate change (United Nations Development Programme 2000; Intergovernmental Panel on Climate Change [IPCC] 2014; United Nations General Assembly 2015). In addition, many countries are dependent on imported energy to meet their populations energy needs (Chalvatzis & Ioannidis 2017), raising concerns for security of supply and control over energy costs (Everet & Rampage 2012; Hawkey et al. 2013). In response to these issues of energy security, affordability and environmental sustainability otherwise referred to as the “energy trilemma” (Pye et al. 2015 p. 673), many countries are taking steps to reduce their carbon consumption and emissions, increasing and diversifying indigenous low carbon energy supplies, thus reducing reliance on carbon-heavy fossil fuel imports (Poudineh & Jamasb 2012). The UK has announced a ‘climate change emergency’ laying legislation to “eradicate its net contribution to climate change by 2050” (Gov.UK 2019, para 1). In addition, the UK has previously agreed to a 15% proportion of the EU carbon reduction target (Hammond & Pearson 2013; Hannon et al. 2013) and has set binding national and international targets (Climate Change Act 2008; European Commission 2019). Within the UK, devolved nations, including Wales, had already declared climate change emergencies (Scottish Government 2019; Welsh Government 2019a) and have also set carbon emission reduction and renewable energy production targets (Welsh Government 2017b). Such targets have initiated many strategies towards their achievement, encouraging renewable energy production and increased energy efficiency at multiple scales.

Transition necessitates added urgency in gaining understandings of spatial aspects of energy vulnerability. Low-carbon transition offers many opportunities to ensure that the energy regime going forward is more ‘just’ than previously. Transition can increase “energy democracy” (Szulecki 2018, p.21) by liberating ‘lock-in’ to traditional carbon heavy energy and de-monopolise and de-centralise what has been traditionally a centrally governed and largely centrally owned system (Foxon 2013). Additionally, local ownership of energy production is recognised as a means of retaining economic benefit within a local economy (Jones 2015; Benedek et al. 2019). Transition within this framing appears to reduce carbon emissions and climate change, in addition to challenging

existing capitalist structures that gravitate towards agglomeration, centralisation and maximum profit.

However, transition holds costs as well as benefits and as is being evidenced in multiple places at varying scales, the distribution of these costs and benefits is not evenly distributed. It is increasingly recognised that low-carbon transition may increase energy vulnerability of social groups already in fuel poverty (Bouzarovski et al. 2017). This is because low-carbon transition, without concerns for justice can “lock-in patterns of exploitation and dispossession” (Healy & Barry 2017, p. 451) through restricting immediate and longer-term benefits of participation in the transition process to those with the most economic and socio-political capacity. Thus, “the challenge of low-carbon energy transition is not just one of shifting to a new and less carbon intensive socio-technical regime. It is also a challenge in terms of making sure societal costs, risks and benefits of that shift are distributed in a way that can be considered ‘just’” (Sareen & Haarstad 2018, p. 624).

Disadvantages associated with peripheralization such as poor infrastructures (including energy), lower incomes and weak governance influence (Copus 2001) link with many aspects of energy vulnerability and also ability to transition. Thus, energy vulnerability, spatialization and transition processes appear highly interlinked, however, academic research has tended to focus on each process individually or as a combination of only two. For example, spatial dimensions of energy justice (Bridge et al. 2013; Balta-Ozkan et al. 2015; Yenneti et al. 2016; Bouzarovski & Simcock 2017) and energy vulnerability (Bouzarovski 2013; Bouzarovski & Triado Herrero 2017; Simcock & Petrova 2017) have begun to be conceptualized, and transition literature has incorporated energy justice (Bouzarovski & Simcock 2017; Healy & Barry 2017; Monyei et al. 2018; Jenkins et al. 2018). Within this emerging field of research there remains a gap in understanding the interplay between geographical processes of spatialization, energy vulnerabilities and low-carbon transition. Understanding such interplay is essential as it illuminates how and where energy vulnerabilities currently exist and how this may or may not change over space and time during transition; how and where transition will progress and to what effect on energy vulnerability and spatialization; and finally how existing spatial structures and hierarchies may influence energy vulnerabilities and modes, locations and outcomes of transition. Such insights will illuminate the spatial distribution of the costs and benefits of transition, thus how just transition currently is across space.

This research seeks to address this research gap, adopting a spatial justice and energy justice framework to illuminate the tripartite interplay between peripheralization and the economic, social and political disadvantages it holds, with energy vulnerability and energy transition. The research is part-funded by the Brecon Beacons National Park Authority (BBNPA) Sustainable Development Fund (SDF) which along with theoretical and pragmatic considerations has meant part of the research activity is within the Park boundary. Theoretical considerations include an understanding of peripheries as socially constructed places of relative low value, experiencing socio-cultural, economic and political disadvantage. These disadvantages perpetuate circular processes of social, economic and political marginalization, realised spatially. They also create and continuously reinforce a dependence on the core. As a relative place, periphery development is symbiotic with core development, peripheries are often spatially distal from cores, on the edge or fringe of core spaces. As a socio-spatial construct, peripheries are subject to scale, thus peripheries can be different places within a neighbourhood, sub-region, region, country or the globe; core places can hold within them lower scale peripheries and peripheries can hold within them lower-scale cores. For the purpose of this research, this theoretic was simplified using Copus (2001) peripheralization model to select places of relative peripherality in Wales.

Thus, the case study is located in and around the Brecon Beacons National Park (BBNP), Mid-South Wales. As observed by Fischer-Tahir & Nauman (2013), often peripherality coincides with rurality (although not exclusively), this is the case here where the study area is made up of predominantly rural areas but also some exurban and post-industrial areas. Within the case study energy has and continues to play a unique role in determining spatial orderings, offering an excellent vantage point to explore variegated reasons for and experiences of energy vulnerability and energy transition within the periphery. To formulate specific research aims, consideration was given to a number of key areas;

- First, the heterogeneity of peripheralization processes and resulting disadvantages, and the multiple ways in which energy vulnerability can be experienced.
- Second, understanding energy transitions as multi-scalar processes influenced in different ways, at different scales by the social, economic, and political position of its actors.

- Finally, within the three key foci of this research: peripheralization; energy vulnerability; and energy transition, how policy has played a key role.

The position of policy making institutions in urban centres, uneven distributions across devolved nations and their regions of policy powers, public funding and political autonomy can interplay with economic and social peripheralization processes. Transition literature has pointed to the strong influence of policy in driving transition towards certain goals, crediting policy targets and incentives for the progress made in the UK in reducing Green House Gas (GHG) and carbon dioxide emissions and increasing renewable energy production. Fuel poverty literature has highlighted the mix of both alleviation of and worsening of fuel poverty due to misaligned policy objectives. Thus, a key area of research interest centred on the role of policy and political governance in processes of peripheralization, energy vulnerability and energy transition. Therefore, the following research questions were posed:

- a) How is peripherality experienced within and around the Brecon Beacons National Park, Wales?
 - How do political, economic and social factors interplay at multiple scales to influence peripherality at regional scales within Wales?
 - How does the production of peripheries at multiple scales influence experiences of periphery at a sub-regional/local scale?
 - How is peripherality experienced at a sub-regional scale?
 - How and to what effect does peripherality impact and interplay with energy vulnerabilities?

- b) How does energy vulnerability manifest within and around the Brecon Beacons National Park, Wales?
 - How is energy vulnerability experienced within a periphery?
 - What are the key conditions affecting energy vulnerabilities in a periphery?
 - How are key energy vulnerability conditions affecting peripheries produced?
 - How are peripheral communities counteracting energy vulnerabilities?

- c) How is low-carbon energy transition experienced within and around the Brecon Beacons National Park, Wales?

- How do energy vulnerability and peripherality interplay with social, economic and political contexts to influence involvement in low-carbon practices and innovations?
- How do low-carbon energy practices and innovation impact upon vulnerability and peripherality?
- How do low-carbon energy practices and innovations interplay with the socio-economic evolution of peripheral places?

To answer these questions a qualitative case study methodology was used providing scope to include a range of different scale energy actors, from energy producers, energy consumers and overall energy governance that included interviews with households, community groups, third, public and private sectors. The case area was bound an area that included rural, exurban and post-industrial peripheries of Mid-South Wales. In this way the research exemplifies a multitude of perspectives that may be spatially influenced and thus illuminates via multiple perspectives the interplay between processes of peripheralization, energy vulnerability and energy transition in Wales.

The thesis is structured as follows. *Chapter 2* explores the evolution of the concept ‘energy vulnerability’. To do so, concepts of energy justice and fuel poverty are unpacked, highlighting their development from theories of social and environmental justice and their political and public use and impact. A critique of fuel poverty is outlined, due to its narrow definition that focuses on energy efficiency, income and energy prices. This limits scope of including differences between household energy access, needs, autonomy and flexibility and energy practices all of which are influenced by geographical contexts and wider socio-economic and socio-political structures. Thus, while fuel poverty is an important means of raising awareness, understanding and addressing energy deprivation, energy vulnerability reveals that there are potentially a greater number of people on the verge of fuel poverty who are currently unrecognized.

Chapter 3 offers a review of current transition literature, outlining that current understandings of transition are largely understood via a multi-level perspective, and that the dominance of this framework may have limited understandings of how transitions have been and continue to be carried out. In particular, the chapter is supportive of other literature in outlining the benefits of viewing transitions through a geographic lens. This then allows for concepts such as place and scale to be used for analysis, thereby taking into account the uneven distribution of a wide range of local endowments and local

contexts. Within this, reference is made to low-carbon transition in the UK, and how spatial factors are important influencers on how, where and by who low-carbon energy transitions are taken forward, and therefore how the transition may progress.

Chapter 4 draws on Wales, as a devolved nation of the UK to highlight the connections between processes of spatialization, spatial justice and energy vulnerability. Such processes affect the relative spatial positioning of Wales within the UK but are also in play within Wales affecting spatial differentiation intra-Wales. It starts by unpacking core-periphery development, after which connections are made between such spatial processes and spatial justice, most notably how the resources required for energy production and the siting of the production itself, energy network distribution and energy prices are beyond the ability of periphery influence. Finally, the chapter focuses on the interplay between multiple and multi-scalar spatial processes with energy vulnerability at a domestic scale. It outlines how energy vulnerability while manifest at domestic scale, is a product of higher scale, socio-spatial, political and economic structures.

Chapter 5 explains the research aims and questions followed by an explanation of the logic of enquiry including the overall ontological and epistemological perspective. It outlines the research design as one of qualitative case study and explains how the ontology, epistemology and research aims directed this decision. Detailed justification is given for how the case study was geographically bound to Mid-South Wales and the Brecon Beacons National Park (BBNP or the Park), including how the bounding reflects several important case criteria based mostly on theoretical concepts of peripherality and energy vulnerability. As the research has a qualitative foundation, discussion centers on justification and critique of qualitative methods and construction of knowledge. Reflections are also made as to researcher positionality and assumptions brought to the research as well as steps taken to address this. Interview participants are outlined with reasons why each group were selected for study and what data collection method will be used. Finally, an explanation of the tools used and methods followed for data analysis is provided.

Chapters 6 and 7 outline the empirical results of data collection and analysis. *Chapter 6* focuses on the theme ‘Multi-scalar Political Peripheralization’. It starts by setting the energy policy context, providing a foundation to explore political peripheralization, first in the core-periphery relationship perceived by interviewees between the UK and Welsh Government, regionally within Wales between rural and urban areas and then within the

BBNP, between Park core purposes and Park communities. The chapter highlights how at regional scales, allocation of public spending and its strategic application along with declining public services make visible to communities their peripheralization. Political peripheralization then links with energy transition injustices in several ways; in misaligned core-periphery energy aspirations, in increased facilitation of energy production within peripheries, and in limited public assistance for domestic energy transition comparative to more populated and ‘more deprived’ places.

Chapter 7 focuses on the themes ‘Peripheral Economy and Income’, ‘Peripheral Infrastructure’ and ‘Peripheral Housing Stock & Tenure’ unpacking how these interwoven aspects of peripherality impact upon energy vulnerability and transition. Initially peripheral economies and incomes are explored, followed by explanations for and experiences of the necessity of personal transport. Following this, focus is placed on peripheral energy infrastructures, highlighting restrictive access, weak structure and additional costs associated with it. Finally, the influence of peripheral housing stock type and energy efficiency on energy vulnerabilities is highlighted, linking the combined influence of this with energy consumption and high energy prices. This section also briefly explores the influence of housing tenure on abilities to alter such living conditions and thus energy vulnerabilities. Within each section links are made with low-carbon energy transition and how this is utilized to counteract energy vulnerabilities, but also where it is unobtainable for some.

Chapter 8 synthesizes the discussions of *Chapters 2-4* and the results of *Chapters 6* and *7* to illuminate the interplay of energy justice and spatial justice. *Sections 8.2, 8.3* and *8.4* are dedicated to answering the three main research questions. *Section 8.2* explains how elements of peripheral disadvantage are experienced by communities within the case study area, and how these experiences can link together spatial injustices and energy injustices. *Section 8.3* elucidates connections between peripherality and energy vulnerability, demonstrating how elements of peripheral energy vulnerability are spatially contingent, creating energy peripheries. *Section 8.4* then unpacks how and to what effect low-carbon transition is taking place within energy peripheries. *Section 8.5* summarizes the overall conclusions of the thesis, highlighting the empirical and theoretical contributions made. Finally, recommendations are made for policy and energy governance and the chapter critically reflects upon the thesis and proposes ideas for future research.

This research contributes to and advances energy vulnerability and transition literature, elucidating the tripartite interplay between peripheralization with energy vulnerability and energy transition. The research demonstrates that spatial injustices inherent within periphery development link and interplay with energy injustices. Energy vulnerability, as a form of energy injustice holds spatial contingency, thus energy vulnerability experienced within a peripheral context is influenced by elements of peripheral disadvantage. Processes of spatialization and energy vulnerability together influence transition mode, trajectory and outcome.

Chapter 2. Energy Vulnerability: Linking energy justice, social justice and vulnerability

2.1 Introduction

Energy is an extremely important resource for sustaining human activities. The energy economy is one of the largest in the world, becoming part of nearly every aspect of modern life, infiltrating economies, politics, culture and social relations (Sovacool et al. 2014). It is an essential resource and a necessary requirement for living to a socially acceptable standard. However, access to affordable and sufficient levels of energy within the UK (like in many places in the world) is unevenly distributed. Amongst others, some of the reasons for this include: the historic and current energy infrastructure has a set geographical reach, leaving some remote parts of the UK without access to mainstream energy flows; a liberalised energy market which works to capitalist logics does not remediate poor energy access in places where costs cannot be recouped quickly, and in which regulation has a limited impact on energy costs overall; or government policies whether around energy, welfare or housing issues that can (inadvertently) leave the poorest people paying the most towards their energy bills. This uneven access to energy can be seen as an ‘energy justice’ issue, resulting in uneven access to life-sustaining resources, with many people being unable to fully participate in society and at risk of physical and psychological harm.

Energy justice is a concept and analytical framework that can encompass many elements of energy production distribution and consumption and is concerned with fair and equitable allocation of costs and benefits, transparent and inclusive procedures and respectful treatment of all people. As a framework, there are many concepts both new and old that may fall under the energy justice umbrella, including ‘fuel poverty’ and ‘energy vulnerability’. Fuel poverty has been part of academic study and the political agenda particularly in the UK and Ireland for many years and has been extremely important in both raising awareness and understanding of uneven access to energy. Despite raised awareness of fuel poverty and policy efforts towards its eradication, fuel poverty persists. As result and in line with growing understandings of its causes and consequences the concept has received some criticism. This centres on its narrow definition and interpretation of having three main dimensions: low income, fuel prices and energy efficiency. As recent studies into fuel poverty have pointed out, often its causes are far

more wide ranging and diverse than its current definition acknowledges. Some authors are now looking to alternative concepts to explore issues around fuel poverty, concepts that can encompass the how and why it comes to be and the wider range of impacts it may hold.

The related concept 'energy vulnerability' has been advanced by the Interdisciplinary Cluster on Energy Systems, Equity and Vulnerability (InCluESEV) between 2009 and 2011 (c.f. Hall et al. 2013). The concept has gained popularity in academic literature (Bouzarovski 2013; Day & Walker 2013; Hall et al. 2013; Middlemiss & Gillard 2015). There is no fixed definition, however, current understandings include energy vulnerability as "the propensity of an individual to become incapable of securing a materially and socially needed level of energy service in the home" (Bouzarovski et al. 2014, p.10) or "a situation in which a person or household is unable to achieve sufficient access to affordable and reliable energy services, and as a consequence is in danger of harm to health and/or wellbeing" (Day & Walker 2013, p. 16). Emerging as a result of various works into energy justice issues, energy vulnerability appears to be a concept that has the capacity to encapsulate multiple contributing causes and effects of energy injustice beyond fuel poverty.

This chapter explores the evolution of the concept of energy vulnerability and demonstrates increased capacity, in understanding the wider factors that contribute to households being unable to access adequate energy and the wide-ranging negative outcomes this may have. It will start by discussing the origins of energy vulnerability as emerging from energy justice literature, reviewing definitions of energy justice and also of fuel poverty, exploring why some authors are looking for alternative concepts to understand household energy deprivation. It will then move on to consider the current understanding of energy vulnerability, describing its multi-dimensional, multi-scalar and temporal character, illustrating why these traits may mean it can encapsulate influencing factors that current conceptualisations only can when combined with others. Finally, it will outline how fuel poverty may be seen as an outcome or a precursor of energy vulnerability, and given this relationship, energy vulnerability is likely to be far more prevalent than fuel poverty.

2.2 Fuel Poverty: Initial understandings of domestic energy deprivation

Fuel poverty had been discussed in broad terms within the literature since it was first used by Isherwood and Hancock (1979), then Bradshaw and Hutton (1983) (as identified by Liddell et al. 2012; Moore, 2012). However, it was not closely addressed and taken forward within the literature until Boardman's (1991) work (Liddell et al. 2012; Walker & Day 2012). Boardman suggested that a household was fuel poor if they were unable "to have adequate energy services for 10% of their income" (Boardman 1991, p. 227) and it is this definition that has been taken forward in UK national policy (referred to hereafter as the '10% measure'). In 1991, with some reluctance (Boardman 2015), the UK government released the Home Energy Efficient Scheme, which was a home energy efficiency scheme aimed at low-income households. Since then, fuel poverty, household energy efficiency and reduction in consumption remained on the political agenda. Initially discussed under the guise of "affordable warmth" under the conservative party, it was only when New Labour were elected in 1997 that the term fuel poverty was "allowed" to be used in official documentation (Boardman 2015, p. 2).

Since then, fuel poverty gained increasing attention within social, political and academic spheres. Politically, the passing of the *Warm Homes and Energy Conservation Act (2000)* and the associated *UK Fuel Poverty Strategy (2001)* led to commitments in England, Northern Ireland and the devolved nations of Scotland and Wales to reduce fuel poverty¹. As, fuel poverty is a devolved policy each country sets targets towards its eradication. England and Scotland have presented a target of eradication by 2016 and Wales by 2018 (Scottish Executive 2002; Welsh Assembly Government 2010; Welsh Government 2016a). In 2011 the UK Government commissioned a review into fuel poverty and how it was measured (c.f. Hills et al. 2013), finding that the target set was unreasonable due to the "long term structural" characteristics of fuel poverty (Department of Energy and Climate Change [DECC] 2013a). Consequently, a new target for England was set to improve as many households with an Energy Performance Certificate (EPC) rating² of Bands F and G to a B and C by 2030 (Department for Business Energy and Industrial

¹ See Appendix 1 for UK Government Fuel Poverty Policy 1991-2018.

² Energy Performance Certificate (EPC) are a legal requirement of all buildings sold or leased under the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007. An EPC provides a rating of how energy efficient a building is. They are graded A (most efficient) to G (least efficient).

Strategy [BEIS] 2018a). Scotland is currently in the process of updating its fuel poverty strategy with the *Fuel Poverty (Target, Definition and Strategy) (Scotland) Bill (2018)*. The Bill seeks to define fuel poverty and agree a strategy that will result in no more than 5% of homes in Scotland in fuel poverty by 2040 (Scottish Parliament 2018). In Wales, the *Fuel Poverty Strategy (2010a)* has not been updated since its release, indeed, it remains unclear as to how successful the strategy was in eradicating fuel poverty by 2018. The *Welsh Housing Conditions Survey 2017-18* is projected to report on current levels this year (2019) (BEIS 2018a), and interim evaluations of Wales' Warmer Homes schemes Arbed (2009) and Nest (2011), which aim to improve housing energy efficiency, have been favourable although have been unable to speculate on reductions in fuel poverty (Welsh Government 2015a; Ricardo Energy & Environment 2017). Despite eradication targets, the number of fuel poor households in the UK has continued to rise year on year. It appears that all policy eradication targets have been missed.

Awareness of fuel poverty has grown both nationally within the UK and on an international level over recent years (Moore 2012; Hall et al. 2013; Roberts & Phimister 2015). Within the UK, much of this has been attributed towards the continuing rising costs of energy (mainly between the year 2000 to present, with the exception of oil see House of Commons Library 2016a), along with research demonstrating the increasing numbers of households living in fuel poverty. A large body of work enhancing understandings of fuel poverty within the UK and Ireland developed, with a widening geographical scope to mainland Europe and beyond since the early 2000s (Bouzarovski et al. 2014; Hall et al. 2015). Such work highlighted the economic, social and health impacts being fuel poor can hold especially for socially marginalised or vulnerable groups (O'Sullivan et al. 2011; Middlemiss & Gillard 2015; Snell et al. 2015). These understandings have been communicated increasingly into the public sphere by the media and third sector, where links between policy, fuel poverty and 'Excess winter Deaths' in particular have been pronounced (c.f. Rankin & Butler 2013; BBC 2018a; National Energy Action 2018).

The most recent report (at the time of writing) by BEIS *Annual Fuel Poverty Statistics Report 2018* estimates that there are still approximately 3.65 million fuel poor households in the UK. Recent studies have demonstrated the negative impacts that being fuel poor has on individuals and households, for example, on morbidity, health, wellbeing and life chances (Barnes et al. 2008; Day & Walker 2013). There is also evidence for the negative

impacts living in a cold home can have on the social inclusion of the household. For example, Harrington et al. (2005) conducted a qualitative study into the health impacts of participants living in fuel poverty, finding that most of their participants felt that living in a cold home may exacerbate existing physical health issues as opposed to create them, but that it could cause feelings of social exclusion. Some participants reported reduced social interactions due to retiring to bed at earlier times to keep warm, limiting social activities within their homes due to embarrassment felt regarding its cold temperature and formations of dampness which create, or add to existing, feelings of isolation and depression (Harrington 2005). As such, fuel poverty is now understood to be detrimental to living a mentally and physically healthy life (Sovacool 2015), as the services that energy provides, such as warmth or lighting, are not “discretionary purchases, but absolute necessities” (Boardman 2010, p. 48).

Thus, in addition to more direct impacts of fuel poverty, there are also indirect impacts due to the permeation of energy on “every aspect of our culture and even our into social relations” (Sovacool et al. 2014, p. 24). For people to perform their everyday life, their energy needs must be met (Lucas 2012), these needs can include a “warm bed, a cooked meal or internet connection”, and will be dependent on “social practices” and “expectations” relative to their specific social culture (Bouzarovski et al. 2014, p. 6). If needs are unmet due to a lack of resource, in this instance energy, those people will experience difficulty in participating “in the normal relationships and activities available to the majority of people” within their society (Levitas et al. 2007, p. 9). Furthermore, energy is increasingly a primary means of obtaining access to, or participating in, most dimensions of life (Sovacool et al. 2014), limited energy access does not just mean limited access to light and warmth, it also means limited access to political, social and economic dimensions of life, which is synonymous with social exclusion (Milbourne 2004; Anderson et al. 2012; Lucas 2012). The negative impacts of social exclusion on individual quality of life and societal equity and cohesion are well studied (Bradshaw et al. 2004; Milbourne 2004; Levitas et al. 2007) consequently fuel poverty can be understood as a matter of injustice (Harrington et al. 2005; Sovacool 2015).

Many studies of fuel poverty point out that despite the number of strategies and schemes informed by the UK government aiming to reduce and ultimately eradicate fuel poverty, it remains prevalent and is increasing year on year (Jenkins et al. 2011; Guertler 2012; DECC 2015a). Since 2010, the government in the UK has implemented an agenda of

reduced public spending and tax rises in order to reduce the budget deficit and reform the welfare state (Reeves et al. 2013; Bailey et al. 2015). This neoliberal regime has attracted criticism around the uneven distribution of spending cuts at both a Local Authority level and household level. With Local Authorities in some of the most deprived areas experiencing a disproportionately high reduction in their spending power (Bailey et al. 2015) and households with “below middle incomes”, particularly those in receipt of welfare benefits, such as disability living allowance, undergoing reductions in their income (Reeves et al. 2013; Collingwood 2015, p. 2; Snell et al. 2015). Official schemes both directly and indirectly aimed at reducing fuel poverty have been impacted, with restructuring leading to reductions in funding to some such as the ‘Energy Company Obligation’ (ECO)³ and its associated regional schemes (Guertler 2012). Therefore, it could be argued that the austerity agenda being followed by the UK government is a likely contributory factor to continuing fuel poverty levels as it is not just policies and schemes aimed at fuel poverty that have an impact on fuel poor households. Indeed, policies around welfare, family, health and housing can have direct and indirect impacts on households’ ability to afford the energy they need (Middlemiss & Gillard 2013).

Policies in relation to climate change have also been criticized for exacerbating situations of fuel poverty for many households. For example, the Feed-in-Tariff (FIT)⁴ schemes that commenced in 2010 received criticism because the initial capital needed by individual households or communities to participate in this subsidy scheme limited its uptake to wealthier households and communities (Knox 2010). Consequently, low-income or poorer households and communities are effectively excluded (Bickerstaff et al. 2013, p. 3). Furthermore, costs associated with the implementation of climate change and low-carbon energy policies in addition to some fuel poverty schemes, such as the Energy Company Obligation (ECO), are passed on to all energy customers via their electricity and gas bills. Thus, they have a “disproportionate impact on low-income homes” (Bickerstaff et al. 2013, p. 3; Atkinson et al., 2015; Institute for Public Policy Research 2018). Creating a “triple injustice”, is that low-income homes consume the least carbon (Preston et al. 2013, p. 3). Spatially, ECO has cost rural customers £70 million in levies

³ The Energy Company Obligation (ECO) requires energy suppliers to deliver energy efficiency measures to domestic gas and electricity customers in order to meet carbon emission and energy consumption targets outlined within the strategy. Each supplier is allocated a “proportional share of the ECO target relative to their share of the domestic gas and electricity markets” Ofgem (2016b). The strategy identifies priority groups as those receiving certain state benefits and the elderly. ECO is paid by all energy customers via a levy on energy bills.

⁴ See Chapter 3, page 47 for more detailed explanation of FIT

over two years, when they have received less of the installed measures (accounting to only £3.5 million of spend) (Institute for Public Policy Research 2018). The combined result of these actions is that the cost of low-carbon policies within the UK, aimed at facilitating the energy transition are paid for by all, but only those with capital to invest will realise returns and be able to reduce the cost of their energy (Stockton & Campbell 2011) and their energy consumption. This poses a risk of creating an “energy under-class” where low-income groups remain dependent on increasingly expensive energy (Walker 2008, p. 4514), with no viable means of alleviating either their cost or consumption level.

Other critiques of fuel poverty point to the way fuel poverty is understood and measured in the UK⁵, which is argued leaves many households living in fuel poverty being unrecognised, or with interventions in place to help them that do not apply to their situation (Liddell et al. 2012; Snell et al. 2015). In line with this is Bouzarovski et al.’s (2014, p. 8) critique of the “narrow triad” that inform the traditional 10% measure and define current understandings of fuel poverty: of low income, high energy prices and low levels of energy efficiency which can act to simplify understandings of factors leading to fuel poverty. Other critiques are of the language of fuel poverty which, it is argued, reflects the underlying understanding of the problem (Day & Walker 2013), linking fuel poverty with issues of energy prices and low income. In this way, current understanding of fuel poverty implies a largely budgetary issue, even though its cause and effects are much wider (Bazar 2007).

In keeping with views that the concept of fuel poverty implies limited and largely budgetary or efficiency causes is the argument that fuel poverty measurements do not address the different and sometimes non-financial factors that lead to fuel poverty, and that it does not address issues of household needs. Households’ energy needs can be multi-dimensional, individual and can be affected by a wide range of internal and external factors. Studies of household needs have been carried out at both a national, regional and sub-regional scale. For example, studies such as Smith et al. (2013) and Roberts and

⁵ In 2011, the UK Government commissioned an independent review of the definition of fuel poverty, to determine the appropriateness of the ‘10 % measure’. The review was undertaken by Professor John Hills of London School of Economics (c.f. Hills *et al.*, 2013). The review proposed fuel poverty should be measured using a ‘low income, high cost’ (LIHC) measure. This measure means that a household is defined as fuel poor if its income is below the national poverty line (after energy costs) and its energy costs are higher than is typical for their household type. It also created a fuel poverty gap measure in which the depth or severity of fuel poverty for a household can be ascertained. The LIHC measure has received some criticism for reducing the numbers of households as identified as fuel poor, it has also received some praise for being more nuanced than the original 10 % measure. The measure has been adopted in England but not within the other devolved nations of the UK, as such overall UK measurements and national comparisons still use the 10% measure (Moore, 2012; Preston *et al.*, 2014).

Phimister (2015) consider fuel poverty from a sub-regional scale, by comparing the needs of rural and urban areas. Comparison of these areas has identified impacts due to differences in energy supply and housing type, with rural areas more likely to have a non-mains gas energy supply, have a less competitive and more limited choice of fuel (Office of Fair Trading 2011) and live in older, less energy efficient houses (DECC 2013b). Roberts and Phimister (2015) found that there were differences in the persistence of fuel poverty and vulnerability to becoming fuel poor between both areas, with urban households being more likely to be in persistent fuel poverty, and rural households being more vulnerable to energy price increases.

Smith et al.'s (2013) research for the Joseph Rowntree Foundation compared the total budgetary needs of households at different levels of spatial isolation (hamlet, village, rural town) with different compositions (retired couple, single adult, family of four and single parent). Results are then compared with earlier research by the Joseph Rowntree Foundation (see Bradshaw et al. 2008) based on budgetary needs for urban households. The study found that in all instances rural households needed a greater income to offset their higher spending costs, which were mainly attributed to transport needs. It also found that the level of income needed rose with the level of household rurality⁶.

From a social perspective, studies have investigated different households' energy needs emerging as a result of them being fuel poor (Middlemiss & Gillard 2015), disabled (Snell et al. 2015), or being young and living in rented accommodation (Bouzarovski 2013). Findings show that household energy needs can widely vary, due to different socio-technical interactions, shaped by cultural and social practices that occur in each individual home (Ellsworth-Krebs et al. 2015). These interactions may be influenced by instances of infirmity, illness, or unemployment for example, which would likely involve people in these instances being at home more often than others, and therefore needing to use various forms of energy for longer periods throughout the day (Snell et al. 2015; Walker et al. 2014). Also, for those households with individuals who are elderly or ill, or even those with young children, the use of energy for heat in particular may be needed much more, and again, over longer periods than others (Snell et al. 2015; Walker et al. 2014), meaning that households with these needs may be more likely to be fuel poor, no matter the price of energy or the energy efficiency of their home.

⁶ Spatialised living costs are explored further in Section 7.4

Other studies have pointed out that even if a household is not formally considered fuel poor, they may still be living in energy deprivation. Anderson et al. (2012) used a mixed methods approach to find out how households with incomes below 60% of national median income cope with financial constraint. They found that most (63%) reduced their spending overall, including spending on essentials such as food and fuel in order to maintain their primary financial commitments. In terms of energy, this meant a decrease in the amount they consumed⁷. Energy deprivation is also evident in households who are not considered poor, but for a number of reasons, such as fear of overspending on energy, as an alternative to rationing another living requirement, or through choosing to live a frugal lifestyle, may self-deprive or “ration” their household energy, thereby “feeling fuel poor” and living with the same negative impacts as those who are fuel poor (Dubois 2012, p. 109).

Fuel poverty also does not address restrictions on household agency in making dwelling efficiency adaption, using energy efficient appliances, or fuel switching. These can be felt by households who live in rented or social accommodation where such responsibilities are held by landlords. Consequently, even a household on a relatively high income, could be in fuel poverty if they are living in an energy inefficient dwelling, with inefficient appliances or using an expensive form of energy which would result in them spending a high proportion of their income on running their home. This situation would result in them having a smaller residual income. Or, as aforementioned, they could be living in energy deprivation by restricting their energy consumption to manage the household budget (Sovacool 2015). Thus, by taking these kinds of instances into account through adopting an energy vulnerable approach as opposed to a fuel poverty one, existing thoughts around who is fuel poor may be challenged. Alternative to stereotypes of “vulnerable consumers” based on social categories such as low-income households, elderly people or welfare recipients (Bouzarovski et al. 2014, p. 17) energy vulnerability can widen the range of those at risk to many more people than just the most socially vulnerable in society.

Finally, as Bickerstaff et al. (2013) points out, there have been an array of concepts discussed within academic literature which are concerned with lack of ability to access energy at a domestic scale. These include energy poverty; energy insecurity; energy deprivation; energy precariousness; and fuel poverty. The most dominant research in this

⁷ See Chapter 7 for exploration of energy practices

area are those concerned with fuel poverty and energy poverty. Traditionally considered as dichotomous (Li et al. 2014), fuel poverty can be seen to describe forms of energy deprivation in developed countries, with a focus on energy prices, household consumption and efficiency, while energy poverty has largely been used in relation to energy deprivation in developing countries, with a focus on equitable access to energy networks, and more recently micro-production (Bouzarovski et al. 2014). The dichotomous treatment of fuel poverty and energy poverty means that each offers only a limited understanding of causes of energy deprivation, when it has been identified that the factors each concept refers to can be present in both developed and developing contexts (Simcock & Petrova 2017).

However, bringing together the two concepts risks further ignoring a key element already missing from fuel poverty conceptualizations: the influence of spatial difference. As already highlighted, different places have different climates and different energy, socio-economic and political structures, all of which influence energy access, affordability, efficiency and cost. Therefore, combining fuel and energy poverty to address similarities in the phenomenon across space must also become nuanced in addressing more specifically spatial differences which affect how and why fuel poverty occurs in different places.

Fuel poverty and the research around it have been successful in highlighting the extent of its prevalence in the UK and also the impacts it can have on households' day to day life, as well as longer-term prospects. However, its definition has inevitably led to a limited understanding of its causes, an underestimation of the potential impacts to households and policy measures limited in impact. Increasingly research has sought alternative frameworks that can take account of the multiple and interlinked social, economic, political and spatial influences on domestic energy deprivation. Most recently 'energy justice' and its progeny concept 'energy vulnerability' have been conceptualised to address such issues. Each is discussed in turn in the following sections.

2.3 Energy justice: A lens for understanding domestic energy deprivation

The concept of ‘justice’ is well established, even if remaining in flux within various disciplines, such as political theory and law (Gross 2007; Schlosberg 2007). With regard to energy justice, it is political theory and its understanding of social justice which have provided the foundations for the concept. Social justice too is a well-established concept that has arguably been present within society in some form since being proposed by the ancient Greeks (Capeheart & Milovanovic 2007). As such, the literature for social justice is vast, nonetheless, a brief background is needed to inform the understandings of energy justice which follow.

Contemporary understandings of social justice can be split into three main schools of thought: Liberalism, Marxism and Post-structuralism (Gregory et al. 2009). Liberal conceptions stem from such work of Rawls (1971) who understands social justice as fair distribution of societal costs and benefits (Gregory et al. 2009). Of particular note are Rawls’ two principles of justice, first, all people within a society should have as many basic liberties possible without infringing on other people’s liberties. Second, inequality in distribution of liberties can only be justified if it serves the least advantaged, known as the “Difference Principle” (Sovacool & Dworkin 2015; Rawls 1971, p. 75). Marxist approaches to social justice consider the concept from a capitalist society perspective, concerned with capitalist social processes that lead to conflict between labour and capital, class formations and resulting exploitation of workers. Post-structuralists consider socially constructed “axis of social differentiation” to be important factors in determining how just a society is, these can be thought of as social group markers such as race and gender (Gregory et al. 2009, p. 694). Without acknowledging such differences, the “deep material differences in social position, division of labour, socialized capacities, normalized standards and ways of living” will “disadvantage members of historically excluded groups” (Young 2005, p. 362). Of course, depending on the social justice perspective, different principles will be considered or given more prominence. However, in general, social justice can be understood as having two main concerns: the first being the fair distribution of societal costs and benefits; the second being the fairness of a social order (Gregory et al. 2009; Miller 1999).

During the 1970s and 80s, social justice was adopted by socio-political movements within the USA to challenge perceived unfairness with regards to the disproportionate negative environmental impact of various developments felt by minority social groups at the time (Agyeman & Evans 2004; Bulkeley & Walker 2005; Schlosberg 2013). Subsequently, social justice with regards to the environment and extraction or utilisation of natural resources developed into environmental justice. Environmental justice raises issues of equality regardless of societal categories, such as race, class or gender (Fuller & McCauley 2016), with a similar original premise to that of social justice, mainly concerned with the distribution of costs and benefits or ‘distributive justice’ (Gross 2007; Schlosberg 2007). However, the concept has since expanded to include issues of procedural fairness and recognition of those affected, referred to as procedural justice and recognition justice (Walker 2005; Gross 2008).

Energy justice can be defined as “as a global energy system that fairly disseminates both the benefits and costs of energy services, and one that has representative and impartial energy decision-making” (Sovacool & Dworkin 2015, p. 436). While energy justice is a relatively new concept (Heffron et al. 2015), it encapsulates many of the different ways that the literature has attempted to address issues around rights to energy. In a similar vein to environmental justice, energy justice is commonly considered along three tenets: distributional justice, procedural justice and recognition justice (Hall et al. 2013; Heffron et al. 2015; Sovacool & Dworkin 2015; Jenkins et al. 2016).

Distributional justice centres on equitable and fair distribution of the costs and benefits of an energy project to those affected by it, regardless of social categories such as age, race, income or education (Heffron et al. 2015; Sovacool & Dworkin 2015). A fair distribution would mean that those who experience the costs should experience an equal or greater benefit (Sabbagh & Schmitt 1998; Skitka et al. 2003; Agterbosch et al. 2007). Research within this context has considered costs and benefits arising from a “fossil fuel-based global energy system” (Sovacool et al. 2016, p. 1). Taking a global perspective, this research illuminates how wealthier countries are able to benefit more readily from energy, for example, by securing constant energy supply. Conversely, the costs associated with high level of consumption in wealthy countries adversely impacts the global climate, with increased likelihood of negative consequences experienced world-wide, but most severely incurred by poorer countries who consume less energy (Sovacool et al. 2016).

At national and regional scales, distributional injustice has also been associated with both high-carbon and low-carbon energy systems. Milbourne and Mason (2017) while using an environment justice lens, emphasise how for centuries the cost of anthracite extraction in South Wales has been borne by communities close to extraction sites in the form of labour exploitation, cultural change and landscape and environmental damage with local benefits limited to job-creation. Links are evident between this and other research regarding large scale low-carbon energy production in Wales, where energy planning strategies are used to promote siting of renewable energy in areas that were previously industrialised (Cowell 2010). For example, the devolved Welsh Government policy *Technical Advice Note 8* (TAN 8) identifies seven areas as potential wind farm sites or ‘Strategic Search Areas’ (SSAs) (Welsh Assembly Government 2005). SSA selection, while based on largely geographical and geomorphological criteria (i.e. upland locations, coniferous plantations) are also areas of social and economic deprivation that in the past, or currently, are home to other natural resource extraction associated with energy production (i.e. anthracite extraction) (Cowell 2010).

This holds implications for those who experience the cost, or negative outcomes associated with these forms of energy, such as: their visual presence, emotional impacts and possible local economic impacts. These costs are frequently being paid by poorer and less socially powerful populations of people ill-equipped to challenge siting decisions (Cowell 2010; Munday et al. 2011; Fuller & McCauley 2016). The above examples have highlighted distributional justice concerns at the point of energy resource extraction or energy production, however, such concerns can also be identified in the distribution of energy itself. This includes spatial distribution of energy infrastructure (Senedd Research 2014), and regional differentiation of energy prices (House of Commons Library 2017a) both of which are unevenly spatially distributed in the UK and hold implications for energy access and affordability⁸. While these issues can be viewed as energy injustices in their own right, a double injustice is felt when the same places that bear the cost of hosting energy production are also the places with limited domestic energy infrastructure and higher energy costs.

Procedural justice centres on the inclusiveness, fairness, transparency and democracy of decision-making processes (Agterbosch et al. 2007; Gross 2007; 2008). While the exact constitution of the concept varies between authors, different definitions share common

⁸ Energy infrastructure, access and affordability are explored further in Section 7.4

principles such as, ability to participate and be heard; to have questions and concerns addressed; information available to make decisions; and to have bias in decision making suppressed (Sovacool & Dworkin 2015; Jenkins et al. 2016). With regards to energy projects, procedural justice may mean that all actors have the ability to find correct and up-to-date information, have avenues available to participate, have their opinions heard, and have processes for decision making that is clear and open to scrutiny. Procedural justice can also be applied to other aspects of energy, for example, both public and academic questions have been raised around the procedural justice involved with forced assignment of pre-payment meters to energy customers who fall into energy payment arrears (Citizens Advice 2016; Navanayagam 2016; Preston et al. 2014). Prepayment customers typically pay more for their energy than those who pay by other means, which can further compound indebtedness for those who are forced to have prepayment meters due to existing payment arrears. Additionally, prepayment meters are most common in low income households who can least afford to pay more for their energy, and in households where lack of bank accounts or internet access means that transferring to alternative payments or tariffs is not possible (Preston et al. 2014)⁹.

Recognition justice is concerned with the equal and respectful treatment of all people, whereby their opinions are valued and they are given genuine involvement and standing in discussions and decisions (Heffron & McCauley 2014). With regards to energy, research around recognition has focussed on the ways in which groups of people can have their opinions disregarded due to stereotyping. One of the most prominent examples of this is evident in research investigating anti-development attitudes, specifically around windfarm developments. While early research such as those by Krohn and Damborg (1999) and Warren et al. (2005) attributed these public attitudes to NIMBYism (Not In My Backyard), the validity of NIMBYism has been debated and largely discredited by many such as Wolsink (2007), Aitken (2010), Ricci et al. (2010) and Walker et al. (2010) with the term now being felt to misrepresent and stereotype many of the people who it described as deviant or selfish (Agterbosch et al. 2007; Cass & Walker 2009). It is theorised that NIMBYism had direct impacts upon policies, codes of practice and how communities have been engaged with by authorities and developers, due to the pre-conceptions of the population it evokes before any engagement is made. Such negative preconceptions can limit or exclude community involvement in developments (Cass & Walker 2009). Others have researched stereotyping around access to affordable energy

⁹ Experiences with pre-payment meters are explored further in Section 7.4

and how labels attributed to different groups in order to assist them in some way can inadvertently mean that other groups in similar positions are unrecognised. For example, within energy policy in the UK a ‘vulnerable group’ label has been attributed to elderly sections of the population in order to recognise their higher energy requirements and weaker financial position (c.f. DECC 2012a; 2015a). However, this has meant that many other groups who may be just as vulnerable with regards to their energy provision, but perhaps for different reasons, are un-recognised and therefore, continue to experience difficulty in accessing affordable energy.

Overall, energy justice has been adopted within a range of research to date, most notably in concerns around distributions of cost and benefits associated with energy production, and to a lesser extent in energy consumption. The three tenets of energy justice can be seen to encompass concerns for distribution, procedure and recognition which are not usually addressed in conceptualisations of fuel poverty, but which hold impacts for understanding how instances of fuel poverty manifest. Additionally, there is potential to broaden understandings of who is recognised as being fuel poor. While a focus of energy justice research has been on energy production, which traditionally may have been a separate issue to that of fuel poverty, bridging the gap between energy production and consumption is increasingly relevant as the energy system transitions from high to low-carbon, centralised to distributed, whereby places of production are increasingly places of consumption.

2.4 Energy vulnerability: An alternative conceptualisation?

Energy vulnerability has developed from advances in fuel poverty and energy justice concepts. As with energy justice, which holds foundations in social justice and environmental justice theories, energy vulnerability too has some origins in social and environmental vulnerability. Vulnerability is a term used to describe a weakness, a way in which someone or something is susceptible to a form of negative impact or harm. Social vulnerability is a concept used in many disciplines, most often as a means of understanding either social harms as a result of exposure to various hazards, not necessarily socially derived, or as a means of understanding how and why certain people are susceptible to such social harms. This is evident in theories of social structures that explore how social interactions, institutions and cultural values can come together to

position some people or groups as vulnerable to harm, but how they can also affect their ability to recover from harm (Kuhlicke et al. 2011).

Social vulnerability depends on how the combination of its “specific spatial, socio-economic-demographic, cultural and institutional” dimensions align, it can affect people intermittently or constantly (Kuhlicke et al. 2011, p. 789). It also suggests that different people or groups within a society may be exposed to the same harm but, will experience it in different ways and varying severity. The reasons for this link social vulnerability concepts closely to those of social justice, as often uneven experiences and exposure to harm can be attributed to uneven or unjust societal structures. Thus, social vulnerability generally proposes that some social groups are more vulnerable to harm than others, namely, the poor, elderly, disabled, women, children and minority ethnicities and religions (Kuhlicke et al. 2011; Massey 1992; Soja 2009). In addition, due to the structurally reinforced nature of their vulnerability, the ability to leave a position of vulnerability is extremely difficult.

This understanding of vulnerability has been adopted for use in climate change research and policy (Walker & Burningham 2011), where the social impacts of climate change or ‘natural’ hazards are often exposed. Within this field, vulnerability is discussed in terms of three dimensions: potential exposure to harm, sensitivity to harm and capacity to adapt (Hinkel 2011). However, these three dimensions have often been investigated in isolation, with little exploration of their interrelationships (Hinkel 2011). In terms of applying vulnerability to an energy justice context, it is precisely the multi-dimensional and interrelated character of vulnerability that makes it so suitable for understanding issues of energy deprivation and as such, it is those inter-relations that should be explored.

Traditionally, energy vulnerability has been applied to two main issues: the security of country’s fuel supply and specific social groups who are considered to be socially vulnerable. The first issue came about due to concerns over climate change, the effect on peak oil on energy prices and the security of fossil fuel supplies. This has been the subject of many academic studies (Bradshaw 2014; Demski et al. 2014; Gnansounou 2008) and political dialogue (Rogers-Hayden et al. 2011). The second instance is most prevalent in national political dialogue and energy market regulators such as Ofgem, where it is discussed in terms of protecting specific socially vulnerable groups from fuel poverty. While each of these issues are important in its own right, this section is concerned with the more recent use of the concept by authors such as Day and Walker (2013),

Bouzarovski (2013; 2014); Bouzarovski et al. (2014), Middlemiss and Gillard (2015) and Thomson (2016). Their understanding of energy vulnerability has been interpreted as “a situation in which a person or household is unable to achieve sufficient access to affordable and reliable energy services, and as a consequence is in danger of harm to health and/or wellbeing” (Day & Walker 2013, p. 16).

Energy vulnerability as defined by Day and Walker (2013) (above) also moves the focus of energy deprivation from being considered an outcome of poverty itself. Instead, energy vulnerability “does not imply a particular emphasis or understanding of cause and effect” as opposed to conveying set outcomes, it conveys potential outcomes (Day & Walker 2013, p. 16), thus allowing research that uses the framework to be more open to alternative or unpredicted areas of investigation. By using the word vulnerable, and by stating “in danger of” in their definition, also conveys a potentiality or precariousness rather than necessarily a situation of demonstrable, measurable existing harm (Day & Walker 2013, p. 16). Energy vulnerability has also combined previously separate concepts of fuel poverty and energy poverty into a single conceptual framework (Bouzarovski et al. 2014). This framework of ‘energy vulnerability’ allows for dual consideration of instances of physical poor energy access in addition to energy unaffordability, energy efficiency and consumption. It allows consideration together of energy production, distribution and consumption, thus, it allows for a more nuanced and comprehensive understanding of the reasons for both fuel and energy poverty which can potentially occur in the same places, affecting the same people individually or combined.

As with social vulnerability, energy vulnerability is multi-dimensional and complex as it is caused by the coming together of interconnected contextual dimensions at a particular space in time that in turn have multiple impacts that themselves vary (Middlemiss & Gillard 2015) depending on their context (Wats & Bohle 1993; Walker 2009). Current literature regarding issues of energy vulnerability suggest that it can be subject to social, technological, natural and temporal processes that are unique to individual locals and households (Bradshaw et al. 2008; Day & Walker 2013; Druckman & Jackson 2008; Ellsworth-Krebs et al. 2015). Therefore, its character can be made up of infrastructure that connects a household to an energy supply, natural processes or institutional structures and policy. Furthermore, each one of these agents are in turn multi-dimensional and made up of other agents and so on.

An attempt to illustrate this phenomenon is presented in Figure 2.1 which is adapted from Polsky *et al.*'s (2007) Vulnerability Scoping Diagram (VSD). The VSD is composed of the three main dimensions of vulnerability: *Exposure*, which signifies the risk and length of exposure to harm; *Sensitivity*, how severe the harm would be; and, *Adaptive Capacity* which signifies agency and resources available to limit harm. In Figure 2.1 the three vulnerability dimensions are not joined, instead multi-way arrows join them to represent and emphasise the interaction between them. The outer segmented ring represents four main factors that can contribute to energy vulnerability. These have been identified as: *Energy and the Energy Network*, which can represent factors such as energy prices, access and technology type or availability; *Politics and Policy*, which can represent all political decisions, policies, schemes and subsidies both national and local in relation to energy and wider areas such as welfare, or housing policy; *Domestic Context*, which includes factors such as, household income, composition, energy needs, energy consumption, energy efficiency and social networks; finally is *Context*, which includes components such as, local geography, local history, local culture, local economy, social networks and local amenities. This outer circle is not joined to the middle circle as each of the four elements are present in exposure, sensitivity and adaptive capacity. Indeed, each four elements interplay with each other and also the three dimensions of vulnerability, for example, energy policy affects both exposure, sensitivity and adaptive capacity as it has the potential to relieve or exacerbate who is exposed to higher or lower energy prices, who has the ability to produce their own energy and, thus, reduce their consumption and energy bills. It also affects the Energy Market and Network and Households. The interconnected nature of the four elements is depicted again with the use of arrows and illustrates the “innately relational” character (Buzar 2007, p. 1908) of energy vulnerability.

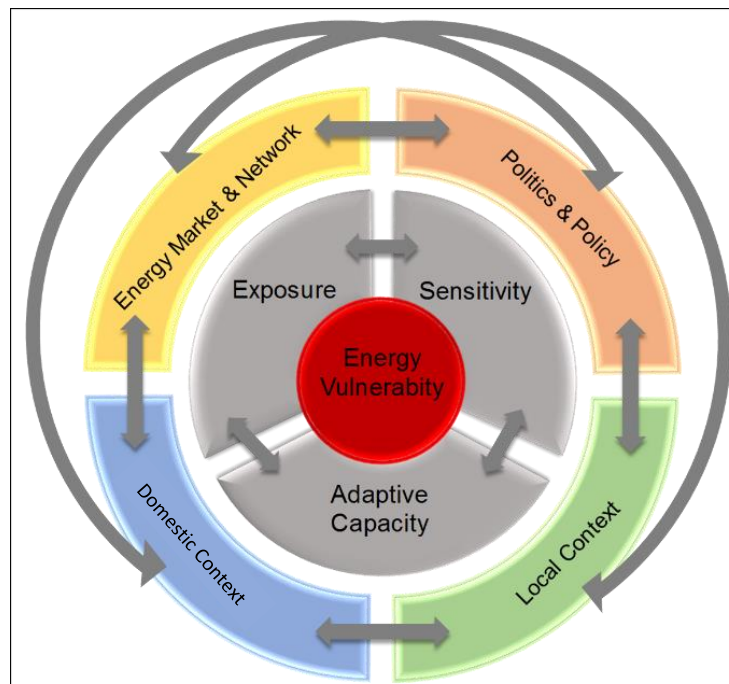


Figure 2.1. Conceptualization of energy vulnerability.
 Source: Author (adapted from Polsky et al. 2007)

This conceptualisation is helpful in highlighting multi-dimensional aspects of energy vulnerability, as well as multi-scalar aspects. For example, its multi-scalar nature may be visible through the relationship between macro-scale elements such as national policy, market conditions and prices, with micro-scale elements such as how energy efficient or old certain household appliances are. Each of these factors at widely different scales can be linked back to individual locations or households and affect each one in different ways depending on the multi-dimensional elements in play for that specific place at that time (Day & Walker 2013). Multi-scalar aspects are also in effect spatial aspects, for example, households are located in local contexts which in turn are within energy regime and political landscapes.

Sometimes, how these factors come together can be surprising, as in Bouzarovski (2014) investigation into Europe-wide fuel poverty demonstrates that northerly countries with very cold climates have highest heat needs do not necessarily have higher levels of energy deprivation. This is attributed to “locally specific social, political and environmental circumstances” (Bouzarovski 2013, p. 278). Indeed, countries with much warmer climates, in the south that had the highest deprivation levels, mainly due to high levels of income poverty and poor insulation. Temporal influences could be evident in the differences between duration of vulnerability caused by certain factors. For example, a broken boiler could cause a household to be energy vulnerable over a few days (or longer, again depending on other factors at play), a very cold winter could last a couple of months

or a chronic illness could render a household energy vulnerable for a number of years (examples from Day & Walker 2013). Thus, people and households can move in and out of being energy vulnerable at different times and for different reasons.

The complex and inter-related nature of energy vulnerability has led to several different approaches or theoretical framings being used for its exploration, including assemblage theory (Day & Walker 2013), variations of actor network theory (Buzar 2007), and emic vulnerability (Middlemiss & Gillard 2015). Buzar (2007) conducted an empirical study to investigate the relational geographies involved in creating situations of domestic energy deprivation in two Macedonian cities, Skopje and Stip. While not specifically adopting assemblage or actor network theory, the approach was similar in that the relations between human and non-human actants were followed to understand the “intersection of a multitude of social and spatial webs” (Buzar 2007, p.1910). However, it also differs from these theories through the conceptualisation of the home as a central figure for the intersection of these webs. The study found that energy poverty in these cities, in these instances, were created through the relationship between three main factors: “institutional transformations, everyday lives, and housing structures” (Buzar 2007, p.1920).

Middlemiss and Gillard (2015) acknowledged that energy vulnerability resembles an assemblage, but instead of using assemblage theory their ontological stance was multidimensionality which they combined with a nursing framework of emic vulnerability. This appears to have given them the freedom to explore the multi-dimensions of energy vulnerability, from a vulnerable household perspective, within a structured theoretical framework. Although the study explored vulnerability, it did so from a fuel poverty stance whereby a household’s vulnerability was measured in relation to how likely they were to be fuel poor, how sensitive they were to that and whether they had capacity to adapt to the situation. Therefore, even though they framed their participant answers in relation to fuel poverty, the framework they used ensured that wider contributing factors towards vulnerability were also considered, such as agency and power, multidimensionality and individuality of circumstances. As a result of their study, Middlemiss and Gillard suggest there are six main characteristics of energy vulnerability, namely: quality of dwelling fabric; tenancy relations; energy costs and supply; stability of household income; social relations and ill health. These indicators appear to include the main concerns highlighted by fuel poverty, but also include indicators that answer

much of the energy vulnerability concerns, such as the social relations, ill health and tenancy relations. Also, by re-positioning low income to income stability, they are re-positioning the power from the level of income, to how reliable it is, again answering some of the fuel poverty concerns around income levels being an unreliable indicator of fuel poverty.

Until recently, an explicit reference to spatial differentiation and its influence on energy vulnerability was missing from the literature. Simcock and Petrova (2017) have addressed this by attributing energy vulnerability to six driving forces to form a globally applicable energy vulnerability framework. The six driving forces are: *Access* to energy sources; *Affordability* of energy, either through the cost of energy or as a relative household expenditure to its income; *Flexibility* to change energy source or system; *Energy Efficiency* of building structures or household energy systems; *Needs* that create a greater energy requirement such as health, age and lifestyle; and *Practices* such as socio-cultural norms that may require energy over-consumption (Simcock & Petrova 2017, p.432). These drivers encompass multi-scalar and multi-dimensional influences on energy deprivation and builds on indicators developed by others, such as Middlemiss and Gillard (2015) (above). Such research encompasses socio-cultural and individual factors such as energy needs and practices in addition to economic and political factors that contribute to energy access and affordability and vary across space. This framework holds capacity to incorporate place-specific interpretations.

Additionally, by focusing on factors that increase the risk of energy deprivation which can be personal to each household, which are applicable, in varying degrees and in varying interconnected ways, to different spatial contexts the framework negates the need for the established but two dichotomous understandings of energy deprivation: fuel poverty and energy poverty. Thus, it can be applied in developed and developing settings and allows comparison between different geographical settings. Place-specific understandings of energy vulnerability to be explored at a variety of scales, for example, in the UK, energy access is likely to be more problematic in places where energy infrastructure is more limited, such as rural areas, however, flexibility may be a more pronounced issue in places with high levels of private rented homes, such as urban areas. Potentially, different places, whether communities, sub-regions and regions can develop energy vulnerability profiles which will allow more nuanced and more effective energy vulnerability or fuel poverty strategies to be developed and implemented.

The energy vulnerability framework provides the opportunity to unpack the various elements that contribute to households becoming fuel poor, as arguably, fuel poverty should be understood as one of several possible outcomes of energy vulnerability, as well as a contributing factor. It allows the energy vulnerable to be redefined as anyone, even people who do not fit the standard definition of fuel poor, instead of usual stereotypes (Kuhlike et al. 2011) that persist in the UK, such as elderly people or people in receipt of welfare benefits (Day & Walker 2013; Bouzarovski 2013). It also holds potential to incorporate geographical difference which variably affects each energy vulnerability driver. By adopting an approach that allows the full dimensions of energy vulnerability to be explored, how and why people are likely to be energy vulnerable can be better understood, leading to more accurate understandings of exactly who may be energy vulnerable in certain times or places and what can be done to relieve this.

2.5 Conclusion

Situations of energy vulnerability not only consist of households experiencing harm due to insufficient energy, but also, that even if not currently in an active situation of harm, they are at risk of being so. As the factors that may lead to a household becoming energy vulnerable are diverse and at different scales, so too may the possible range of harms that a household would be in danger of. Therefore, possible outcomes of energy vulnerability could include becoming fuel poor with the adverse effects that can bring. But it can also capture the adverse effects of those households who are preventing themselves becoming fuel poor through restricting their social engagements, restricting their diets, restricting their mobility, restricting their energy consumption or through working longer hours etc. These possible actions hold possible negative consequences: for social inclusion; physical and mental health and wellbeing; along with others that may not yet be defined. These actions also have the possibility of having multi-scalar impacts for example, parents spending longer in work may have impacts on their children and their attainment, reductions in spending may have impacts on local businesses, which if concentrated in a number of households in the same area can have impacts on the local economies, possibly leading to decline, or reductions in mobility may have impacts on the level of public transport use leading to possible reductions in transport services to certain areas.

The prevalence of people living within an energy vulnerable state is unknown. Fuel poverty figures suggest that there are 3.65 million households living in fuel poverty today (BEIS 2018a). Given that fuel poverty is a possible outcome of being energy vulnerable and that it is generally acknowledged that fuel poverty estimates are most likely lower than reality (Moore 2012), it is likely that those who are energy vulnerable is significantly higher. By attempting to understand the dynamics of energy vulnerability, it is argued that measures to tackle fuel poverty can become more nuanced and effective. However, it appears that it will also mean that a far wider range of people and a far higher number of people will be identified, possibly highlighting fundamental issues within society and governance generally, not just around energy and its governance.

The fundamental necessity of energy for participation in modern life means that issues of justice in relation to fair and equal access to it are of the utmost importance. As such it is only right that the concept of energy justice is gaining prevalence within the literature. One of the main reasons for this is the use of the now widely known and recognised concept, both academically and also within political and public spheres within Wales and the UK as a whole, of fuel poverty. While fuel poverty has done much for advancing research and understandings of the multiple and diverse negative impacts living in fuel poverty can have, its well-known triad components of low income, low energy efficiency and high energy prices which alludes to largely budgetary causes and effects, has over recent times been criticised as being too narrow to allow a full understanding of the problem at hand. In addition to this, is the concept less well established within the UK of energy poverty which, although better encompasses equitable access to modern and safe energy networks, lacks the focus on affordability and efficiency that fuel poverty can bring. As a result, some authors now encourage the merging of the two concepts into one framework of understanding (Bouzarovski et al. 2014). Subsequently, the concept energy vulnerability, with its multi-dimensional, multi-scalar and temporal characteristics, is gaining recognition for its ability to be strong in areas where fuel poverty and energy poverty alone are weak.

Energy vulnerability, understood as risk of exposure, sensitivity and capacity to adapt, that it is a mixture of energy network, political, household and contextual factors that come together over particular spaces at particular times, depending on each given circumstance means that the elements that create it are not fixed in space or time, Likewise, neither are the people who are energy vulnerable. However, this is messy and

complex, thus, energy vulnerability requires a framework that provides some structure but that also allows the inclusion of multiple and diverse factors. Thus, the energy vulnerability concept, comprised of six drivers has the ability to enable a much fuller and nuanced understanding of the factors that can cause household energy deprivation, as it allows space to account for the effects of geographical context on each driver. Adopting the concept energy vulnerability at a political level may allow for policies aimed at reducing household energy deprivation to become more effective, there is also the possibility that numbers of energy vulnerable households would be significantly higher than those currently identified as fuel poor. This would have massive implications for the type of policy that could be created to address this issue.

The next Chapter explores how geographic concepts of place and scale can be adopted to take account of factors associated with peripheral disadvantage which impact upon low carbon transition capabilities. It highlights that linked to this are potential impacts for energy justice during transition where peripherality determines not only the trajectory and velocity of transition, but also where costs and benefits are experienced spatially.

Chapter 3. Low-carbon energy transition: Implications for energy and spatial justice

3.1 Introduction

The “energy trilemma” conceptualises concerns around energy security, energy affordability and environmental sustainability (Poudineh & Jamasb 2012; Pye et al. 2015 p. 673). Currently, energy consumption is largely sourced from fossil fuels, meaning carbon dioxide (CO₂) and other greenhouse gas (GHG) emissions remain. For countries, such as the UK, dependent on energy imports from few other countries, their energy supply is vulnerable to external contexts that can cause disruption to supply chains and fluctuations in the energy prices (Chalvatzis & Ioannidis 2017). To address the energy trilemma, many countries now aim to reduce their carbon emissions through limiting their reliance on externally sourced carbon-heavy fossil fuels by increasing indigenous renewable energy production and at the same time provide low-cost energy services to their populations (Poudineh & Jamasb 2012; Pye et al. 2015 p. 673).

In the UK, binding international targets have been agreed that demand a reduction in the country’s carbon emissions and an increase in its use of energy sourced from renewables (Climate Change Act 2008; European Commission 2019). Most recently the UK has announced a ‘climate change emergency’ laying new legislation to “eradicate its net contribution to climate change by 2050” (Gov.UK 2019, para 1). This legislation is a driver of the UK energy transition, so far resulting in a growth in energy sourced from renewables (Department of Energy and Climate Change [DECC] 2016) and reductions in carbon emissions (DECC 2015c). However, despite the progress made against the targets there is growing awareness that longer-term targets will not be met. Awareness is growing too that as transition has progressed so far, the costs and benefits have not been evenly distributed. This uneven transition trajectory holds immediate implications for energy costs, in addition to longer-term concerns for increasing societal wealth gaps and potential lock-in to what will become increasingly expensive and carbon-heavy technologies.

Accordingly, research on energy transitions has sought to explore how and why energy transitions have manifested in the past (Schot 1998) in order to inform the present (Foxon et al. 2010). Or have analysed the current transition in order to predict what its main influences are, how this may be managed and what energy future may result (Geels et al.

2016). While questions remain over whether the three aims of the energy trilemma can be resolved in unison (Poudineh & Jamasb 2012), research into energy transitions aims to advance understanding of transition dynamics in order that they can be directed (Turnheim et al. 2015) and become more 'just'.

While low-carbon transitions are occurring in multiple countries, their dynamics are generally explored within individual national scales, with traditionally less exploration of smaller-scale regional and sub-regional influences (Faller 2015). Focus on national scale transition is somewhat understandable in the UK where energy related policies and utilities are national scale, highly influential dominant forces in the current energy regime and transition (Geels et al. 2016). While understanding how this national-scale regime impacts upon the emergence of small-scale technologies and innovations - which are viewed as a 'just' means to obtaining transition success - is no doubt important, so too is understanding transition dynamics from a regional or sub-regional perspective (Faller 2015). In order to do so, attention should be paid to local-scale, social, natural, technical and political contexts from which innovations emerge (Bridge et al. 2013).

Established concepts such as scale, place and spatiality allow for the deeper understanding of how innovations form (Faller 2015; Longhurst 2015) and how transitions manifest and progress at different scales in different places, relative to others (Hawkey et al. 2013). These concepts synergise within a spatial justice framework. To date, transition literature has centred on socio-technical perspectives using multi-level perspective frameworks which explores structural and temporal processes of socio-technological transition, with an emphasis on the technological aspects (Nye et al. 2010; Seyfang & Haxeltine 2012; Geels et al. 2016). A second branch of transition literature has focused in on energy justice (Bouzarovski & Simcock 2017; Healy & Barry 2017; Monyei et al. 2018; Jenkins et al. 2018). There has been less exploration of the role of sociological aspects of transition (Seyfang & Haxeltine, 2012), thus, socially constructed, relational and relative concepts of scale, place and space have been traditionally under-researched (Bridge et al. 2013; Faller 2015). Where this attention to space, places and scale have been addressed, it has resulted in studies that have mainly focused on urban regions and cities (Devine-Wright & Wiersma 2013; Bulkeley et al. 2014; Bouzarovski et al. 2017) with little attention paid to non-core or peripheral regions. This indicates energy transitions are not being fully understood. This chapter demonstrates the role for geographical concepts and spatial

justice in furthering understandings of energy transitions and highlights the need for further research of energy transitions in peripheral places.

3.2 Low-carbon energy transition in the UK: A spatially uneven process

Low-carbon transition in the UK has been driven forward by both international and national political, economic and environmental concerns regarding energy supply security, affordability and climate change otherwise known as the “energy trilemma” (Foxon et al. 2010; Hawkey et al. 2013; Pye et al. 2015, p. 673). Consequently, the UK is attempting to reduce national reliance on carbon-heavy non-indigenous energy supplies such as fossil fuels, by transitioning to low-carbon energy sources, such as renewables or nuclear. This ambition is reflected in and driven by international climate change agreements and EU and UK policy.

Internationally the need to address climate change was formally recognised in 1992 when the United Nations Framework Convention on Climate Change (UNFCCC) was established. The UNFCCC was responsible for administering the *Kyoto Protocol (1997)* which commits party countries to reduce their carbon emissions to prevent further interference with the global climatic system by stabilizing global temperatures. The protocol came into force in 2005, where 37 countries and the EU community each agreed to reduce global Green House Gas (GHG) emissions by 5% of 1990 levels between 2008-12, and then by 18% between 2013-20 (UNFCCC 2019a). This was broken down into individual targets for each country reflecting their long-term past contribution to the current climate change and their current economic development. The protocol reflected a ‘just’ target measure via “the principle of common but differentiated responsibilities” as it recognised “that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity” (UNFCCC 2019a). Thus, a heavier burden in the form of higher carbon emission reduction targets was placed on developed nations. As part of the Kyoto Protocol where the EU agreed to 8% GHG reduction from 1990 levels. Within the EU a ‘Burden Sharing Agreement’ was also adopted whereby the target was divided between 15 member states with those most industrialized receiving higher targets that allowed those still

industrializing to emit GHGs at a higher level. Of this target, the UK committed to a 12.5% reduction in GHG emissions.

The *Paris Agreement* is a new international agreement that follows on from the end of the Kyoto Protocol in 2020 and similarly aims to stop global temperature increasing more than 2°C. The Paris Agreement was ratified in 2016 and is effected from 2020. It differs from the Kyoto Protocol in that its targets are non-binding and each country creates its own nationally determined contribution to GHG emission reduction in addition to plans for managing and maintaining their targets. The Paris Agreement is open to developed and developing countries as well as other parties such as regions, local authorities or cities (UNFCCC 2019b).

EU climate policy development is closely related to international climate agreements. In 1990, the first European climate target was set: to stabilise greenhouse gas (GHG) emissions of the European Community at 1990 levels by 2000. In 2007, EU member states (by then 28 countries) committed to the *2020 Climate and Energy Package* (20% reduction in European CO₂ emissions, a 20% increase in energy efficiency and 20% of energy for heat, transport and electricity from renewable sources) (European Commission 2019). Building from the 2020 EU targets is the *2030 Climate and Energy Framework* which sets three key targets for the year 2030; at least 40% cuts in greenhouse gas emissions (from 1990 levels); at least 27% share for renewable energy; and at least 27% improvement in energy efficiency. As an EU member state, the UK has agreed to a proportion of the GHG emission targets set out in EU climate change and energy policy (in addition to signing the Paris Agreement). Of the 2020 Package the UK has agreed to a 16% reduction in GHG emissions and to meet 15% of its total energy needs from renewable sources (Hammond & Pearson 2013; Hannon et al. 2013). The renewable energy obligation is further broken down as 30% of its electricity, 12% of its heat, and 10% of its transport demand from renewable sources. 2030 targets for EU member states have not yet been agreed.

In addition to its global and European obligations, the UK set its own national legally binding target in the *Climate Change Act 2008*, to reduce carbon emissions by 80% of the 1990 levels, by 2050. This target has been broken down into five incremental carbon budgets, monitored every four years up until 2032 so far¹⁰. Additionally, the *Energy Act*

¹⁰ UK 4 yearly carbon budgets measured against 1990 carbon emissions: Year 1 2008-2012, 25% below; Year 2 2012-2017, 31%; Year 3 2018-2022, 37%; Year 4 2023-2027, 51%; and Year 5 2028-2032, 57%.

(2010), sets out three principal objectives: to financially support commercial-scale demonstration of Carbon Capture and Storage (CCS); introduction of fuel poverty schemes; strengthening the powers of the UK Government and Ofgem to ensure fair energy markets for customers while delivering secure and sustainable energy supplies (Secretary of State for Energy and Climate Change 2015). These acts have been taken forward by several strategic plans such as the *Low Carbon Transition Plan and Renewable Energy Strategy (2009)*; *UK Renewable Energy Roadmap (2011)*; *Community Energy Strategy (2014)*; *Clean Growth Strategy (2017)*; *Air quality plan for nitrogen dioxide (NO₂) in UK (2017)*; *Implementing the end of unabated coal by 2025 (2018)*¹¹.

Within these policy levers, several schemes have been implemented that aim to reduce UK CO₂ emissions via encouraging investment in and up-take of low-carbon energy technologies in the UK and reducing energy consumption. These can be divided between those aimed at the private commercial, public and not-for profit sectors and those aimed at the domestic sector, most notable of these have been; the Climate Change Levy (2001-15) which increased industrial energy efficiencies and encouraged energy to be sourced from renewables, leading to an estimated carbon emission reduction of 3.5 million tonnes by 2010 (House of Commons Library 2016b); and the Renewable Heat Incentive and Feed-in-Tariff (RHI and FIT) (2011/12) which supplied payment for the generation of renewable energy – for 7 years in the case of RHI, and for 20 years (originally 25 years) in the case of FIT - additional payment for export to the grid. Up to 2017 it is estimated that the RHI and FIT saved 23.5 and 1.5 million tonnes of CO₂ emissions respectively (DECC 2015d; Department of Business Energy and Industrial Strategy [BEIS] 2018c).

The electricity market reform in 2014 introduced Contracts for Difference (CfD) which has also influenced the growth of renewables (although cumulative impacts will take longer to be realised). Two rounds of CfD have taken place (2015 and 2017). In the 2017 round, two wind projects delivered a strike price of £57.50 per MWh, on a par with new gas power and lower than subsidies for nuclear (Hinkley Point C). Additionally, policy interventions not directly within the Governments' climate change remit can also hold outcomes for reducing carbon emissions, for example, schemes aimed at improving housing conditions usually hold some aspect of increasing property energy efficiencies and thus, indirectly carbon consumption. For example, the *Energy Efficiency (Private rented property) Regulations (England and Wales) (2014)* state that private landlords

¹¹ See Appendix 2 for UK climate change policy overview

must ensure their properties achieve EPC¹² of at least E rating prior to leasing (BEIS 2017a).

Such policy interventions are not typically solely aimed at reducing carbon emissions, they are also devised to increase investment in the renewables market, increasing production, and reducing the cost of renewable technology. As Figures 3.1 and 3.2 demonstrate energy produced from renewables in the UK has grown over time, particularly electricity production. In 2017, 11.3% of all energy consumed was from renewable sources compared to 1.1% in 2004.

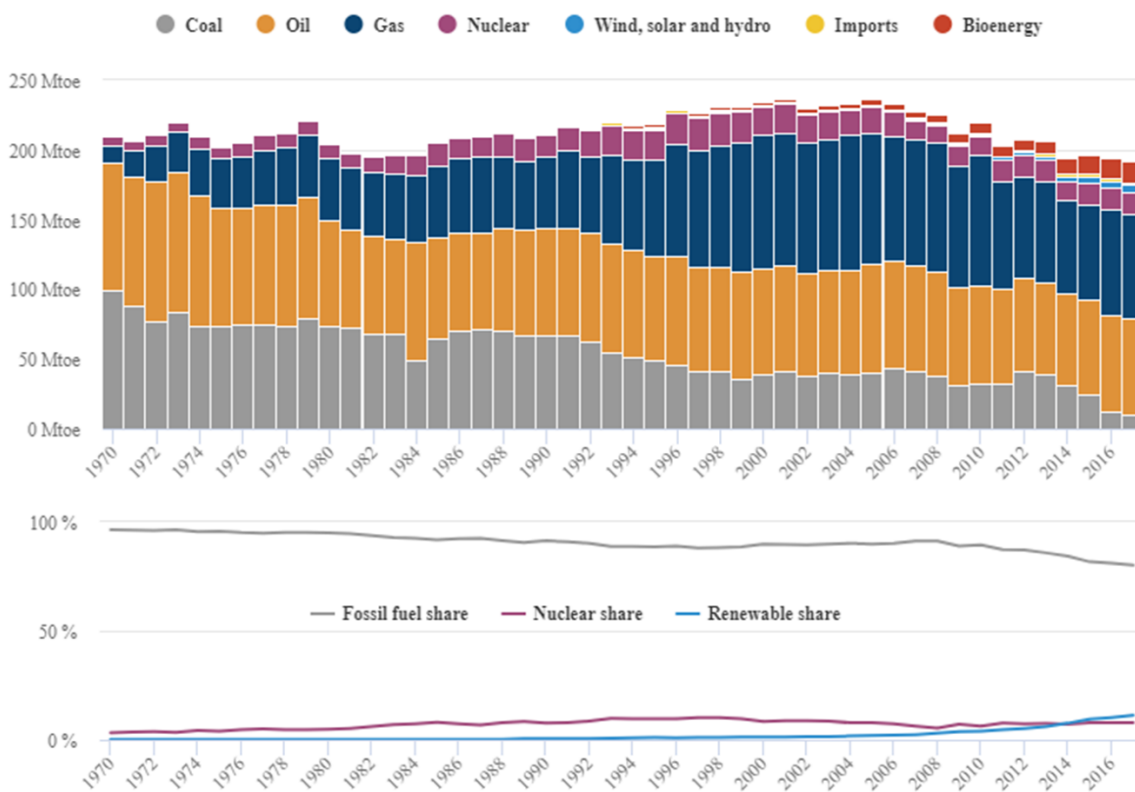


Figure 3.1. UK energy use by source 1970-17.
Source: Carbon Brief (2018)

¹² See section 2.2 for further outline of EPC

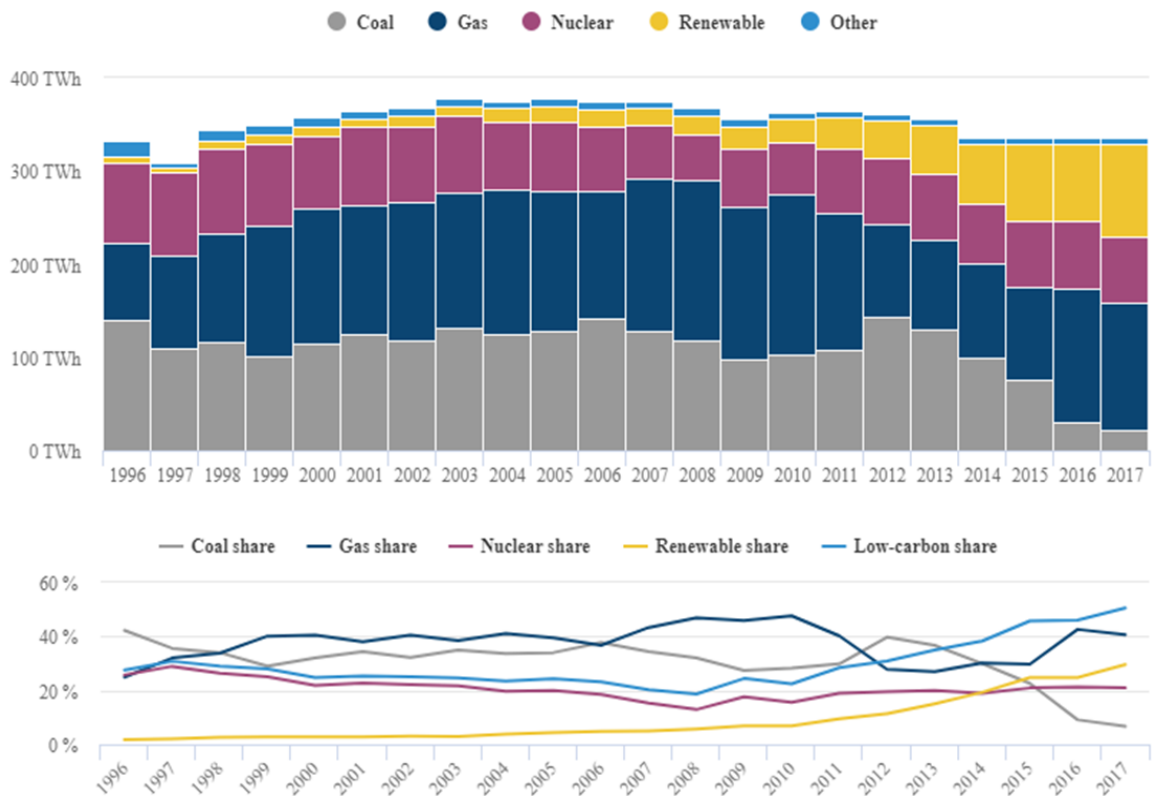


Figure 3.2. Electricity production in the UK 1996-17.
Source: Carbon Brief (2018)

Despite this progress, there remains questions as to whether the UK can meet EU 2020 obligations. While the 16% reduction in GHG emissions will be met and overall a 15% renewable energy demand is likely, it is unlikely that the UK will be able to ensure that of this 12% will be heat demand and 10% will be transport demand (House of Commons Energy and Climate Change Committee 2016a). Additionally, the UK is not currently expected to meet its own fourth and fifth carbon budgets (2023-27 and 2028-32) which require 51% and 57% reductions respectively, compared to 1990 levels (Committee on Climate Change 2018). Several reasons have been cited for this and are outlined below.

First, policy attention has largely focused on the energy sector itself, which although has been successful due to the increased diversity in energy sources and reductions in energy demand and CO₂ emissions. However, this focus has meant other sectors have been relatively neglected, as Table 3.3 shows, the transport sector, building sector and domestic sector have remaining relatively static or have increased energy demand (Committee on Climate Change [CCC] 2018).

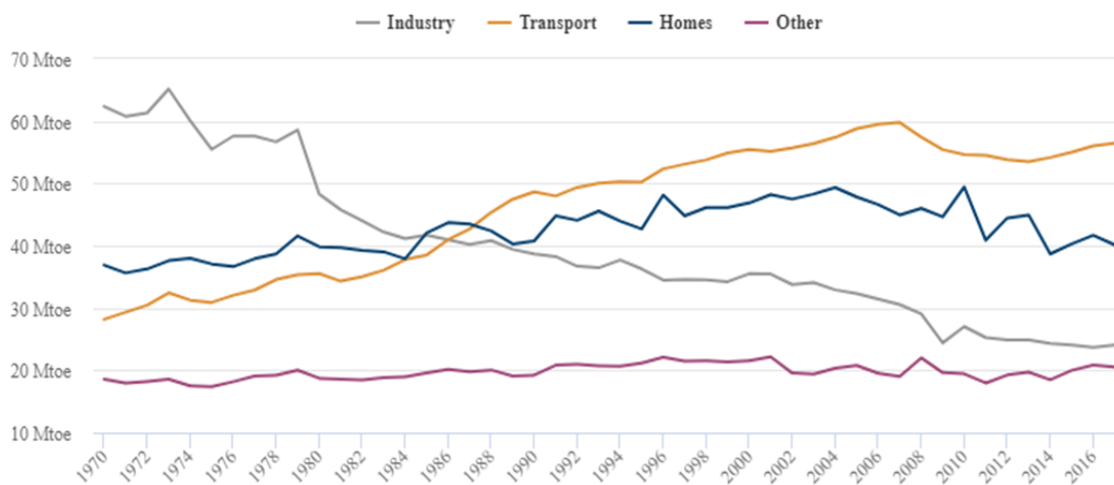


Figure 3.3. UK energy consumption by sector 1970-17.
Source: Carbon Brief (2018)

Second, policy has been “chopping and changing” often at short notice, negatively impacting investor confidence, development of UK supply chains, employment and development costs (Hawkey et al. 2013; CCC 2018, p. 12). The CCC (2018) points to several policy changes that have had negative impacts on UK targets and the economy more generally; the *Zero Carbon Homes (2006)* policy outlined that from 2016 all new buildings would need to generate as much energy as they consume, this was supported by tighter energy efficiency standards. However, the policy was discarded in 2015 less than a year before its implementation. This decision was critiqued as without such a policy the UK will continue to build housing which leave a legacy of higher energy consumption needs and thus higher domestic energy bills. It also held ramifications for the energy efficiency sector where employment levels dropped by around 45% in 2016 (Office for National Statistics 2018a).

The FIT has been reduced several times since 2015 and is now scheduled to end in 2019. Its constant reduction has been cited as contributing to the 56% reduction of renewable energy investment in 2016/17 (Environmental Audit Committee 2018). Two competitions for carbon capture and storage (CCS) developments were cancelled by the UK Government at late stages, leading to a financial loss for developers who had formulated bids, and also for the Government itself of around £100 million (National Audit Office 2017). In 2015 the Government also announced that it would not support additional CCS investment and would instead seek out more cost effective low-carbon developments such as nuclear (Carrington 2015; HM Treasury 2015a; HM Treasury 2015b). However, most recently CCS has once again become a policy priority (BEIS 2019b) while investment in new nuclear have become questionable (BEIS 2019c). Finally, policies aimed at

improving domestic energy efficiency had their budgets cut by 83% in 2015 (House of Commons Energy and Climate Change Committee 2016b).

While the UK Government is responsible for delivering on the UK’s national and international targets, meeting them is dependent on cooperation and progress being made within the devolved nations of Northern Ireland, Scotland and Wales (Muinzer & Ellis 2017). However, at devolved spatial scales, difference in low-carbon transition trajectories is evident. This may in part be explained by policy devolution, which has not been equally allocated to each devolved administration¹³. For example, while each has devolved competencies over new energy production developments (see Table 3.1) such as the type of energy, scale and location, these are uneven in scope and until April 2019, Wales held the least competencies. This has been cited as limiting “a more comprehensive Welsh-specific energy policy” (Llewellyn et al. 2017, p. 818) also holding implications for the type, scale and installed capacity of renewable energy As per Figure 3.4, aside from Northern Ireland, Wales has the lowest levels of installed renewable electricity capacity in the UK. For an explanation as to the apparent paradox of Northern Ireland’s highly devolved energy policy but low renewable energy installed capacity (c.f. Muinzer & Ellis 2017).

Table 3.1. Devolution of energy related powers in the UK

Country	Energy policy is ...	Provision of market support for renewable energy	Planning and Consents (onshore)	Planning and Consents (offshore)	Economic development spending
Northern Ireland	Fully devolved	Fully devolved	Fully devolved	Fully devolved	Fully devolved
Scotland	Executively devolved	Scope to shape delivery of some schemes	Fully devolved	Fully devolved	Fully devolved
Wales	Executively devolved*	No Powers	Power to determine applications of up to 350 MW**	Power to determine applications of up to 350 MW***	Fully devolved
UK & England	Full competence	Full competence	Full competence for England, partial for Wales; full competence over projects 350 MW+	Full competence for English and Welsh Waters (subject to Welsh exceptions, above)	Fully devolved

* Until the Wales Act (2017) energy policy was not devolved to Wales.

**Until the Wales Act (2017) this power was limited to partial powers over planning policy and consent for smaller schemes only (below 50 MW).

***Until the Wales Act (2017) this power was limited to determining applications up to 1 MW (with exception under Transport and Works Act 1992).

Source: Cowell et al. (2015)

¹³ Policy devolution and political marginalization are unpacked further in Chapters 6 and 8

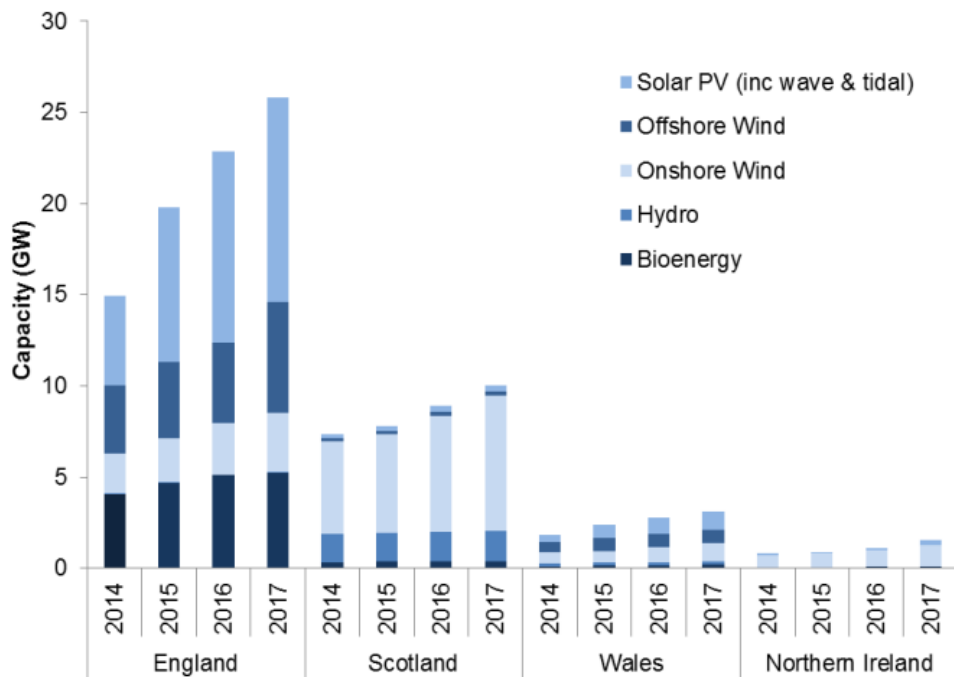


Figure 3.4. Renewable energy capacity per UK country
Source: BEIS (2018g)

Each devolved nation has its own CO₂ reduction targets (see Table 3.5) these are directly influenced through devolved competencies in demand-side measures for transport, energy efficiency, aspects of energy policy, waste, agriculture and land use (CCC 2018). However, as competencies over demand-side measures themselves are not equally devolved there are variances in the ability of each devolved nation to reduce emissions. This is evidenced in Table 3.2 and Figure 3.5 where due to progress so far, overall, Scotland is the only administration likely to meet its 2020 targets (CCC 2018).

Table 3.2. Devolved Administrations GHG reduction targets and progress.

	Policy	GHG reduction targets (from 1990 baseline)	Emissions Change (1990-2016)	Relative Change (2015-2016)
UK	Climate Change Act 2008	35% by 2020	-41%	-5%
N. Ireland	No separate climate change legislation. GHG reductions contribute to UK total under the Climate Change Act 2008	35% by 2020	-16%	+1.3%
Scotland	Climate Change (Scotland) Act 2009	42% by 2020	-45%	+2.5%
Wales	A Climate Change Strategy for Wales 2010*	27% by 2020	-14%	+4.8%

* Superseded by the Climate Change (Carbon Budgets) (Wales) Regulations 2018.
Adapted from: CCC (2018)

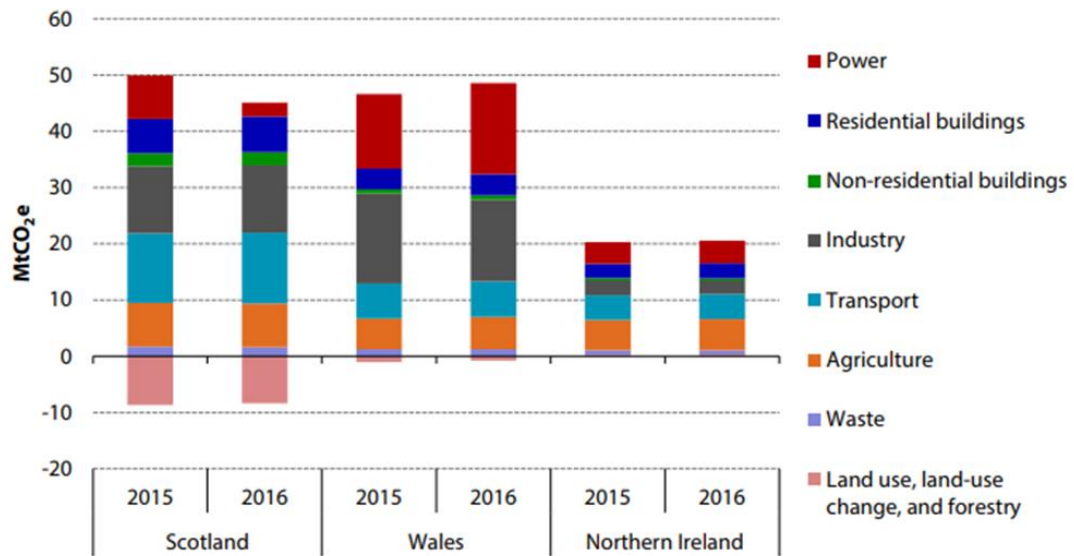


Figure 3.5. Devolved administration GHG emissions by sector. Source: CCC (2018, p. 246)

As hinted at above, several factors contribute to regionally differential transition trajectories. These include a mix of elements that are directly impactful upon energy transition such as; devolved political power and ideologies, natural resources, built environment and infrastructure, and regional energy economics (including ownership and supply chains). Additionally, wider contextual elements hold influence, such as non-devolved national policy and politics, the wider economy, internal and external historical and cultural framings. For example, in Wales, its relative high levels of GHG emissions compared to other devolved countries in the UK (and indeed many EU countries) is attributed to “its large industry sector compared to its size and population; harder to treat residential housing stock (hard to treat properties have solid walls and are off the gas network)...and the fact that it is a net exporter of electricity and energy services” (Georgakaki et al. 2015, p. 107).

Additionally, large areas of Wales have poor transport connections, this can necessitate high dependence on personal vehicles, for example via “forced car ownership” (Mattioli et al. 2017, p. 95)¹⁴. Wales, as a devolved country with fewer devolved powers than Scotland and Northern Ireland also produces GHG and carbon emissions that are beyond the scope of its powers to alter. As Georgakaki et al. (2015) point out over 60% of Wales’s emissions are outside of Welsh Government authority. Indeed, energy infrastructure and distribution, regulation and production over 350 MW¹⁵ are not devolved, thus, Wales

¹⁴ See Section 7.3 for exploration of personal vehicle ownership

¹⁵ Power to consent energy projects of up to 350 MW was devolved to Wales in 2018.

large emissions due to gas combustion is a UK national competence. It also demonstrates the interconnectivity between places, as Wales's gas emissions have risen as Scotland's coal emissions have fallen – this mirrors national energy demand: as coal has been phased out, gas has helped filled the demand gap (see also Figures 3.1 and 3.2).

It should also be pointed out that while much of Wales' own transition ability may until recently have been limited, where there was ability to take forward transition, for example in setting carbon budgets, Wales has been slow to progress. Initial carbon targets were set out in *A Climate Change Strategy for Wales 2010*, two years after the UK and other devolved nations policy. Additionally, while carbon budgets were set for 2016-2020, a plan to achieve this was only ratified in 2019 (in *Prosperity for All: A Low Carbon Wales*). Consequently, while some of Wales slow progress in reducing GHG emissions (Table 3.2 and Figure 3.5) is a result of external control over how and where emissions are produced within Wales, its own slow policy development has also restricted progress.

Within this brief snapshot of Wales in the UK it is clear that historical, material, political and economic factors, and how they interplay within Wales and also relatively between other UK countries influences low-carbon transition progress. Thus, to fully understand low-carbon energy transition in the UK, plan future trajectories and ultimately achieve climate change goals, the scale it is understood as taking place within must alter to accommodate smaller scale influences in addition to accounting for the wider context. Reducing the scale of transition exploration necessitates a spatial lens because so many of the elements that influence the ability to take forward transition are spatially situated and spatially differentiated. This also allows further recognition of spatial and energy injustices that may be embedded within places and that may be reproduced as part of transition.

3.3 Towards a 'just' socio-technical transition process

Energy transition involves a large-scale change in the composition of primary energy supply that will be influenced by, and in turn will impact upon technologies, institutions, businesses and energy customers, to name a few (Rotmans & Loorbach 2008). Much research has explored how low-carbon transition may progress, investigating the main influences on this progression (Geels et al. 2016) and what influence this may hold on

social structures, energy and political governance, and landscapes (Foxon et al. 2010). Energy transition is a change to the current energy regime, with the regime being the dominant energy system in place at that time (Foxon 2013). Regimes are stable configurations of politics, markets, infrastructures and social networks (Grin et al. 2010), this stability and complex configuration means regime change can be difficult. Within the UK, it is argued that a “market logic” dominates, and the regime consists of centralised systems and technologies and large-scale actors and distribution networks (Foxon 2013, p.11). While a stable regime such as this with barriers at all levels from production, infrastructure and distribution, market dominance and consumer behaviour make transition difficult, as section 3.2 demonstrates it is not impossible. However, it is debatable how ‘just’ transition is.

The fundamental changes brought by low-carbon transition on socio-economic and political structures at all scales, combine with growing concerns on the inclusivity of transition processes to necessitate deeper understandings of how and why it unfolds in particular ways and how can it be ‘justly’ progressed. Energy transitions are extremely complex and involve “multiple scales, geographies and temporalities” (Turnheim et al. 2015, p. 240). The complexity of structures and number of actors at all scales, in addition to the numerous interplays across time and space means, “there is no single vantage point from which socio-technical transitions can be comprehensively analysed or steered” (Turnheim et al. 2015, p. 241). Consequently, several approaches attempting to unpack energy transition have developed. Of these, two dominant frameworks have emerged, a socio-technical framework and an energy justice framework (Sareen & Haarstad 2018, p. 624).

Socio-technical frameworks focus on energy production and supply, exploring how technological innovations can be fostered and become normalized, or mainstreamed, and thus challenge existing socio-technical regimes. Energy justice, whilst often accounting for supply-side dynamics, also focus on the demand-side, exploring fairness and equity with the “distribution of costs, risks and deprivation associated with energy” (Sareen & Haarstad 2018, p. 624). Given their different foci, each framework has emerged from distinct scholarship areas, socio-technical holding foundations in science and technology studies (Sareen & Haarstad 2018) and energy justice holding foundations in social and environmental sciences and law. This section will unpack each framework in turn.

Socio-technical frameworks focus on the interaction of technical, institutional and socio-political change processes (Turnheim et al. 2015) and essentially understand that “technology is always mediated by social practices, institutions, systems and structures” (Sareen & Haarstad 2018, p. 625). Thus, socio-technical theorising seeks to understand how and why some technological innovations, initially developed within safe spaces or protected niches, become integrated into social regimes while others do not (Rip & Kemp 1998; Sareen & Haarstad 2018). Such framings have developed to include; multi-level perspective (MLP) (Geels 2005) and technological innovation systems (Mattes et al. 2015); transition management and strategic niche management (Loorbach 2010; Meadowcroft 2009); and actor-networks (Nye et al. 2010). Additionally, different transition modelling methods have advanced, for example; quantitative system modelling attempts to predict energy transition outcomes through exploring possible behavioural and techno-economic options; initiative-based learning focuses on micro-scale projects and the interplay of actors in their development and scaling-up (Turnheim et al. 2015).

While each framework offers a certain focus to transition research, MLP is most often used for research with a socio-technical quantitative modelling and actor-networks are most often used for initiative-based learning modelling (Turnheim et al. 2015). Each analytical framework holds similarities in focuses on temporal and hierarchical processes, however, as each approach is undertaken in isolation the field of transition research has been criticized as being incomplete and therefore having limited policy and practice benefits (Turnheim et al. 2015). Of the different frameworks MLP as a framework for socio-technical transitions has become most explored and developed within European research (Foxon 2013).

MLP was originally put forward by Schot (1998) as an analytical framework for exploring historical technological developments, and also by Rip and Kemp (1998) as a means of understanding technical change. It is the most recent conceptualisation of MLP put forward by Geels (2005), then Geels and Schot (2007), which has been most advanced within the literature (Grin et al. 2010; Sareen & Haarstad 2018). This current understanding combines both original approaches by Rip and Kemp (1998) and Schot (1998), whereby technical transitions can be understood to occur due to an alignment of socio-technical trajectories at three structural levels, niche (micro), regime (meso) and landscape (macro) (Grin et al. 2010). The three levels operate within a ‘nested hierarchy’ whereby niche level is embedded in the regime level and the regime level is embedded in

the landscape level (Grin et al. 2010; Lopolito et al. 2011). But it is the regime level changes that are fundamental to transitions being successful, therefore, a transition in the case of the MLP can be viewed most notably as a change in an existing regime (See Figure 3.6). Regime change however, is difficult, as existing regimes resist the changes of transition due to lock in, embeddedness and path dependency (Foxon et al. 2010). For regime change to occur, social and technical innovation at a niche level and pressure exerted on the regime from the wider landscape need to be synchronised so that space made at regime level through landscape pressure can be filled by niche level innovations that are ready at that time (ven den Bergh & Bruinsma 2008; Grin 2010; Lopolito et al. 2011; Jørgensen 2012).

Lock-in can also occur as part of the transition process. For example, UK low-carbon policy and subsidies have emphasised some renewable energy sources, such as nuclear, onshore wind, and more recently solar PV, over newer, untested technologies such as tidal. This is due to the more established technology's relative cost effectiveness, ready technology and energy returns (Pearson & Winter 2013; CCC 2017), although the cost-effectiveness of different technologies in the UK is still debated (Pfenninger & Keirstead 2015). This new regime 'lock-in' holds influence over technology development as it becomes more difficult for newer technologies to break out of their niche and access the market as they are not tested on a larger scale and cannot achieve the same economies of scale as more established technologies. This could mean that low-carbon technological developments that would better meet UK energy needs at a lower-cost (longer-term) are being depressed in favour of better known, older technologies.

Within the energy literature MLP has been used for mapping historical energy transitions (Verbong & Geels 2007), the understanding of which in turn has enabled MLP to be used as a tool for imagining how the current energy transition is unfolding (Foxon 2013) and how that may continue as time progresses (Geels et al. 2016; Longhurst & Chilvers 2016). A major output of MLP research within this field is that of transition pathways (Foxon et al. 2010; Geels 2016, Turnheim et al. 2015). Transition pathways are defined as "patterns of changes in socio-technical systems unfolding over time that lead to new ways of achieving specific societal functions" (Turnheim et al. 2015, p. 240). As such, it is argued that understanding the dynamics and particular context-specific factors that lead to the evolution of certain transition pathways, the process itself can be managed in order that

the resulting regime change is steered towards set goals (Loorbach 2010; Turnheim et al. 2015).

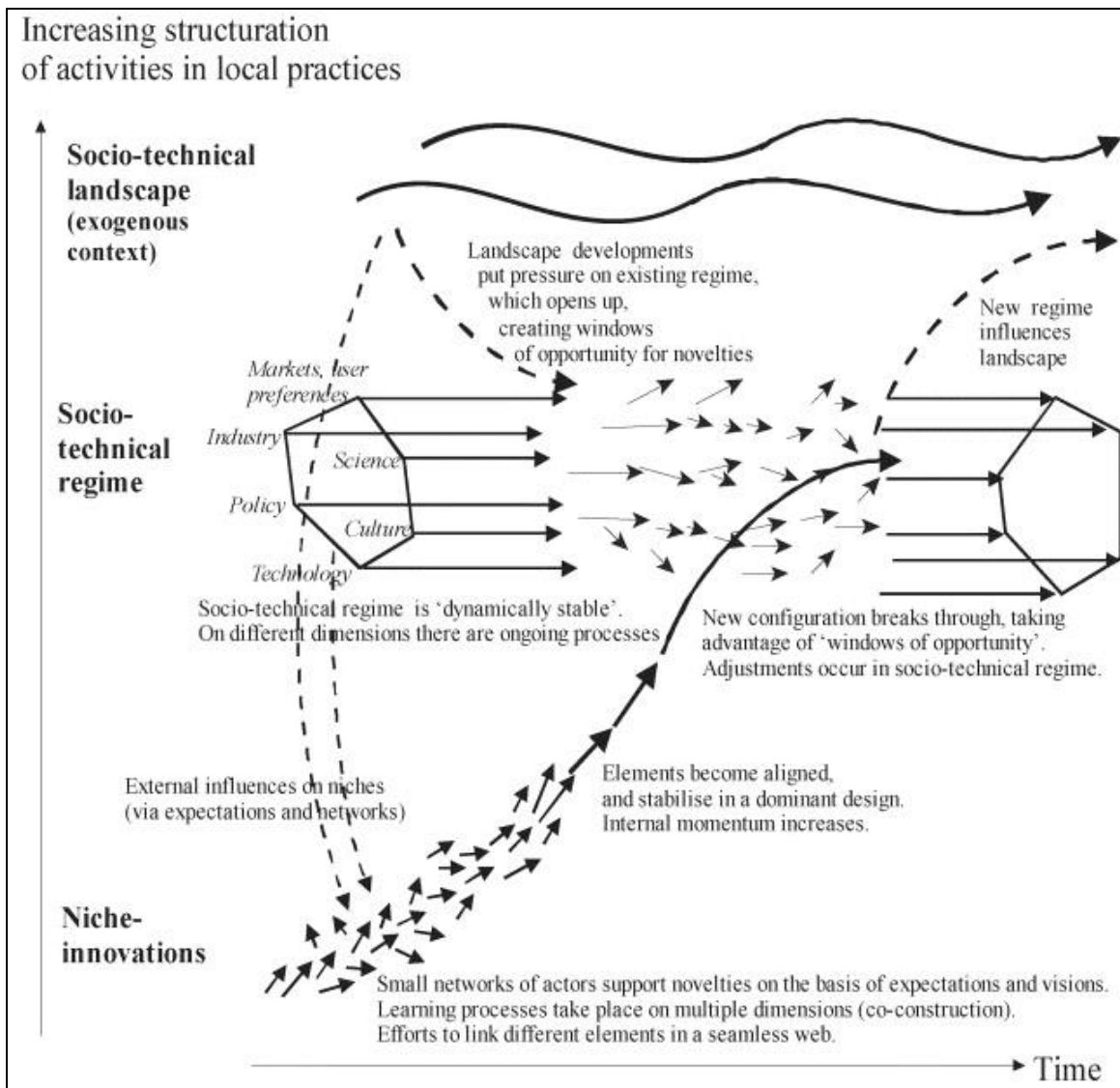


Figure 3.6. Multi-level perspective on transitions.
Source: Geels and Schot (2007)

Foxon (2013) expands on the traditional MLP theory that transition pathways arise through the dynamic interaction of technological and social factors at different scales. These interactions are mediated by the actions of three main actors in the UK: Civil Society; Market; and Government. The three actors hold influence over the transition process, however, usually only one of these will be the dominant force and consequently will determine the outcome or new regime in their favour (Foxon 2013). Foxon et al. (2010) and Foxon (2013) suggests three possible transition pathways - 'Thousand Flowers', 'Market Rules' and 'Central Coordination' - each shaped by the dominant actor within a transition process. For example, Thousand Flowers represents a transition originating in civil society and a more 'bottom-up' approach, that would involve a

transition with concerns for equity, biodiversity and the environment and may result in de-centralisation and de-growth; Market Rules represent a pathway most similar to the current regime, whereby the energy market has minimal interference from government or civil society and remains centralised and dominated by the existing large energy firms; finally, Central Coordination sees an active role for the government in (amongst others) selecting future energy technologies, stimulating the energy market directly and indirectly through influencing customer behaviours and placing regulations on new-builds (Foxon et al. 2010).

Low carbon transition represents more than a change to the energy regime, “it is also a challenge in terms of making sure societal costs, risks and benefits of that shift are distributed in a way that can be considered ‘just’” (Sareen & Haarstad 2018, p. 624). Therefore, there are increasing calls for socio-technical and energy justice framings to be re-conceptualised as one. Energy justice transition frameworks focus on either “humanising” existing socio-technical frameworks (Jenkins et al. 2018); or emphasising the social and material structures and processes involved in shaping the speed and trajectory of transition (Bridge et al. 2013) which influence to whom the costs and benefits of transition may fall throughout the energy system (production, distribution, consumption and waste) (Bouzarovski & Simcock 2017; Healy & Barry 2017; Monyei et al. 2018).

In humanizing socio-technical transitions Jenkins et al. (2018) integrates the three-tenet energy justice approach (recognition, procedure and distribution) into all levels of the MLP framework (niche, regime and landscape). At a niche level developments can be exclusionary. For example, Jenkins et al. (2018, p. 69) point out, electric vehicles at a niche level have social and environmental benefits, but “they can perpetuate already widening gaps between the wealthy and poor, as well as potentially raising new forms and geographies of injustice”. At a regime level, energy justice can humanize sometimes vacuum based policy making that “locks in” regions and nations to an energy pathway for a number of years (Jenkins et al. 2018, p. 70). Finally, at the landscape level, placing energy justice as a priority here, can lead to cracks in the regime level that would allow niche level innovations that incorporate it to break through more readily than those that do not. However, changes at the landscape level are incredibly slow moving, political and imbued with self-interest, as such it may fall to niche, regime and wider society to pressure the landscape into change.

In their “whole energy system approach” to a “just transition” Healy and John (2017, p. 451) highlight the role of existing socio-economic structures in creating dependencies, which can “lock out” new low-carbon innovations by “locking in” large scale investment in carbon-heavy developments for a number of years. Additionally, concerns for employment opportunities or regional growth which are currently dependent on fossil-heavy energy technologies, but that would be reduced by low-carbon alternatives, should be legitimised. Re-framing just energy transition as a need for divestment in fossil fuels illuminates: the debilitating influence current carbon-heavy energy incumbent actors have on transition progress; injustices for those impacted by the current regime; and injustices created by low-carbon transition. This makes possible the identification of specific changes which facilitate transition and also address energy injustices. Healy and John (2017, p. 453) put forward that politicians and policy makers play a pivotal role in their decision-making for example, regarding energy subsidies, the energy-economy or in creating pathways or new options for labour and citizens who otherwise may become “stranded” as low-carbon transition progresses.

While both approaches to conceptualising a just energy transition differ, they share a strong premise; that without integrating energy justice and transition theory together, low-carbon transition risks replicating further or worsening uneven socio-economic and political distributions of power, opportunity and representation. This can occur by disenfranchisement, exclusion from transition process, increased socio-economic gaps and causing those with the least political and socio-economic capacity, including those currently marginalised, to be disproportionately negatively affected by distributions of transition costs and benefits. Additionally, they both highlight the role of powerful incumbent actors in slowing and diverting transition, Jenkins et al. (2018) point to the landscape level of the MLP while Healy and John (2017) trace back injustice to its root causes within the energy system as a whole.

These insights are important as low-carbon transition is increasing the range of energy generators and their distribution spatially. This is evident in the UK where energy policy has expanded the ability to generate and profit from energy from the traditional ‘Big 6’ to the public sector, third sector and community groups and households. This new usually smaller-scale distributed energy production raises new issues of justice, such questions have asked why are some households able to produce energy and therefore generate some form of income or bill reduction, while others cannot? And, what differential impacts

may this hold for those who can or cannot participate in energy transition in in such a way? Such questions have received some attention within the literature which has largely focussed on how policy affects the inclusivity and fair access to energy production. For example, the FIT and RHI allow households who install low-carbon production in their homes to benefit from reduced energy bills (as they consume their own energy first) in addition (in the case of FIT) to exporting surplus energy to the national grid and generating an income. However, due to the initial financial investment by the household to install such technologies and level of autonomy over the building structure itself, energy production schemes have been criticised for benefiting wealthier, home-owner households (Walker 2008; Stockton & Campbell 2011; Bickerstaff et al. 2013). The inequity between those who can generate energy and those who cannot is worsened further as all energy consumers in the UK have subsidised such schemes, regardless of income level or energy consumption.

While transition pathways and possible energy futures for the UK derived from the MLP are debated, there is no doubt that the MLP has been important in furthering understanding the dynamics of energy transitions. In particular, the role of the regime and the possible barriers it can present for transition, such as inertia, lock-in and path dependency (Foxon et al. 2010; Jenkins et al. 2018) which can be evident in different UK scenarios. However, MLP, and transition literature more generally, have been criticised for a number of reasons. Some of this is in relation to the way existing transition analytical frameworks, in particular the MLP, can overly homogenise what are in reality diverse and complex relationships between and within structural levels (Smith et al. 2010a) and actors (Raven et al. 2012). Similarly, critique has highlighted that the framework does not easily account for non-path dependent developments, for example, forms of disruption that could occur at any stage of the ‘pathway’ (Sareen & Haarstad 2018). Interplay between different elements within each level are unaccounted for as they are bound or partitioned in both space and time (Smith et al. 2010a; Essletzbichler 2012).

The national-centric view that is employed within most transition research, particularly that using MLP is problematic (Bridge et al. 2013; Raven et al. 2012). The focus on national level, especially for transition research that focuses on the UK, is in part related to the close inter-relationship between national level politics and the ‘big 6’ large scale energy utilities in the UK and the high level of dominance and influence these actors have over the current energy system (Turnhiem et al. 2015). This regime operates under a

highly centralized governance system and via a centralized infrastructure of production and distribution (Hannon et al. 2013; Foxon 2013) with high levels of embedded sunk-costs leading to lock-in by actors and built infrastructure and consumer behaviours leading to embedded consumption habits (Bridge et al. 2013). In addition, the reliability of energy and relatively cheap prices the current system in the UK have added to embedded consumption behaviours, which all in all, presents a strong, stable regime that holds many obstacles for niche development and eventual regime change (Hawkey et al. 2013). However, it is possible that the centralised nature of the energy system in the UK, with its limited number of actors makes transition more streamlined and easier to govern (Committee on Climate Change 2018). Regardless, the dynamics of low-carbon transition is changing the configuration of the current energy system. It is becoming increasingly decentralised with increasing numbers of diverse actors that vary in scale and motivation. This means that it will be increasingly unlikely that the energy system and its modes of governance will fit within the existing MLP model.

Finally, most niche level innovations, at least initially, occur at a local or regional level (Smith et al. 2010a). Neglecting differences in spatial scale can mean that the full impact of developments at a niche level, or how these developments may be nurtured to push into the regime, may not be fully understood. For example, Essletzbichler (2012, p. 796) suggests that the development of “energy regions” and smart grids are likely to happen at a “non-core” or peripheral regional level, these developments hold the possibility for these regions to reduce their imports and even generate revenue from sale of their surplus energy. This can impact not only their local level energy regime and economies but also the broader national regime through possible scaling-up and replacement or transformation of existing regimes that operate at a national scale (Essletzbichler 2012). Additionally, ignoring locality will inevitably lead to a limited understanding of niche development and why such development is spatially uneven (Raven et al. 2012).

Therefore, transition theories must more adequately account for scalar, spatial and place specific factors can only offer a partial understanding of transition dynamics. This holds implications for transition management and policy and practice (Loorbach 2010; Turnhiem et al. 2015). MLP as a dominant framework within the literature for exploring energy transitions currently does not fully address these influencing factors, instead dominant transition literature focuses on large-scale national transition dynamics or comparisons between countries. As some have highlighted, a geographical perspective

has the capacity to account for these and other missing transitional elements (Raven et al. 2012; Bridge et al. 2013; Hanson & Coenen, 2015; Faller 2016), and because “when it comes to energy, geography always matters” (Calvert 2016, p. 107).

3.4 Accounting for geographies: A spatial justice framework

By incorporating geographical perspectives into transition research “the way in which spatial processes shape energy systems and influence capacity to transform” can be understood (Bridge et al. 2013, p. 332). This expands existing understandings of transition processes and the outcomes that may result from predominantly temporal and structured process analytical frameworks, which without a spatial focus, have limited accuracy in predicting future imaginaries, or limited effectiveness when applied to policies and practice. It has been recognised in recent years that a geographical focus on energy transition is needed as energy is a fundamental element in the development of spatial differentiation, affecting physical, social and political distributions of value and power (Calvert 2016; Bridge et al. 2018). It is such elements and how they are distributed across space, creating places that drive forward energy transition. Thus, energy transition trajectory will be informed in large part by where transition is taking place. There have been a number of studies that have approached energy transition research with a spatial lens (c.f. Raven et al. 2012; Fuller 2016; Yenneti et al. 2016; Bouzarovski & Simcock 2017). This section will unpack how geographic concepts of scale, place and proximity have advanced transition theory before identifying their synergy within a spatial justice framework which may be the most appropriate geographical lens for exploring energy transition.

Scale refers to a number of components of the energy transition. From a socio-technical perspective scale identifies niche, regime and landscape levels while energy justice refers to scales of costs and benefits arising from energy production processes (Sareen & Haarstad 2018). Considering scale from a spatial perspective allows a widening of the concept, including the physical scale of energy production and consumption i.e. micro (household), meso (sub-regional, regional) and macro (national, global) (Turnhiem et al. 2015). Spatial scale can also refer to scales of power and the capacity for action of the actors involved, i.e. energy importer versus exporter or energy producer versus consumer (Bridge et al. 2013; Turnhiem et al. 2015). It impacts upon how political power is

organised and exercised over space, or within different places, be it streets, neighbourhoods, cities, regions, nationally or globally. Whereby local civil innovations or organisation can be interpreted as small scale and national institutions or national energy providers being large scale, however, even this is open to interpretation, especially if factoring in global actors in which case they become large scale and the national and civil/local actors reduce in scale accordingly.

Within the current regime in the UK at a political level the status quo of large-scale centralised transition solutions prevails, in part due to preferences for a more easily managed central system and a dependence on large scale energy producers for reliable energy supplies (Bridge et al. 2013). This leaves smaller scale energy producers or niche innovations politically marginalised, affecting their access to available finance and energy markets. Marginalisation of small scale de-centralised projects at a national level could possibly contribute to non-engagement of people working and living within smaller community or town scales during transition. While socio-technical transition frameworks help to exemplify these issues, largely attributed to national level lock-in and path dependency (Hawkey et al. 2013), there is a growing body of research that now addresses the lack of attention to transition at different scales (Hanson & Coenen 2015).

For example, some research has focused on exploring the importance of inter-relationships at different scales as a means of advancing transitional projects and innovations and the interplay between technology, regime particularities and actor agency (Fuenfschilling & Truffer 2016). Other research has used scale to focus on specifically sub-regional or regional dynamics and the actors driving transition forward at this level (Hodson & Marvin 2012; Spath & Rohrer 2012; Mattes et al. 2015), while the inter-relationships and interplay of actors between different scales has also received attention (Truffer & Coenen 2012) with some suggesting that this area in particular is still under theorised (Matte et al. 2015). Research with a sub-regional or regional focus has tended to focus on urban locations such as cities (Bulkeley et al. 2011; 2014; Devine-Wright & Wiersma 2013; Hawkey et al. 2013; Rutherford & Coutard 2014; Bouzarovski et al. 2017) with little attention to date paid to non-core or peripheral regions and the unique characteristics within these regions that may influence transition within these places. Such scaling down of transition research would be of benefit in the UK where, as per section 3.2, it is evident transition trajectories differ between devolved countries.

Places can be both absolute, physical spaces and/or locations that are used by and hold that meaning to people (Bridge et al. 2013), this can be highly diverse and individual. Individual interpretations of place are themselves formed by how people “know the world” through their historical, cultural and political experiences and viewpoints (Creswell 2015, p. 18) along with more tangible factors such as the physical location of the place, its landscape or environment and history (Longhurst 2015). These differences affect how places are experienced and lived which in turn impacts upon how transitions progress in these places (Essletzbichler 2012; Shove & Walker 2014). As energy transition is likely to impact upon cultures and lifestyles (Rotmas & Loorbach 2008) this in turn will impact upon how energy is embedded within local landscape and built environments, and the different ways consumers may access and use energy in different places (Shove & Walker 2014). This too plays a role in determining the form of energy transition and illustrates the spatiality of transition processes.

In addition to places being ‘lived spaces’ and reflecting the perceptions of the people who use them, they also have different “relational assets” (Raven et al. 2012, p. 70) which can include endowments, social relations and conventions. These physical and socially created assets can lead to spatial differentiation between places, whereby the levels of knowledge, skills, capital, social capital and identity that they influence in turn impact upon the distribution of resources, products, services and amenities (Raven et al. 2012). As most of these endowments are largely the result of human activities, they are themselves subject to continuous evolution over time as socio-demographics and economies change, some are present regardless of human activity. For example, “local natural resource endowments” (Hansen & Coenen 2015, p. 99) which are geographical features or natural resources (Baker & Mehmood 2015) that hold some form of value, cultural, social, political or economic. With regards to low-carbon energy, resources of value could be in the form of waterways (micro-hydro), highland plateaus (wind turbines) or south facing fields (solar-PV). As such, in addition to local infrastructure capacity and social acceptability (Hansen & Coenen 2015), the availability of natural resources could somewhat dictate whether low-carbon transitions are a viable option for some places and if so, what types of technologies may be used and at what scale.

Other endowments that differentiate and define places are human created and therefore relative. These can include socio-demographics and cultures which impact upon knowledge, behaviours, social structures and capital and social capital (Raven et al.

2012). In relation to low-carbon transitions, these may influence the ability of different places to plan and organise transitional energy projects or develop and progress innovations (Baker & Mehmood 2015). Research has demonstrated that places of current social deprivation are also places of land degradation and have little community capacity (Robbins & Rowe 2002, cited in Middlemiss & Parish 2010, p. 7560) meaning that, at least as the current energy transition stands, these same places are likely to experience transition in a more passive way. For example, through simply paying more for their energy (subsidising renewable energy policy) (Bickerstaff et al. 2013) or through being selected as viable sites for private low-carbon energy production developments (Cowell 2010; Cowell et al. 2012). Therefore, these places are likely to have little say in what technologies are pursued, in what locations and what impacts there may be on landscapes and economies¹⁶. However, more affluent places with high land values and high social capital may be in a stronger social and financial position to actively pursue a low-carbon transition of their choice. This is where issues of lock-in and marginalisation of alternative energy developments within the current regime become apparent, whereby even places on the best positions to pursue low-carbon energy projects may experience difficulty in realising their plans.

For instance, at a community scale, energy production projects owned in some part by a community themselves have gained a reputation both politically and within the literature as being a means of not only creating income, but, of increasing community cohesion, development and resilience (Haggett & Aitkin 2015). In order to start a community energy project and then benefit from these positives a high level of agency, social capital, expertise, organisation and time (or ‘community capacity’) (Middlemiss & Parish 2010, p. 7560; Adams & Bell 2015) is required from individual community members. Communities without the ‘capacity’ needed to take an energy production project forward will find it extremely difficult to take advantage of community energy production. However, research has demonstrated that not only are “communities unequal in capacity” (Bristow et al. 2012), but that communities with low capacity also tend to be those in poverty and experiencing social exclusion (Robbins & Rowe 2002, cited in Middlemiss & Parish 2010, p. 7560) suggesting that those who most need the benefits that a community energy project can generate, may find it hardest to achieve.

¹⁶ Section 6.3 explores experiences of large-scale and community lead energy production

Community capacity with regards to the sharing of benefits that an energy project can bring is not just confined to community owned projects, but also those owned by external agencies such as energy companies, who offer community benefits (usually monetary annual payments) to “affected communities” (Bristow et al. 2012, p. 1109). In these instances, the loose application of community, usually based on geographic boundaries, can be positive in that a wide range of different social groups can be considered part of the community and therefore benefit, however, questions have been raised over the ability of different groups to assert themselves within such discussions (Bristow et al. 2012). Other instances of perceived inequality within communities is possible if the project is funded through a cooperative model for example, in which only those with financial capital to invest would see direct benefits (Haggett & Aitkin 2015). Thus, these projects have the potential for being exclusionary to those within a community who for various reasons are not positioned to participate. This can cause or renew divisions between different social groups who are perceived to have benefitted and those who have not (Walker & Devine-Wright 2008; Hobson et al. 2014). Policies and political rhetoric have been criticised for disguising such in-community divides or inequities by using terms such as “localism”, “local” and “community” when discussing community energy projects creating perceptions of inclusivity and community homogeneity (Walker et al. 2007, p. 75).

Endowments can also be considered in the material form of a place for example, in past and current land use or in its building stock. These material endowments can impact greatly on how land is designated and on the energy needs of people living within the buildings. For example, studies have demonstrated that many areas within the UK, with industrial pasts that have left the land largely degraded have been highlighted as key places for energy production (Cowell 2010). This links with social endowments, whereby these places are also typically socially deprived, and therefore less able to influence energy development plans (Cowell 2010). With regards to concepts of social capital, social networks and knowledge exchanges, research has explored the effects of these on niche management and regional energy projects (Seyfang et al. 2013), the scale-up of innovations into regimes (Longhurst 2015) and intra-personal social networks as an influence on consumer behaviour (Catney et al. 2013). The research carried out by Seyfang et al. (2013) consisted of a survey sent out to all the existing community energy projects within the UK (at the time), to establish how and why the groups had developed and what their general activities were along with their networking activities within the

energy sector. They found that over 80% of the survey respondents had used their networks to either give or receive help and that this had been between energy projects within the same localities. Thus, not only are actor-networks important for maintaining community energy projects, but so is proximity.

Proximity then is generally regarded as an important positive factor for network building, collaboration, knowledge sharing and ultimately innovation progression (Seyfang et al. 2013). It should be noted that proximity, as with space, can be both an absolute measure whereby there exists absolute physical distances between places or actors, and a relative measure whereby close collaboration, shared interest or aims can bring actors closer together relatively even though they may be absolutely distal (Raven et al. 2012). Relative or relational proximity, and the emergence of knowledge or innovation clusters has received much attention within the literature (Rotmans & Loorbach 2008), but, the effects of absolute distance on energy transitions has received much less. For example, as mentioned, much of the transition research that has a regional focus has studied transitions in urban areas such as cities or core areas. These areas are generally physically in close proximity to smaller towns and also have a larger amount and variety in scale of resource assets. Thus, transitions in non-core physically proximately distal locations, with fewer and limited variety of resource assets and may (or may not) have higher amounts of natural resource assets is likely to be highly different.

Incorporating geographical lens' such as scale, place and proximity to explore energy transitions highlights the multiple interconnections between energy and space. It illuminates how transition trajectory is a socio-technical process, but that it is also a socio-economic, socio-political and therefore, fundamentally spatial process. Thus, understanding transition involves unpacking place-specific, socio-economic and socio-political processes which interplay within and across multiple scales to affect spatial differentiation. Furthermore, within differentially spatialised places, ability to be recognised, to be involved in transition processes, or to make use of endowments fairly and experience 'just' transition is contingent on a places relative spatial position. Spatial justice could provide such an analytical framework as it already brings together understandings of the co-dependencies between spatial difference, scales of power, and ability to access and use socially valued resource.

Work has commenced in adopting a spatial or spatially just framework within transition literature. Such work considers the influence of various scales (of places, actors and

energy developments) and spatial difference exerts on transition trajectory, including how 'just' it is or is not (Sareen & Haarstad 2018). Sareen and Haarstad (2018) combine concepts of socio-technical transition and energy justice transition with spatial concepts of scale, spatialization and relativity to investigate energy transition in Portugal. Their approach was "responsive to characteristics of specific cases, to their spatial scales and to the political economy of their context while retaining cognisance of justice implications" and found that socio-technical transitions are "entangled" with justice concerns which "play out in different ways across contexts and scales" (Sareen & Haarstad 2018, p. 630). Yenneti et al. (2016, p. 96) adopt a spatial justice lens to investigate how low-carbon transition whilst conceptualised in India as "progressive development" can actually be used to further disenfranchise places with little socio-economic or political power. This disenfranchisement is carried out for the benefit of the nation (large scale), where the costs are paid by the villagers (small scale) via processes of accumulation by dispossession. As Yenneti et al. (2016) point out, a spatial justice lens highlights how such even distributions of the costs and benefits of transition are reflective of already uneven spatial distributions of social, economic and political power. In this way, a spatial justice lens is key facilitating the mobility of energy transition in a way that avoids such repetitions of uneven distribution.

Understanding the effects of scale and differential spatial justice is essential for understanding how and why energy transitions occur in different places. By introducing scale to transition research and scaling down from national level to regional and sub-regional scale new paths are exposed that allow exploration of a number of other factors that have bearing on how transitions may unfold (Matte et al. 2015; Raven et al. 2012). For example, it allows for deeper understandings of the dynamics of 'place' in different locations, how economic, historical and cultural factors shape how people live in different places and thus how they may view transition processes and what may be acceptable and achievable in different places. It allows for the exploration of the interplay of power between different actors at within and between levels, such as operators, planners, engineers, politicians and local residents and the impact they have in shaping energy transitions through the development of innovations and on a local level, changes in culture and behaviours (Faller 2016; Matte et al. 2015). As "distinctive local conditions shape evolutionary change" (Faller 2015, p. 86) and that "the spatial diffusion of energy technology is culturally contingent" (Bridge et al. 2013, p. 336) understanding natural resource endowments in addition to social, cultural and economic endowments at a place-

based level is essential in understanding why transitions occur in some places (and not others). Therefore, energy transition cannot be understood as a homogenous national process, it is more likely and evident in the literature that transitions can occur simultaneously in different places and will be unique to the opportunities presented within each place.

3.5 Conclusion

Energy transitions are highly complex and dynamic processes that involve changes to existing energy regimes that are influenced by a wide range of factors from political, energy and wider economic conditions, social and cultural and also natural and environmental. Thus, energy transitions in turn are likely to have causal effects on all of these factors. Energy transition also involves different scales of organisation, power, and innovation and it occurs in different ways in different places. Diversity between how transitions manifest in different places can be attributed to scales and amounts of natural local resources, local (social) resources, local histories and politics and also wider influences such as national policies and the embeddedness of the current regime. While there is a wealth of literature focused on understanding the dynamics of energy transitions, much of this has done so using the MLP and as such much of these elements have been somewhat neglected.

The view of energy transition from a UK perspective focuses on policy drivers that aim to create regime change towards transitional goals. It provides a perspective on how at a national level, the regime is changing and in what ways, it also allows to a certain extent energy injustices to become evident. However, it treats the nation as a homogeneous space with transition likewise appearing from this perspective to be uniformly progressing across this space. Indeed, due to the dominance of transition viewed as a national scale, “it can be challenging to derive insights into the regional potential of different technologies and transition pathways” (Georgakaki et al. 2015, p. 97). Additionally, it ignores the spatial elements of low-carbon transition, not least important because of the spatial distribution of energy systems and increasing distribution of energy generators, but also because spatial injustices are already present and will affect how, by whom and where transition will progress.

Over recent years research has been carried out that addresses issues of scale, place and space (Essletzbichler 2012; Raven et al. 2012; Bridge et al. 2013; Faller 2015). Further demonstrating the importance of these concepts and advancing transition studies and theory. However, while this literature focuses on regional energy transitions, much of it is done so from urban and city perspectives (Bulkeley et al. 2014; Devine-Wright & Wiersma 2013), leaving understandings of energy transitions from a non-urban or non-core perspective under-developed. Exploring energy transitions from this perspective is essential for the advancement of transition theory, as transitions are highly spatially contextual and therefore, non-core or peripheral transitions are likely to be highly differential to that of urban or city transitions. Thus, while energy transition understandings remain incomplete, so too will attempts to manage or steer transitions towards specific goals (Loorbach 2010). This has political implications on a national level for the UK whereby low-carbon transition is essential for meeting international targets (DECC 2015c; 2016) it also holds issues for justice whereby there remains a risk of reproducing already present uneven spatial distributions of social, economic and political power.

The next Chapter focuses on Wales to highlight the connections between processes of spatialization, spatial justice and energy vulnerability. These processes affect the relative spatial positioning of Wales within the UK but are also in play within Wales, affecting spatial differentiation of intra-Wales. Such peripheral positioning also affects the interplay between multiple and multi-scalar spatial processes with domestic scale energy vulnerability.

Chapter 4. Energy peripheries: Spatial injustice and energy vulnerability

4.1 Introduction

Peripherality is commonly explored as part of economic core-periphery models, used to understand uneven economic development between places at global, national or regional scales. Alternatively, social constructionists understand peripheries as imagined, marginal places, socially created through their difference from central places, but not necessarily related to development. In each instance, periphery is used to define places that are different from and outside of the core. Capitalism as the dominant world system has shaped core cultures and norms in many countries, including the UK. As a result, such cultures and norms hold strong focus on economic functions such as consumption and growth. Consequently, peripheries as understood from a social constructionist perspective can be representative of socio-economic values. The strong economic element present in social peripheralization creates a link with economic peripheralization. Further strengthening this link are understandings of economic processes as fundamentally social. Therefore, peripheralization of place involves both economic disadvantage and processes of social and political marginalization.

Relatively weaker social, economic and political position also affects private investment, with small labour pools and sales markets, in addition to issues of poor transport and energy infrastructure means peripheries are less attractive to capital. As energy is a market commodity, energy access and affordability are directly influenced by such interplays. Poor energy network coverage in peripheries, formed in part by wider core-periphery dynamics, affect energy access. It also holds implications for energy affordability whereby network losses (c.f. Hammond 2000) due to longer transmission distance to peripheries increases the price of energy, or where lack of network access necessitates alternative energy is sourced, usually at higher price. Such material energy structures can influence energy practices whereby more frequent electricity 'cut-off' or higher prices influence the use of multiple energy sources and the use of equipment with the capacity to run without electricity. High volumes of energy inefficient and harder to make efficient housing stock in some peripheries, means that satisfying energy needs can require higher levels of energy consumption.

Overall, energy has and continues to play a key role in uneven spatial development, based on how and where it is sourced from, who it is distributed to, for what purpose and at what cost. Interplaying with other elements of spatialization, such as “lack of agglomeration advantage” or the “tyranny of distance” (Copus 2001, p. 541) energy has contributed to the economic growth in some areas and decline in others. Such processes are visible at national and regional scales and are affected by both material energy structures as well as social structures and their interplay (Shove & Walker 2014). The intertwined and inseparable relationship between spatialization processes and energy holds implications for energy vulnerability, again at multiple scales. At a domestic scale, the six energy vulnerability drivers as outlined by Simcock and Petrova (2017) can all be spatially contingent when considered from a peripheral perspective, implying increased likelihood of energy deprivation in the periphery.

Drawing on broader literature as well as the example of Wales this chapter illuminates the connections between processes of spatialization, spatial justice and energy vulnerability. Wales as one of four devolved nations of the UK is relatively peripheral in terms of its economy, and political and social representation and power. This weak position marginalizes Wales’s needs and ambitions overall, but also in terms of energy, whereby decisions regarding energy developments above a certain scale are taken by central UK government reflecting wider national needs. Additionally, regulation of the energy market and infrastructure is beyond the controls of Wales and is carried out by central regulators Ofgem. Within such structures Wales will experience difficulty in altering its peripherality and meeting the energy needs of its population. Spatialization processes are at play within regions of Wales, for example, differentiating rural peripheries and peri-urban Valleys from urban centers. At this smaller-scale (despite heterogeneity between peripheries) similar social, economic and political marginalization of peripheries holds multiple negative consequences for energy vulnerability manifested at a domestic scale.

This chapter starts by unpacking core-periphery development, after which connections are made between such spatial processes and spatial justice, most notably how energy production, the resources needed to produce it, network distribution and energy prices are positioned beyond periphery control. Finally, the chapter focuses on the interplay between multiple and multi-scalar spatial processes with energy vulnerability at a domestic scale.

4.2 Spatial differentiation: Core-periphery development

Traditionally, the concept ‘periphery’ is spatially defined and is often employed within economic, development and social studies to indicate a location that has economic, cultural or political disadvantage. To be peripheral, a place has to be on the periphery of something, therefore, when exploring issues of peripherality, comparison is often made with a core or centre, in terms of economic prosperity. Consequently, spatial peripheries are usually derived and measured by comparing levels of economic activity between different geographically bounded areas using market accessibility models (Bell 1996) most commonly in the form of core-periphery models. By using core-periphery models to explore issues of uneven economic development at various scales economic and development geographers initiated a model that has heavily influenced development policy on a global scale since the mid-nineteenth century (Gregory et al. 2009; Ottoviano & Thisse 2004).

Initial core-periphery theories were pioneered and advanced within trade, economic, development and political geography disciplines. One of the most prominent theories was the ‘dependency theory’ of Frank (1969) who argued that globally there were developed (core) and under-developed (periphery) countries. Capitalist world market economy mean that production focused on market exchanges, but the exchanges between core and peripheries are characterized by the monopoly the core holds over markets (Simon & Ruccio 1986). Developing countries are in weak trading positions, as such, their trade with the core takes an extractive form, exacerbating their existing underdevelopment (Simon & Ruccio 1986).

Later, the ‘World System Theory’ was developed by Wallerstein (1979) who argued that divisions of labour and the share of the wealth derived from such labour was unevenly spread globally and in a geographical form, as some countries are able to exploit the labour of others for their own benefit. This uneven spread of economic activity is due to a social organization of the workforce (c.f. Frank 1967) and is attributed to the capitalist economy. Wallerstein put forward that, due to capitalism’s innate dependence on accumulation of wealth, it is only logical that those countries already in the strongest economic positions will seek to remain so by both retaining and growing economic power. Inevitably those countries will need to expand their markets to other economically weaker countries who can provide low-cost labour, as well as natural resources and

products, thus perpetuating the position of powerful core and weaker periphery countries (el-Ojeili 2014).

In the 1990s 'New Economic Geography' (NEG) re-imagined core-periphery models as an economic and neo-classical perspective (Pain 2008). Informed by prior neo-classical development theories such as 'cumulative causation' (Myrdal 1957), and retaining a capitalist logic, NEG was pioneered by Krugman (1991) and further advanced by Fujita et al. (1999). NEG seeks to make core-periphery modeling mathematically robust and take into account core-peripheries in places with few natural resources, which likely developed in different ways to those with natural resources (Copus 2001; Ottaviano & Thisse 2004). NEG core-periphery models focus on meso-scale developments, that is, they largely focus on changes within single countries or regions while retaining a dichotomous dialogue between two different locations, cores and peripheries.

Simplified, NEG core-periphery models propose key factors that contribute to the agglomerative effects in a core comparative to a periphery. First, NEG proposes that it is more profitable for firms to concentrate production activities in set locations as opposed to being more widely dispersed as they can take advantage of "scales of economy" (Ascani et al. 2012, p.3). Second, transport costs are accounted for, highlighting the benefit of firms servicing markets close to their area of production as the cost of transport reduces a products profitability (Ascani et al. 2012). Finally, "external economies" take account of the wider benefits firms achieve through concentrating production activities, for example, through taking advantaged of "pooled labour" and "technological spillover" (Ascani et al. 2012, p.3) allowing them to further increase their efficiencies. These industry agglomerations hold impacts on socioeconomics within the area also. As more firms are established and grow, so too does competition in the market, thus, the cost of living for residents in the area will decrease due to the decrease in local price index (Forslid & Ottaviano 2003). The attraction of economic activity and employment leads to population increases, further growing the labour pool and trade market (Forslid & Ottaviano 2003).

The outcome of this is a circular feed-in effect (Forslid & Ottaviano 2003) where over time, core areas gain in population size, economic activity and industry investment. This in turn attracts further population and industrial growth. Areas peripheral to the core will experience opposite effects, of depopulation due to out-migration and both public and private disinvestment, impacting infrastructure such as public "transportation, health,

educational, cultural and leisure services” and therefore, socio-economic shrinkage (Fischer-Tahir & Nauman 2013, p. 9).

This is a “self-reinforcing process” that is informed by place past socio-spatial development which strongly determines whether it will grow or decline (Hudson 2015, p. 27). The self-reinforcing nature of core-periphery development, in addition to its foundation in capitalist systems, leads to increasing pronounced “quantitative and qualitative” differences between the two spaces over time (Hudson 2015, p. 25). Additionally, trajectories of either thrive or decline can become locked-in (Myrdal 1957; Hirschman 1958; Krugman 1991). Thus, uneven development, and spatial differentiation as characterized by core-periphery is symbolic of, and indeed crucial to, capitalist economic development (Smith 1994) and once initiated can be difficult to escape. However, it should be noted that as “places can appear, disappear, change in size and character...accordingly to the way people construct them” (Shurmer-Smith & Hannam 1994, p. 13), peripheral places may not always be considered peripheral and core places will not always be core. This is especially relevant within a capitalist system where “capitalist development results - inevitably and unavoidably - in capital eroding the place-specific conditions of profitable production that first attracted it to a place” (Hudson 2015, p.30). After such profitability is removed, capital flows to new places, leaving even places already considered peripheral, further economically disadvantaged.

Uneven development has also been theorized using Marxian political economy theories. Such theories argue that within core and peripheral areas themselves, internal socio-demographics are continuously at play, creating micro-hierarchies, whereby the population is split by income levels, class, education, gender and race. In many places this can result in sections of these populations being segregated or peripheralized. For peripheralized populations in core areas, this often means living in densely populated neighborhoods, on low incomes. This impacts on many things from public investment in schools and local services, to how well housing is maintained. With regards to education, when public funding is limited in areas where the population are already stigmatized, this runs the risk of continued stigmatization for the next generation of those people. This creates further limitations in changing where or how they live. This process can also occur in peripheral areas, whereby socio-economic divides can lead to further peripheralization of people who are arguably, already living in a periphery.

Core-periphery models, and NEG core-periphery models in particular, have received some critique, because they assume a high level of equilibrium. For example, initial contexts such as the number of available workers, their wages, and market outputs are assumed to be the same in different regions. Also, as noted by Copus (2001) NEG based models of core-periphery are “driven almost exclusively by distance costs” (Copus 2001, p. 539) and agglomeration pulls. While there is no getting away from the existence of these differences in costs between core and periphery areas, at least when considering traditional heavy industries, there is an argument to be made that the growth of the service sector and decline of heavy industry should alter the formation of the models and understandings of how core and peripheries develop (Ottoviano & Thisse 2004). Additionally, due to improvements in infrastructure and communication structures, along with the growth of the internet and e-commerce, some argue that peripheral development is becoming increasingly defined by aspatial elements (Copus 2001; Grimes 2003).

Critique of core-periphery models has also identified that they often focus on the core dynamics and secondary peripheral impacts instead of exploring periphery dynamics in their own right (Hayter et al. 2003). Copus (2001) addresses this criticism with an analysis of traditional peripheral development based on NEG regional core-periphery models (see Figure 4.1). Copus (2001) suggests that traditionally peripheral regional agglomerative disadvantage is attributed to causal, contingent and associated elements. Causal elements are those that are created by the remoteness of peripheral places relative to core centers of population and economic activity. The first of these elements is the “increased travel and transport costs” that can be measured both economically and in time taken, termed “the tyranny of distance” (Copus 2001, p. 541), whereby additional costs either in time or money that would be incurred by businesses who may otherwise invest in peripheral areas deters them and makes core areas all the more attractive for investment. The second is the “absence of agglomerative advantage” (Copus 2001, p. 540), which includes elements such as the absence of markets, demand and labour pool. Contingent elements are dependent on the presence of causal elements, these can include higher costs of service provisions and low levels of new business development and innovation. Finally, are the associated elements such as sparse populations, dependence on primary industries, poor infrastructure and poor political power.

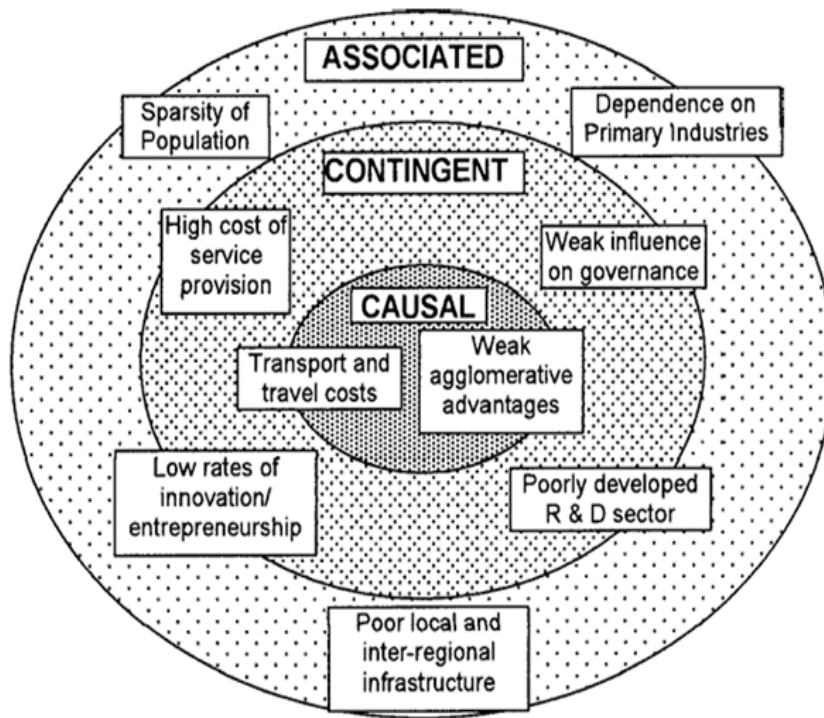


Figure 4.1. Conceptualization of peripheral disadvantage
 Source: Copus (2001, p. 540)

Copus's model also acknowledges some socio-political influences on peripheralization, for example in accounting for "weaker influence on governance" (Copus 2001, p. 540). This marries with most recent spatial theorizing which considers social and political processes in addition to economic processes that both influence 'the production' of space and are continuously influenced by space (Lefebvre 1991; Harvey 1996; Massey 2005; Soja 2009). Socio-cultural influences that will vary between people and groups create meaning and value attributed to spaces, which may differ between those living within the space and those outside of it. Such meanings and value are relative as well as symbolic, they will also be subject to how a place is positioned relative to other places (Massey 1994; Pritchard & Morgan 2001; Murdoch 2006). These claims can be applied to core and peripheral places, first, the degree to which a space is symbolic and representative of the dominant social culture and values will determine its meaning and importance (Creswell 2015). Those spaces highly symbolic can be understood as core places, while peripheral places will be those that do not fully represent these dominant cultures and values and can become stigmatized. Second, core and periphery are relative concepts, meaning each is at least in part defined by its relative position in relation to the other. So, for a peripheral place to exist, there must be a core place that it is peripheral to.

Core-periphery concepts simplify complex processes into simple terms that immediately invoke understanding, increasingly such understandings associate core or periphery with classifications of urban and rural. These simplifications also lead to generalizations and stereotyping, with core and peripheral places perceiving the other negatively. Social theory argues that it is those within society that hold economic, political and socio-cultural power that determine and distribute normative rules and values (Schneider & Ingram 1993). Spatially these elements of power are usually concentrated in core places, meaning the core will “reproduce and reflect the perspectives, ideologies and the ‘political unconscious’ of the cultural framework producing them” (Vanolo 2010, p. 26). Thus, as due to the relative position of power of the core compared to the periphery, it could be argued that the negative perceptions and discourse of the core are more influential and therefore, more damaging. Oversimplification of complex reasons for differences between cores and peripheries mean that material issues such as low employment levels or social and economic deprivation become viewed as cultural problems instead of development or economic problems (Eriksson 2010). Such perceptions are further legitimized in media and political discourse (Fischer-Tahir & Nauman 2013).

Negative perceptions and stereotyping of people and place have wide influence and material outcomes - “representations are often more determining than hard facts in influencing our actions” (Vanolo 2010, p. 26). The core usually holds a political majority and consequent dominance, along with economic wealth - considered symbolic of merit and hard work (Jones 2015) - also projects representations of itself, culture and lifestyle as superior to peripheries and as markers for peripheral assimilation (Allen 2003). This includes when core development is contingent on peripheral resource exploitation, for example in the formation of “resource peripheries” where natural resources are removed and sold for profit elsewhere (Hayter et al. 2003, p 16). In such instances, peripheries are often expected to be grateful for core investment, even though peripheral economic gains are generally limited to low-skilled employment opportunities (Knowles et al. 2008) and further economic “instability, crisis and dependence [on the core]” (Hayter et al. 2003, p. 19). Often, stereotyping and stigmatization of “whole regions and their inhabitants” fosters and legitimizes the “territorialization of social injustice in terms of access to material and symbolic resources on sub-regional, regional, national or trans-national scale” (Fischer-Tahir & Nauman 2013, p. 9). Stereotyping of peripheral places can also affect institutional arrangements and practices (Shields 2002) whereby political decisions around economics and wellbeing for example, are taken on their behalf by the core

(Botterill et al. 2000) and are not necessarily in their best interests (Schneider & Ingram 1993).

Material peripheral formation has traditionally focused on the influence of economic forces and presence of natural resources. However, contemporary theorization understands that such economic forces are themselves socially produced and also interplay with wider social and political processes which, along with historical and cultural influences, create meaning and value that is attributed to space (Heatherington 1998; Harvey 1996; Massey 1992). This interplay of values, meanings, actions and processes “filters through the web of interconnections that make up the living world” (Harvey 2000, p. 218) continuously producing knowledge, meaning and materiality (Schmid 2008). Thus, core-periphery development is “not just a product of the uneven distribution of natural resources and the influences of nature on economic geographies, but [arises] out of the constitutive social relations of capital” (Hudson 2015, p. 29). Spatial categories and territorial divides are therefore a product of social forces of politics, economics and culture, articulated through the influence of the spatial (Soja 2009). As political, economic and cultural forces are unevenly distributed within society, spatialization is also unevenly experienced and creates places of domination, exploitation and marginalization (Lefebvre 1991; Hayter et al. 2003). The core-periphery concept can then be used to understand spatial differences in economic, political and social power and thus recognize places that are at risk of domination, exploitation and marginalization during low-carbon transition. Currently theorizations of the spatiality of energy vulnerability or transition are emerging (c.f. Hagg et al. 2012; Baker et al. 2014; Balta-Ozkan et al. 2015; Calvert 2016; Bouzarovski & Simcock 2017; Bouzarovski & Triado Herrero 2017; Simcock & Petrova 2017; Weller 2018), few have considered explicitly the influence of core-periphery processes. Thus, there remains a gap in understanding the interplay between processes of peripherality, energy vulnerabilities and low-carbon transition.

4.3 Spatial injustice and peripheralization: The case of Wales

Spatial justice holds its origins in works by Harvey (1973) regarding justice and space and was discussed under concepts of “Territorial” and “Distributive” justice. Through

these concepts' spatial perspectives on social justice¹⁷ were explored at a regional or 'territory' scale, raised questions as to the applicability of the concepts to smaller scale spaces. Further critique was levied at the concept due to its dependence on social justice, raising questions as to whether a concept of spatial justice was needed as it only appeared to highlight social justices in space. Such critiques have been somewhat addressed by Soja (1980) and Pirie (1983) who highlight that while social structures, interactions and indeed justice or injustices occur within spaces, space itself is a social construction, as such, the social and the spatial are co-constitutive and mutually reproductive. In other words, the social production of space reproduces social structures including elements of injustice (Dikeç 2001; Soja 2010). For this reason, spatial justice can never truly be separate from social justice.

Most recently, spatial justice is understood to encompass both elements of material spatial distributional inequalities in addition to the processes that produce and reproduce such inequalities (Harvey 1996; Dikeç 2002; Soja 2010). In doing so, spatial justice provides an "intentional and focused emphasis on the spatial or geographical aspects of justice and injustice" (Soja 2009, p. 2). Spatial justice unpacks dynamics behind locational discrimination, political organization of space and geographical development, all of which impact upon the spatiality of socially valued resources and opportunities to use and benefits from these resources. This can include location and availability of public services, employment and education as well as infrastructural resources such as energy production and distribution networks. In this way spatial justice highlights wider forms of social injustice, which due to the materiality of human existence and the dialect between society and space, have spatial consequences.

Uneven development that creates core and periphery places can be understood as a form of spatial injustice whereby core places are systematically advantaged - economically, culturally and politically - compared to peripheral places (Hayter 2003). As peripheral development creates a self-reinforcing vicious circle of disadvantage (Copus 2001; Fischer-Tahir & Nauman 2013) peripheral spatial injustice can too be circular. As understood by Soja (2009, p. 2) spatial (in)justice is both "outcome and process" as the uneven geographies that are produced through socio-spatial processes act to recreate further uneven development and resource distribution.

¹⁷ See also Section 2.3

Examples of core-periphery dynamics and spatial injustice are available around the globe and at multiple scales. Within the UK there are many examples of core-periphery dynamics at play. Wales is a peripheral UK country in many respects including: materially, as it occupies the Western fringe of the UK (see Figure 4.2); economically, in terms of its relative economic outputs; politically, having only recently gained its own government which holds limited powers than other devolved countries; and socially, evident in how Wales and Welsh people are perceived by the rest of the UK, most notably the core (England), and how stereotyping and stigmatization remain largely unquestioned. Each of these aspects of peripherality is unpacked below.



Figure 4.2. UK constituent countries
Source: Author

Wales was conquered in the late 1200s and later annexed in 1536 by England, during which English rule and law was imposed and the Welsh language, one of the oldest in Europe, was banned (Pitchford 2001; Pritchard & Morgan 2001). A class division also took place where gentry assimilated to English norms while culturally Welsh peasantry worked land under the mixed English and Welsh elites. As Pitchford (2001, p.45) states, during such subjugation “the targets of ethnic aggression are stigmatized in the process”. Already existent and long-held English-Welsh division, followed by later Welsh class division, laid foundations for tensions and perceptions of the ‘other’, for example an 1847 Report on the State of Education in Wales reported that Welsh people were “degenerate. . . dirty, ignorant, bigoted and contented; promiscuous; wanting chastity; immoral; violent and vicious” (cited in Adams 1996, p.28). Such perceptions of English

superiority and Welsh inferiority persist today in media and political forums (c.f. Cornock 2018; Cosslett 2018) and are unbalanced by Welsh views due to a lack of Welsh media (Public Policy Institute for Wales 2017). A recent example of public belittlement of Welsh culture and language occurred in *The Times* newspaper in 2018 after it was announced Plaid Cymru – a Welsh political party – had raised a petition opposing the proposed new name for the Severn Bridge: “The Welsh, or some of them, are moaning that a motorway bridge linking their rain-sodden valley with the First World is to be renamed... They would prefer it to be called something indecipherable with no real vowels, such as Ysgythysggymlngwchgwch Bryggy” (Huws 2018, p1).

Perceptions of Wales as undeveloped are perpetuated by economic measures and comparisons with other UK countries - England, Scotland and Northern Ireland. In most instances Wales “languishes at the bottom” (Dickins, 2016) (see Figures 4.3 and 4.4), indeed, Wales has had the lowest GVA per capita of the UK countries since 2001 (National Assembly for Wales 2018a)¹⁸. However, as Pritchard and Morgan (1998) point out, Wales has been the most successful of the UK countries in attracting global investment, but in terms of internal UK investment it receives the lowest levels. This is attributed to the continued negative perceptions held of Wales and Welsh people, by other UK countries (Pritchard & Morgan 1998), thus highlighting the dualistic interplay between economic and material outcomes with social perceptions and prejudice. Morgan (2006, p. 190) argues that the North-South economic divide between, notably Wales (and the North of England) with the South of England is “the most serious form of territorial inequality in the United Kingdom”. Wales’s economic peripherality is not only evident at a national level, considering economies of EU countries, the UK (including Wales) has the second largest economy contributing 16% (Gross Domestic Product (GDP) per capita) towards the total EU GDP (Eurostat 2017). However, Wales contributes only 0.5% GDP per capita, positioning it as one of the weakest economies in the EU overall (Eurostat 2017a).

Wales’s poor economic position is often largely attributed to the enduring effects of the decline of Wales’s coal and metal industries in the 1900s (Botterill et al. 2000). At its peak, coal mining in Wales employed over 250,000 people, which by the 1980s had reduced to around 25,000 (Beatty & Fothergill 1996; Milbourne & Mason 2017). Currently employment is limited to few hundred people in open-cast mining or mine

¹⁸ See also Section 7.2

restoration. However, aside from securing an income, it is questionable how much mine labour and the wider communities economically benefited from such industries. While huge profits were generated, this mostly “slipped” (Argent 2013, p. 323) from Wales to the benefit of external industry proprietors (Carter & Jones 1989). It can be argued the cost of such development was paid by the mineworkers and their families who experienced lower wages in Wales than the UK average, poorer housing, poor education and poor health (Pitchford 2001). The landscape and natural environment too bore cost as “mine owners approached the land as a commodity to be exploited”, little or no regard was given to the environment during mine excavation, timber sourcing and dumping of waste (Milbourne & Mason 2017, p. 30). The dominance of heavy industry with largely unskilled labour-forces and consequent high levels of unemployment in its decline reaffirmed existing stereotypes of Welsh people being backward and Wales itself being the “backwaters of Britain” (Pitchford 2001, p. 50). This again highlights the interplay of socio-economic processes in the formation of core and periphery. As highlighted in section 4.2 stereotypes and stigma interplay with other material issues such as, slow economic development to become cause and evidence for each other’s existence, ultimately becoming a truism. Thus, weak economic development becomes a self-inflicted lack of hard work or merit (Jones 2015) unrelated to wider context of historical legacy and contemporary subordination.

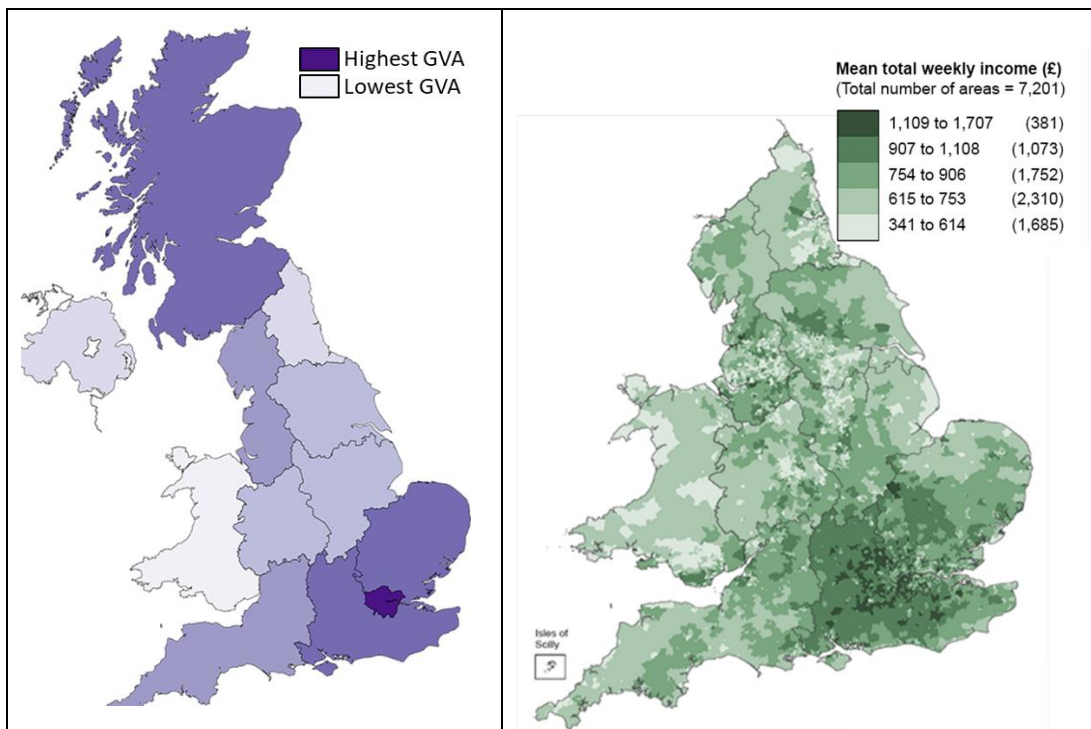


Figure 4.3. GVA per head of population
 Source: Office for National Statistics (2015)

Figure 4.4. Income estimates 2013/14
 Source: Office for National Statistics (2016a)

As per *Section 4.2*, stereotypes and stigmatization of peripheral places legitimizes action that result in their exploitation. While there are numerous examples of such processes taking place in Wales (c.f. Milbourne & Mason 2017) a striking example may be the flooding of the Afon Tryweryn Valley in North Wales in 1965 to create a water reservoir to service the English city Liverpool (Griffiths 2014). Capel Celyn was also a culturally significant place for Wales, one of the last remaining completely Welsh speaking villages that up to the point of its inundation maintained a traditional Welsh way of life (Milbourne & Mason 2017). Ten farms were also dispersed from the area resulting in the sale of their farming equipment and stock and the loss of their cooperative community (Griffiths 2014). The plans were contentious and protested by many people and the overall process and outcome typifies core-periphery socio-political dynamics in several ways. In the positioning of ‘big’ versus ‘small’, of ‘powerful’ against ‘powerless’ of ‘modern industrial’ against ‘traditional agriculture’ and of ‘English’ against ‘Welsh’ (Griffiths 2014, p. 453).

Politically, Liverpool City Council applied for an Act of Parliament, thus negating any requirement to consult with Welsh planning authorities. Despite the bill being voted down by 35 out of 36 Welsh MPs, it was approved overall by Westminster (Saville-Roberts 2015). This highlights the powerlessness and disregard of Welsh civic and political opinion. The treatment of the Welsh community and wider protesters by Liverpool City Council was callous and indifferent, and the council refused to hear any objections. Indeed, after the fact, it has become known that Liverpool City Council chose to flood an area of Wales over uninhabited areas in England as they could obtain water at lower cost to potentially re-sell at a profit (Saville-Roberts 2015). This is perhaps a further affront to Wales where £4.5 billion per year could be generated through water sales to England (Osmond 2012), but due to trading restrictions on water, no remuneration can be made for such trade (Jones 2015; Nation.Cymru 2018). Protests against the inundation did not end after the event. On two separate occasions attempts were made to explode the dam or its machinery. Today an unofficial monument to the valley has been painted onto a derelict wall reading ‘Cofiwch Dryweryn’ or ‘Remember Tryweryn’. However, despite its cultural importance in Wales this wall has not been officially protected or recognized by the Welsh Government and has suffered several acts of vandalism, including in February 2019.

The flooding of Tryweryn was not the first use of Welsh resource for UK-national needs. For example, the expulsion of over 200 farms in the west of the Brecon Beacons for military training has been cited as causing a major divide between predominantly Welsh-speaking west Wales and predominantly English-speaking east Wales, as prior to this the Welsh-speaking farms connected the two (Griffiths 2014). These actions have been connected with the slow dissolvment of the Welsh language (Griffiths 2014). Tryerwyn was a turning point for many in Wales who resented the lack of Welsh political power and autonomy and/or who feared the Welsh language and culture were dying out. Indeed, Tryerwyn coincided in time with already active, but somewhat radical, Welsh-Nationalist movement. Thus, Tryweryn is recognized as symbolizing the resurgence of Welsh politics, increased calls for devolution and increased recognition for the Welsh language in Wales (Milbourne & Mason 2017).

While the establishment of the autonomous Welsh Assembly Government in 1999 has brought more political powers to Wales, devolution has not been as complete as in Scotland or Northern Ireland. Wales does not retain full control over many policy fields, including water, transport and energy. An example of this is in transport policy where Wales has fewer devolved powers than Scotland and Northern Ireland¹⁹. Additionally, while Wales holds 11% of UK rail track, it has only received 1.5% of rail funding since 2011 (Welsh Government 2018c). The limited power over its transport networks has led to debate around passenger fares as rail passengers in Wales incur the highest cost rail travel in the UK (Staffell et al. 2018). Also, the Welsh Government requested devolution of rail powers, during creation of, and after passing of the *Wales Act (2017)*, which were rejected (see Table 4.1 for devolved transport powers). Finally, plans to electrify the Great Western Mainline were scaled back in 2018 resulting in plans to electrify the line to Swansea being cancelled. This decision has been deemed “unfair” by the Welsh Government (2018c, p. 2) especially as the electrification had been heralded as a means of connecting smaller cities in England and South Wales with London and thus increasing bi-lateral flows of employment and prosperity. Now there are concerns that in Wales “journey times will at best be similar to those achieved in the 1970s” (Welsh Government 2018c, p. 2).

¹⁹ See Sections 3.2 and 8.4 and Chapter 6 for further discussions of Welsh devolution

Table 4.1. UK Transport policy devolution

	Wales	Scotland	N. Ireland
Road	Limited	Totally	Totally
Rail	Mostly*	Mostly	Totally
Bus	Limited	Totally	Totally
Air	None	Limited	None
Sea (Ferry)	None	Substantial	None

**Note. Devolution of rail powers were increased under The Welsh Ministers (Transfer of Functions) (Railways) Order 2018.*

Adapted from: Mackinnon et al. (2010)

There is also concern that the high-speed rail link (HS2), being developed at the same time, from London to Birmingham will have a negative impact on the Welsh economy. Furthermore, the non-devolution of rail powers to Wales means that rail developments in Wales and England will continue to be considered together. This impacts the amount of block grant²⁰ afforded to Wales. Additionally, as Welsh and English rail infrastructure budgets are combined, spending in England, for example on the HS2, results in reduced money available for Welsh rail development. For next year's budget (2019/20) it has been estimated that Wales's transport budget will be £25 million less than the year prior due to the HS2 (ap Gwilym 2015). Altering this context to a degree is that additional funding has been secured for rail improvements in Wales via the Cardiff Capital Region deal (CCR). The CCR is predicted to encourage increased economic activity in Wales. The Cardiff City deal in particular will receive £1.229 billion in funding over 20 years, £375 million from UK Government and the rest from Welsh Government, the EU and 10 Welsh Local Authorities within the CCR region (National Assembly for Wales 2017). Of this funding £734 million has been designated as funding for a new metro system for the region, including rail and other travel facilities (National Assembly for Wales 2017).

Fragmented devolution has led to tension between the UK and Welsh governments, further aggravated by each being led by opposing political parties and feeds into speculation that Wales is “the first and final colony” (Price 2018, p. title). The uneven allocation of devolved powers in Wales compared to other devolved countries is regarded

²⁰ “The block grants are the element of the devolved administrations’ funding which comes directly from the UK Government. Once the block grant has been determined, the devolved administrations have freedom to make their own spending decisions in areas of devolved responsibilities within the overall totals. Spending by the devolved administrations is not funded exclusively by the block grant. The devolved administrations are also funded by “local and devolved tax revenues, other revenue-raising powers (including fees and charges, and sales of goods, services and assets), grants from European institutions, and borrowing” (HM Treasury 2018, p. 2).

as unfair and unnecessary (Upton 2014). Especially around areas that are perceived to affect the Welsh economy, such as energy and transport. The tensions over policy devolution have gradually produced concessions from London. For example, with the passing of the *Wales Act* in 2017, a new ‘reserved powers’ model of devolution is in place whereby areas outside of the Welsh Government powers are listed with anything not included being devolved. This model is now most similar to Scotland and comes into effect in Wales on 1st April 2019.

In line with core-periphery concepts whereby peripheries experience economic, social and political disadvantage relative to cores (Copus 2001; Fischer-Tahir & Nauman 2013; Hayter 2003), Wales is a periphery of the UK. However, within Wales processes of core and periphery are evident. Core places include the southern cities of Cardiff and Swansea within urban Local Authority areas such as Swansea, Cardiff and Newport, with peripheral places, generally speaking, being areas that are spatially located north of these cities. Such areas include predominantly rural Local Authorities, such as Carmarthenshire, Ceredigion and Powys, and Valleys Local Authorities such as Blaenau Gwent, Merthyr Tydfil and Rhondda Cynon Taf (Statistics for Wales 2008). For rural areas, peripheralization has been a long process, starting in the main part due to industrialization in the 1800s which saw the migration of vast numbers of the rural population into new centers of industrial activity (Saville 1957; Milbourne & Mason 2017). This activity concentrated on natural resource extraction (most notably coal) and transportation to urban dock areas for use in the metal industry or export. Industrial revolution also interplayed with agriculture, offering new opportunities for mechanization, reducing the need for large numbers of human labour (Yang & Zhu 2010). As such, rural areas in Wales have become peripheries, characterized by sparse and widely dispersed populations and relative weaker economies reliant on agricultural and manufacturing sectors. Over recent years, the public and tourism sectors have become more prominent in the economy. The Valleys were where much of the extractive activity of the Industrial Revolution was based in Wales, however, they have continued to suffer negative effects of the sudden loss of such industries during the 1980s. These negative effects include high levels of economic inactivity and unemployment. Both areas generally have weaker economies than urban centers, reflected in their GVA outputs (National Assembly for Wales 2018a).

Social perceptions of the areas are similarly negative to those of Wales as a whole. This is particularly evident in discourse of the Valleys which are apparently ‘unbearably sad’ (Easton 2013) and synonymous with decline and deprivation (Tannock 2015). Such perceptions are formed by visible evidence of economic depression coupled with negative portrayal in the media and political rhetoric. For example, Tannock (2015) highlights an instance of representations of Merthyr people in national media as “work-shy population lacking even the most basic skills and ambitions” (Sky News 2010, cited by Tannock 2015); this was reinforced by the then British Secretary of Work and Pensions Iain Duncan Smith, who quoted from the news report and advised the people of Merthyr to get on a bus to Cardiff where there were lots of jobs waiting. Thus, as with Wales, oversimplification of the reasons for low economic status and the numerous barriers faced in altering this for the Valleys becomes a characteristic of the people who live there. Stereotyping of places and the people within them has normative and material outcomes (Schneider & Ingram 1993), as “the fate of the group is bound up with the words that designates them” (Bourdieu 1984, p. 483), this “helps to legitimize processes of uneven development” (Fischer-Tahir & Nauman 2013, p. 20). First, it homogenizes places and the people within them, which means in the case of economic depression, regeneration interventions may not be suited to the actual population or place. Second, when stereotypes are essentially negative, as with that of Wales generally, or Merthyr more specifically, they can act to disincentivize private investments and legitimize lack of public investment, thus impacting upon the wellbeing of the people within those places.

A further alternative spatialization process is present within these peripheries, in the form of the spatialization of designated areas as national parks²¹. National parks fall within the International Union for Conservation of Nature’ definition of protected area, as “clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values” (International Union for Conservation of Nature 2008). A result of social and environmental crisis during the Industrial Revolution, national parks embodied beautiful, natural, clean and healthy spaces, in direct contrast with growing industrial centres at the time. This, in combination with newly romanticised visions of the countryside and growing working class civil rights placed political pressure on Government to increase access to the countryside, which until then had been restricted by private landowners. In 1949 Parliament passed the *National Parks and Access to the*

²¹ Sections 6.4 unpacks perceptions of political marginalization in the Brecon Beacons National Park

Countryside Act in recognition of these issues and putting into law the means of creating designated areas of natural beauty to not only be protected and conserved, but to be accessible to the public.

National parks were chosen as spaces that were both outstandingly beautiful in terms of their landscape and close to centres of population, their boundaries were overlaid onto existing spaces of rurality and peripherality, governance and daily life. However, due to being chosen as exemplars of natural beauty “the nation’s finest landscapes” (Rennie 2006, p. 224) and nature and cultural heritage, they may also influence local identity, acting as, or preserving, symbolic attributes of the nation and national identity, putting into physical form places of legend, myths, moralities and history (Gruffudd 1995; Palmer 1999). Representing a “slice in time” (Foucault 1984, p. 6) and increasingly symbolic of the nations they sit within, the character, ecology and culture of each national park is what define them and gives them symbolic and economic value. National parks as such are “sacred centres” (Smith 1991, p. 16 cited in Palmer 1999), and are afforded not only special designations, but also different rules and governance relative to other landscapes.

In addition to the concerns around poor living conditions in industrial centres, national parks also formed part of a solution to concerns of growing urbanisation and its spread into the countryside, offering a means of preventing urban sprawl in certain rural areas. Perceptions of the countryside as “better, more fulfilling and community driven. Where man and nature worked together side by side, hand in hand” (Palmer 1999, p. 8), offered an antithetical space to the poor living conditions and social conflict within urban areas, and are still widely perceived to offer an escape from modernity (Sharpley & Jepson 2011; National Parks 2018b). Consequently, national parks are also places of experience, meant to open access to the countryside for all people, most notably people living in urban areas. Rural spaces are often “considered according their potential for satisfying urban needs” (Antrop 2004, p.30), thus, the privileged positioning of national parks may only be realised because of the functions they serve for the centre.

National Parks’ overriding duties are to first conserve the landscape (and associated habitats and culture) and second to encourage its public use. The well-being of people living and working within them, while being acknowledged, is assigned to a ‘duty’ placed below the first two ‘purposes’ in priority. Here lays a conflict between the wants and rights of visitors to national parks and the lived experiences of the rural communities who inhabit them. The idealized vision of rural life expected to be experienced within national

parks, which is conserved via its purposes is, in effect, a romanticized vision of peripherality. Consequently, national park designation serves to maintain peripheralization, albeit, a romanticized version.

Different peripheries within Wales - rural, Valley or national park - hold commonalities. All are located within a national scale periphery and thus, are highly influenced by decisions made externally. But also, the development of each holds some connection to the Industrial Revolution and to each other, this highlights the relativity of each place. Out-migration and decline in rural Wales was caused in a large part by the attraction of secure and better paid jobs in the Valleys and industrial centres. Likewise, the poor health and living conditions brought on by mass-migration and low-quality housing in the Valleys (and other similar areas in the UK) influenced the formation of national parks. However, even the connection of each to the Industrial Revolution and designation of national parks were themselves influenced by core UK interests.

Additionally, despite differences between peripheral places in Wales, they are disadvantaged due to their peripheralization in similar ways – physical distance to core areas, few employment opportunities, low wages, poor access to services, poor infrastructures and weak governance influence. Such disadvantage directly impacts the lives of peripheral communities in the present and in terms of future prospects. For example, low public spending impact numbers of essential services, such as educational services, and subsequently impacts educational attainment and employment prospects. Poor infrastructures and power to alter them results in low agglomerative advantage, increases the tyranny of distance and living costs for peripheral communities. Weak governance influence, especially in terms of government institutions and political representation means peripheries' needs are rarely heard, recognized or addressed.

In terms of energy, spatial injustices that lead to peripheral disadvantage is likely to hold direct and indirect impacts on how energy vulnerable peripheral communities are. For example, lower incomes and higher cost energy affect energy affordability while poor energy infrastructures affect energy access. It may also follow that due to weaker social, economic and political positions, in addition to characteristics such as sparse populations, peripheries may be more likely to be favored as locations for new energy developments without gaining substantial benefits that come with ownership or stake holding, repeating past resource peripheralization. As Bryn et al. (2017) highlight, low-carbon energy production in Wales is unlikely to be economically transformative without Welsh

development of supply chains, R&D processes, maintenance and ownership. The lack of social, economic and political power held by peripheries in comparison to cores also implies inhibited ability to change their peripheral position and create more just landscapes. This is explored further in the following section.

4.4 Spatialized energy vulnerability

Energy has huge impacts upon both material and social space. Spaces of energy production and consumption are often physically bound to specific geographical locations, with production depending on the energy source and how it is being extracted from the physical environment, and consumption depending on the form the energy takes in being used by consumers (Bridge 2010; Bridge et al. 2013). Thus, whether during its extraction, transportation or consumption or its secondary uses, as in how it is harnessed to create raw materials or large-scale manufacturing, energy has and continues to play a huge role in the creation of the various landscapes including the uneven development of core and periphery.

Historically energy played a major role in the economic development of countries that are commonly considered “advanced, industrialized” (Hammond 2000, p. 305) or “developed” (Chow et al. 2003, p. 1528). As energy can be considered the “lifeblood of technological and economic development” (Chow et al. 2003, p. 1528) the availability of fossil fuels within countries, such as the UK, enabled them to play significant parts in past energy transitions, including the Industrial Revolution of the 1800s (Hammond 2000). Being at a forefront of such change and over a resource (coal) that had almost limitless capacity and influence over social structures, economics and politics meant that the UK was able to rapidly develop and grow their economy. This reinforced their global hegemonic position gained during colonialism and has ensured that even when direct hegemony was lost, and world economies shifted from heavy industry to a focus on finance and service industries (Pitzle 2004), the UK remained part of the ‘developed’ core.

Regionally, within the UK, the impact that energy has in creating spatial core and peripheral places is materially visible. Its past power is evident in the still present industrial hubs of the Industrial Revolution, urban centers such as Manchester and

Swansea; the old peripheries that serviced these industrial hubs, the more remote coalfields and docks of the North of England and South Wales; and the continued sparsity of population in rural peripheries after vast labour migration. As with global core-peripheries, past regional core-peripheries in the UK remain despite the decline in heavy industry and energy that was required to fuel it. The current material structure of the energy system in the UK also continues to follow old industrial patterning. The strongest and most extensive network coverage and main power stations are typically located close to densely populated urban areas, in order that they may be used to their maximum potential and therefore maximum profit (Soja 2010). This spatial arrangement contributes to the creation of core and peripheral spaces of energy access that mirrors existing economic core-periphery structures. It also means that places spatially distal to the core energy network will not experience the same reliability, affordability or access to energy (Roberts et al. 2015) as it costs more for energy producers to service remote areas and areas of low population (Sovacool et al. 2014). As such, energy costs in Wales are some of the highest in the UK (House of Commons Library 2017a), and for peripheral areas without access to mains gas network alternative fuels are again, more expensive (Senedd Research 2014). In this way energy interplays with other peripheral disadvantages to make business development in peripheries less attractive, reinforcing peripheralization.

Politically, Wales' limited powers over energy production and network regulations mean that despite being a net exporter of electricity, it cannot use such supplies to the benefit of the Welsh population. Additionally, energy ambitions that do not fit with national ambitions can be curtailed by the political core in Westminster. Frustration in Wales's restrictions over large scale energy developments recently came to the fore when the UK government declined to support the Swansea Bay Tidal Lagoon (SBTL) development. The proposed lagoon was envisaged as a pathfinder development, meant to test tidal lagoon technology in the UK and if successful commence the development of further lagoons, the size of which (in Mega Watt [MW] capacity) is currently outside of Welsh Government remit. The development had gained support from communities close to the project, development consent from UK government and a £2 million pledge from Welsh Government. It was also subject to an independent review in 2016 which found the development would cause "no-regrets" (Hendry 2016, p. 89):

I don't believe there would be any debate in decades to come about whether this was the right thing to do, even if it ended up as the only lagoon constructed

– but I would expect it is much more likely to be seen as the decision which started a new industry, and all done at the cost of a small number of pence to consumers each year (Hendry 2016, p. 89).

Despite this, the SBTL was unable to secure a Contract for Difference (CfD)²² with the UK Government as the cost was deemed not “value for money” and energy generated would be “variable” (Department for Business, Energy and Industrial Strategy [BEIS] 2018b). Critiques of this decision have argued that it didn’t allow for the 120-year lifespan of the lagoon, inclusion of this factor in financial calculations makes the SBTL comparatively lower cost in the longer-term (Messenger 2018) highlighting inbuilt bias against tidal energy technology and other renewable energy forms (Hendry 2016). This decision appears symbolic of the reduction in renewable energy subsidies implemented by the UK Government since 2015, with no renewable energy targets set for the UK after 2020. The change in priority of renewables comes as increased priority is placed on nuclear energy. In Wales, in synchronicity with SBTL debates, the UK Government has tendered and approved a CfD for a new nuclear reactor at Anglesey, North Wales (Wylfa Newydd), although it was not unwelcomed by Welsh Government, investors in this development have recently pulled out so for now its future is uncertain.

At a regional level there can also be conflicts between Welsh Government energy ambitions and Welsh communities. The Welsh Government views low-carbon energy transition as a means of diversifying and growing its economy and there is the ambition “to create a sustainable, low-carbon economy for Wales” and to be a world leader in low-carbon renewable energy production (Welsh Government 2012, p. 5). Changing the source of energy necessitates new energy production technologies are built in Wales. Welsh peripheries with natural resources, space suitable for renewable energy development, small populations and weak economic and political power hold limited ability to take advantage of such opportunities for their own benefit. Such peripheries risk being exploited as in previous rounds of development that required Welsh natural

²² CfDs are a reverse auction that pays a subsidy to developers of low-carbon energy which is a flat (indexed) rate for the electricity they produce for 15 years (BEIS 2019a). The rate is the “difference between a ‘strike price’ – a price for electricity reflecting the cost of investing in a particular low-carbon technology – and the ‘reference price’ – a measure of average GB market price for electricity” (BEIS 2018d, p. 3). Should electricity prices increase above the agreed rate, the additional cost is met by the Low-carbon Contracts Company (LCCC) (a government-owned company), should the cost fall below, the developer pays the LCCC the saving. This way the developers and electricity customers are protected from dramatic changes in the market and risk for investors is reduced.

resource, such as coal mining and metal industries, forestry and water (c.f. Milbourne & Mason 2017).

As energy has permeated modern culture and plays a part in creating social norms, lack of energy consumption - whether through lack of accessibility, unaffordability or personal choice - can be seen as a form of deviance and lead to marginalization, social and political exclusion and stereotyping. For example, as economies grow, so too does energy consumption (Chow et al. 2003; Fankhauser & Jotzo 2018), with energy itself becoming a major element in the evolution of social and cultural norms, at least in 'developed' economies. Subsequently, as energy is increasingly needed for some of the most basic day to day activities and its consumption is a means of participating in socio-cultural norms, those who do not consume energy at an equivalent level to others in their society cannot participate fully in normal relationships and activities (Levitas et al. 2007). The inbuilt bias of the energy system towards capitalism and economic growth means that for many people, either through their additional energy needs (Ellsworth-Krebs et al. 2015; Snell et al. 2015), low incomes (Middlemiss & Gillard 2015) or lack of connection to mainstream energy sources (Roberts et al. 2015), purchasing the energy they need can become unaffordable. Therefore, for many, participating fully in a society where high levels of energy consumption are normative is extremely difficult, negatively affecting social structures, social inclusion and mental health (Harrington et al. 2005; Walker et al. 2016) in addition to morbidity, health, wellbeing and life chances (Barnes et al. 2008; Day & Walker 2013; Sovacool 2015; Gillard et al. 2017).

For Wales and its peripheral regions, peripheralization has in part been driven by energy. Additionally, peripheralization inhibits abilities at all scales to decide energy source and location of production, energy distribution, and energy cost. As Figure 4.5 conceptualizes, elements of peripheral disadvantage and energy are interlinked in numerous messy ways, the presence of each element and driver, either singularly or in combination, holds impacts for other elements and drivers, including the reinforcement of their presence. This demonstrates the embeddedness of energy within peripheralization processes.

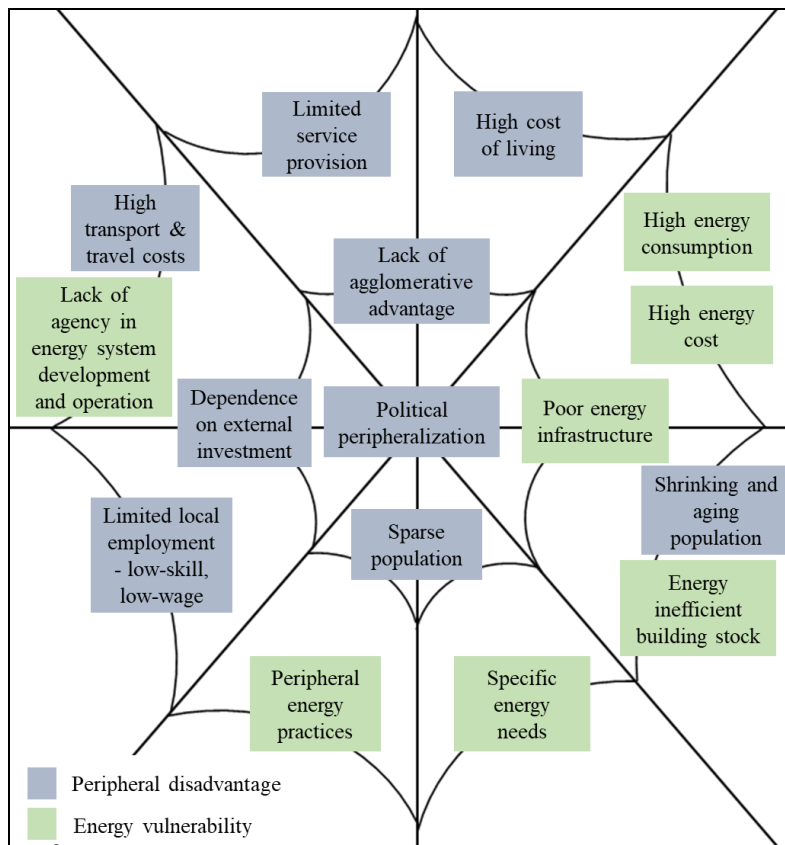


Figure 4.5. Elements of peripheral formation combined with associated energy vulnerabilities.
 Source: Golubchikov and O'Sullivan (2020)

Acknowledging energy's embeddedness within spatialization processes infers possible spatial contingency of energy vulnerabilities. Within the literature the spatiality of energy justice (Bridge et al. 2013; Balta-Ozkan et al. 2015; Yenneti et al. 2016; Bouzarovski and Simcock 2017) and energy vulnerability (Bouzarovski 2013; Day & Walker 2013; Simcock & Petrova 2017) have begun to be conceptualized. However there remains a gap for the empirical exploration of the influence of space and spatialization processes on energy vulnerability. As per *Section 2.4* most recently the causes of energy vulnerability have been attributed to six driving forces: *Access* to energy sources; *Affordability* of energy either through the cost of energy or as a relative household expenditure to its income; *Flexibility* to change energy source or system; *Energy Efficiency* of building structures or household energy systems; *Needs* that create a greater energy requirement such as health, age and lifestyle; and *Practices* such as socio-cultural norms that may require energy over-consumption (Simcock & Petrova 2017, p.432). Each of these vulnerabilities potentially holds spatial contingency (see Table 4.2).

Table 4.2. Energy vulnerability drivers linked to peripheralization elements

Energy Vulnerability Driving force	Description	Spatial -Peripheral Contingency
Access	Lack of ability to access energy appropriate for household needs	Poor regional/sub-regional energy infrastructure & old domestic energy systems
Affordability	High ratio between costs of fuels and household income	Remoteness from core increases fuel costs
Flexibility	Lack of ability to change energy service provision	Energy infrastructure and place-specific building style create 'lock-in'
Energy efficiency	Disproportionate high loss of energy	Domestic energy systems and building style can be place-specific
Needs	Greater energy requirements due to personal circumstances	Aging populations, reliance on transport
Practices	Lack of knowledge, socio-cultural norms	Place-specific coping practices and/or energy systems

Adapted from: Simcock and Petrova (2017)

For peripheries in Wales, all the spatially contingent energy vulnerabilities appear to be present. Evident in poor energy infrastructures (gas and electric) which coupled with distance from centers of energy production create difficulties in access and affordability; poor energy infrastructure and dominance of older harder to heat or insulate homes means there is little flexibility for households to change their energy source or energy efficiency; faster rates of aging populations can increase energy needs as typically older people require higher temperatures for longer periods. Additionally poor transport infrastructures coupled with services deprivation and limited local employment necessitates a reliance on personal transport, necessitating a need for increased energy consumption in the form of vehicle fuel which together with other running costs adds strain to household budgets; lastly there are place-specific energy practices, such as the use of solid fuel range cookers, developed to overcome poor energy infrastructures but that contribute to increased energy consumption²³. As peripheries in Wales appear to possess all six energy vulnerability drivers, the likelihood of experiencing energy deprivation is enhanced.

Energy has and continues to play a key role in uneven spatial development, based on how and where it is sourced from, who it is distributed to, for what purpose and at what cost. Interplaying with other elements of spatialization, such as (lack of) agglomeration

²³ Experiences of these drivers of energy vulnerability are illuminated in Chapter 7 and unpacked further in Chapter 8

advantage or the ‘tyranny of distance’ to fuelling economic growth in some areas and affect decline in others. Such processes are visible at national and regional scales and are affected by both material energy structures as well as social structures. The intertwined relationship between spatialization processes and energy holds consequences for energy vulnerability, again at multiple scales. At a domestic scale, the six energy vulnerability drivers as outlined by Simcock and Petrova (2017) all appear to have spatial contingency when considered from a peripheral perspective, implying increased likelihood of instances of energy deprivation for such places.

4.5 Conclusion

Energy takes many forms, materially energy is a natural resource (or generated from natural resources) and requires physical extraction or production, and it is distributed in material space. Economically energy is a market commodity, and socially energy is a necessity for multiple components of every-day life. While this list is not exhaustive, in these different forms energy plays a fundamental role in creating both material and social spaces and in the development of core and periphery. Core and periphery development represent spatially organized uneven power relations, where peripheries are disadvantaged relative to the core (Copus 2001; Fischer-Tahir & Nauman 2013). The circular nature of periphery development means that peripheral disadvantages both create and reinforce their relative weak position to the core, including marginalization of population needs (Fischer-Tahir & Nauman 2013). Spatially arranged marginalization can create banal and overt prejudice towards places and their populations. This undermines periphery’s abilities to assert their needs politically, hinders economic development and restricts access to socially valued resources. This is a spatial injustice. As energy and the natural resources needed to generate it have played a key role in uneven spatialization processes, they are also fundamental to the creation of spatial injustice. Spatial injustice and energy injustice are connected by spatially contingent control over energy resource whether in its production, distribution or consumption.

As one of four countries forming the UK, Wales’ relatively weak social, economic and political position has led to Welsh human and natural resources contributing towards the needs of the UK as opposed to those of Wales. Within Wales similarly asymmetrical dynamics are at play between regional core and peripheries. Thus, spatial injustices are

present at a Welsh-national and regional scales. There are numerous examples of spatial injustices in Wales, from natural resource exploitation in the form of water or comparatively weaker transport infrastructure and substantially lower allocation of public transport funds. However, energy provides a lens that most readily illuminates spatial injustices created by social, economic and political dynamics that manifest both materially and socially and at multiple scales.

In Wales the connection between spatial injustice and energy injustice is visible at many scales: in unequal access to policy powers and disregard of civic and political representation; in the lack of autonomy over natural resources and inability to profit from resource trade; and lack of ability to affect the cost of energy to its own populations. Regional peripheries within national peripheries may suffer a double disadvantage. Being affected by national level peripheralization which for example increases the cost of their energy compared to other places. But additionally, being subject to lower-scale peripheral disadvantage, such as poor energy network coverage, older harder to heat homes, high energy consumption practices, low-incomes, low employment opportunities, low levels of public services including transport, and ‘forced car ownership’. All of these can create energy vulnerabilities where energy access, affordability and energy efficiency are difficult to achieve, there is little flexibility to alter existing contexts, energy practices meant to circumvent access issues and meet energy needs result in higher energy consumption or higher cost energy. Thus, spatial injustice leads to increased energy vulnerability, consequently peripheries are especially energy vulnerable.

In considering *Chapters 2-4* together the following research gaps are made visible: First, there is a need to understand spatial drivers of energy vulnerability; second, there is a need to understand the spatial elements of transition; and third, there is a need to understand both energy vulnerability and low carbon transition from a peripheral perspective. Limited understanding of the interplay between energy vulnerability, energy transition and peripherality holds a risk that spatially contingent energy vulnerabilities will remain unaddressed and possibly lead to spatialized fuel poverty. It holds a risk that transition benefits will be limited and costs will increase for peripheral places. Additionally, there is potential for low-carbon transition to address issues of spatially contingent energy vulnerabilities, but without understanding either, these opportunities cannot be grasped. The next Chapter outlines the methodology adopted for this research

in its attempt to meet these research gaps and illuminate the interplay of energy vulnerability, low carbon transition and peripheralization.

Chapter 5. Methodology

5.1 Introduction

This chapter provides an overview of the methodological framework which structured the thesis examination into the impacts of energy transitions on vulnerable peripheral communities. The research adopts a predominantly qualitative, inductive approach to primary data collection, in combination with interrogation of secondary quantitative and document-based data. This mix of data allows for in-depth understandings of personal experiences of peripherality, vulnerability and energy transition to be gained via interviews and focus groups while also positioning such experiences within their wider socio-economic, political and cultural context. In this way, the research unpacks the interplay between processes of vulnerability, peripherality and energy transition, exploring how these processes coalesce to affect how, where and why transitions occur (or not), in addition, how energy transitions affects vulnerability and peripherality is also illuminated.

The research understands that peripheries are heterogeneous in their formation and disadvantages, and that energy vulnerability is experienced by singular or multiple vulnerability ‘drivers’ which are variable depending on specific contexts. Additionally, energy transitions are understood as multi-scalar processes influenced in different ways, at different scales by the social, economic, and political position of its actors. Within the three key foci of this research: energy vulnerability; energy transition; and peripheralization, policy has played a key role. The position of policy making institutions in urban centres, uneven distributions across regions and sub-regions of policy powers, funding and autonomy can interplay with economic and social peripheralization processes. Transition literature has pointed to the strong influence of policy in driving transition towards certain goals, crediting policy targets and incentives for the progress made in the UK in reducing Green House Gas (GHG) and carbon dioxide (CO₂) emissions and increasing renewable energy production. Fuel poverty literature has highlighted that misaligned policy objectives can leave many in fuel poverty unrecognised and consequently unassisted. Thus, a key area of research interest centred around the role of policy and political governance in processes of peripheralization, energy vulnerability and energy transition. The following research questions were posed:

- a) How is peripherality experienced within and around the Brecon Beacons National Park, Wales?
- How do political, economic and social factors interplay at multiple scales to influence peripherality at regional scales within Wales?
 - How does the production of peripheries at multiple scales influence experiences of periphery at a sub-regional/local scale?
 - How is peripherality experienced at a sub-regional scale?
 - How and to what effect does peripherality impact and interplay with energy vulnerabilities?
- b) How does energy vulnerability manifest within and around the Brecon Beacons National Park, Wales?
- How is energy vulnerability experienced within a periphery?
 - What are the key conditions affecting energy vulnerabilities in a periphery?
 - How are key energy vulnerability conditions affecting peripheries produced?
 - How are peripheral communities counteracting energy vulnerabilities?
- c) How is low-carbon energy transition experienced within and around the Brecon Beacons National Park, Wales?
- How do energy vulnerability and peripherality interplay with social, economic and political contexts to influence involvement in low-carbon practices and innovations?
 - How do low-carbon energy practices and innovation impact upon vulnerability and peripherality?
 - How do low-carbon energy practices and innovations interplay with the socio-economic evolution of peripheral places?

A case study approach was adopted that bound the research area to mostly rural peripheries but also some exurban and Valley peripheries of Mid-South Wales, UK that are based in and around the Brecon Beacons National Park (BBNP). In this way, a broad range of differential scales of policy and peripheral experiences could be explored that could uncover variegated reasons for and experiences of energy vulnerability and energy transition. The research used interviews, focus groups, observation, document analysis and quantitative statistical analysis to uncover and connect the interplay between the processes of peripheralization, energy vulnerability and energy transition in Wales.

5.2 Methodology: A qualitative case study

A paradigm can be understood as “a set of assumptions about the social world, about what constitute proper techniques and topics for enquiring about that world; a set of basic beliefs, a world view, a view of how science should be done (ontology, epistemology, methodology)” (Punch 2014, p. 351). Ontologies, epistemologies and methodologies can vary between researchers and impact to greater or lesser extent all aspects of a research design (Blaikie 2009). Thus, it is important that the position of the researcher in relation to these philosophies is clear in order that any knowledge claim based upon their research is also made clear (MacIntosh & O’Gorman 2015).

Ontology is concerned with what exists in social reality, the conditions of their existence and their relationship with other things in existence. Ontological theories can be broadly split into two opposing schools of thought, relativist and realist. Realists view the world objectively, as such they believe reality is ‘out there’ in the world, independent of researcher influence and occurring whether or not it is discovered or measured in a research process, but it is possible to find and explain “universal principles and facts” (MacIntosh & O’Gorman 2015, p. 57). Relativists on the other hand, take a subjective world view, whereby, reality is socially constructed and consequently, there is no such thing as a set reality ‘out there’. Instead, reality is fluid, in constant flux and is constructed by individuals who themselves are influenced by their own cultures, histories and viewpoints and where they are positioned in a particular space at a particular time (Bryman 2016).

Epistemology is concerned with how knowledge is known, and what constitutes reliable knowledge. Traditionally, within scientific research a positivist approach dominated, focusing on the use of objective methodologies (Bryman 2016) to measure reality that is ‘out there’ and will remain so whether it is measured or not. Therefore, research can be replicated and obtain the same results each time. As such, positivist approaches search for evidence or ‘truth’ to build or form part of causal laws, and over time have become mostly associated with empirical studies in the natural sciences. An interpretive position, however, maintains that there are distinct differences between the natural science and social science (Bryman 2016), whereby “physical systems can not react to predictions made about them, social systems can” (MacIntosh & O’Gorman 2015, p. 65). This implies that social research can never truly measure reality, as through the act of research itself, the reality as it was will change and adapt to the research context. Additionally, as

individual's perspectives, experiences and cultures that influence their viewpoints and behaviours in different ways, their engagement in research will be highly dependent on a variety of non-controllable factors, from how they view the research and researcher to how they personally feel at the time of the research. Therefore, if a social research project were to be exactly duplicated, it is highly unlikely that identical results would be gained. Recognising this variability, research with an interpretivist position will attempt to understand trends as opposed to truths or social law.

Different ontological and epistemological positions are more naturally aligned than others, for example it is unlikely that research with a realist ontology would adopt an interpretivist epistemology as the two positions conflict with each other. This research has been conducted from a subjectivist ontology and interpretivist epistemology, that understandings gained are themselves subjective to the context of the research and the participants, where each of these are situated socially, culturally and physically in space and time (MacIntosh & O'Gorman 2015). In addition, research is carried out by "gendered researcher(s) who speaks from a particular class, racial, cultural and ethnic community perspective. The researcher approaches the world with a set of ideas, a framework, which specifies a set of questions, which are then examined in specific ways" (Outhwaite & Turner 2007, p. 580). As such, qualitative understandings of reality are variable and highly interpretive. Realities are subjective and co-constructed by research participants and the researcher, as by entering the research, the researcher inevitably alters that reality, thus, insights gained are always partial and additionally are subsequently interpreted by the researcher themselves, which means, that some forms of bias will inevitably shape such interpretations.

As different ontologies can more naturally couple with certain epistemologies, methodologies with a qualitative approach are usually more closely aligned with relativist, interpretative paradigms. Considering the overall aims of this research along with a subjective ontology and interpretivist epistemology (or overall constructivist world view), the overall methodological approach lends itself to a qualitative inquiry. Qualitative research aims to understand social phenomena, personal views, ways of life and social structures and cultures by studying "things in their natural setting, [and] attempting to make sense of or interpret these things in terms of the meanings people bring to them" (Denzin & Ryan 2007, p. 58). It aligns well with interpretivist worldviews by understanding that partial and "multiple realities" are present simultaneously and can

be accessed through understanding the perspectives of others within the context of their reality (MacIntosh & O’Gorman 2015, p. 65).

Creswell (2013) outlines five qualitative methodological approaches, narrative research, ethnography, phenomenology, grounded theory and case study with a combination of these suiting the research aims. Narrative research typically focuses on one or two individual’s life stories and experiences of a phenomenon in great detail (Creswell 2013). While this approach may have been suitable for investigating peripherality or energy vulnerability, it didn’t necessarily encompass well investigating the two together with energy transition as the focus would be too narrow. Ethnography examines shared patterns of behaviour, language and beliefs through researchers sustained emersion within the research context (Creswell 2013). This approach did not suit the aims of the research which focus on variegated experiences as opposed to culture formation. Finally, phenomenology involves the identification of a phenomenon and the investigation into the lived experiences by people of that phenomenon and Grounded Theory attempts to create new theory driven solely by data derived from research (Creswell 2013). These approaches appeared to suit several of the research aims in which exploring how and why people experience energy transitions in certain ways is key and new theoretical insights are hoped to be gleaned from the research data. However, phenomenology, does not appear to account for wider contextual factors that may shape these experiences, nor does it allow for the wider expansion of exploring the impacts of said transitions on a wider scale, such as groups or communities, which is also a key aim of the research questions. Grounded theory does not use existing theory as research framework; however, the use of theoretical frameworks forms a key part of this research design.

Therefore, on further consideration, a case study methodology was chosen with elements of grounded theory used to decide sample size and in part, the thematic analysis approach later on. Case studies are sometimes used merely as a relative bounding tool, deciding what is to be studied (Richie & Lewis 2003; Stake 2005), increasingly and especially within qualitative research, case studies are thought of as methodologies, or as an overall research strategy (Yin 2014). This can involve using the case to bound the research, but also, to direct the overall research strategy, including data collection and how it is analysed (Yin 2014). It is this dual approach to case studies that this research adopted. In that respect, a case study methodology involves the exploration of “real-life, contemporary bounded system, or multiple bounded systems over time, through detailed,

in-depth data collection involving multiple sources of information” (Creswell 2013, p. 97). A case study methodology offered a framework for the exploration of personal experiences and community experiences, while also acknowledging wider contextual factors that impact directly and indirectly upon these experiences and transition phenomenon.

While the ontological and epistemological considerations were important in deciding to adopt a case study approach, so are the type of research questions, degree of researcher control, and research timeline (Yin 2014). First, research questions for a case study should generally be “how” or “why” as these types of questions suggest an explanatory, qualitative strategy is needed, as opposed to “what” or “who” questions which suggest a quantitative approach may be best (Yin 2014, p. 11). Second, the degree to which a researcher wishes to control behaviours can be suggestive of whether a case study is the right choice. As case studies attempt to investigate phenomena within their real-world context little or no researcher control on the case are expected. This is contrary to an experimental approach for example, that may purposefully seek to influence the participants or phenomena under investigation in order to control for external influences. Finally, whether the phenomenon under investigation is contemporary or historical will help distil whether a case study is suitable, for example, where the research is focused on past events a historical approach would be better suited. Therefore, as this research design has adopted qualitative and exploratory research questions that seek to explain why and how contemporary energy transitions occur, accounting for external and contextual factors, instead of controlling them, it suits a qualitative case study methodology.

Having identified the area of research, defined the research questions and decided that a case study methodology as the most fitting, the next step was to identify and bound the case. This meant deciding on whether the case would be a single or multiple case study, which in turn meant considering what the primary focus of the research was, whether it was to explore and describe a particular case, test theory or compare the same phenomenon in different instances. This was particularly challenging as the research aims could be investigated in a number of ways, for example, a single household or a single community project involved in energy transitions could be identified as single cases in their own right. Likewise, two or more households and/or community projects could be identified as multiple actors within a single case study. Finally, two or more households

and/or community projects could be identified as two separate case studies, whereby, comparisons could be drawn.

When considering these options, much of the criteria was at least in part theoretically driven. For example, peripheral areas could be identified by Copus (2001) elements of peripheral disadvantage, i.e. lack of agglomerative advantage, proximity from centres, poor infrastructure, weak governance influence etc. Simcock and Petrova (2017) energy vulnerability drivers could identify possible places that were more energy vulnerable, i.e. places with difficulties in accessing energy, with inflexible energy systems or buildings, high energy costs and poor energy efficiencies. Finally, transition could be indicated by places where there was evidence of low-carbon energy production. However, practical considerations and constraints also influenced the selection of the case study. For example, how viable would it be to complete a multiple case study individually ‘in-depth’ within the research timeframe? Personal circumstances also meant that extending the research to places outside of the UK, and to some extent outside Wales, would be extremely difficult. Finally, as the research itself is part funded by the Brecon Beacons National Park Authority (BBNPA), there was a need for it to reflect some of the energy transition issues within the national park itself, although this need not be exclusive.

Considering the case study criteria, it appeared that the case would be best investigated as a “single case” (Yin 2014, p. 51) bound in three ways. First, as an “exemplifying case” the aim of the case was to explore and understand the “circumstances and conditions of everyday situations” (Bryman 2016, p. 62). In this instance, the aim was to understand energy transition as a phenomenon that is occurring nationally, from a peripheral and non-urban perspective. Second, the case was bound to instances of low-carbon energy transition, but also as the literature suggested transitions may be unevenly distributed, instances of ‘deviance’ or non-transition perspectives would also be sought. Finally, as the literature also suggested energy transition is largely influenced by policy and the availability of subsidies and grants, the case was bound in a way that replicates some governance and funding arrangements. Therefore, it was bound geographically in and around the BBNP, Mid-south Wales.

The BBNP was established in 1957, it is one of three National Parks in Wales. As with all National Parks in the UK, the BBNP is physically situated within a periphery of Wales, between rural mid-Wales and the northerly points of South-Wales industrial valleys. The Park overlays nine Local Authority areas including; Blaenau Gwent, Caerphilly,

Carmarthenshire, Merthyr Tydfil, Monmouthshire, Neath Port Talbot, Powys, Rhondda Cynon Taf and Torfaen (Table 5.1 and Figure 5.1).

Table 5.1. Local Authorities within the BBNP boundary.

Local Authority	Land area of BBNP (%)	Population of BBNP (%)
Rhondda Cynon Taf	3.9	3
Carmarthenshire	16.7	5
Powys	66.1	70
Monmouthshire	11.1	21
Torfaen	0.1	0.1
Merthyr Tydfil	1.8	1
Blaenau Gwent	0.2	0.1

Source: BBNPA (2012)

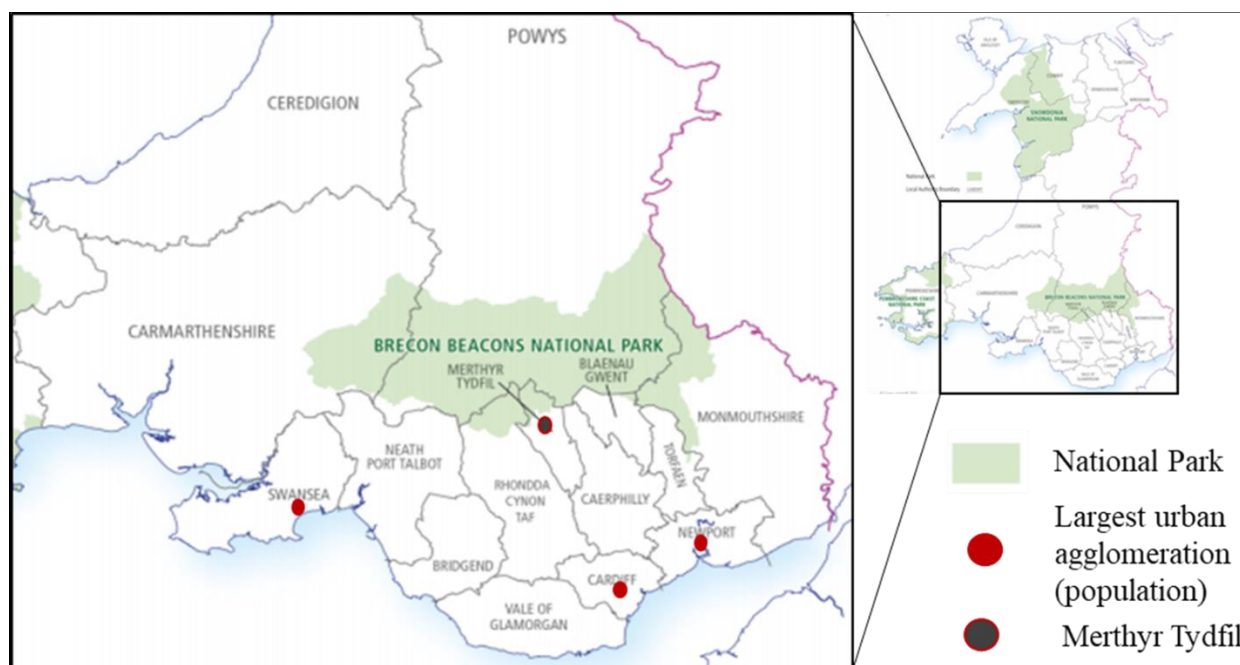


Figure 5.1. BBNP and Local Authorities.
Source: Welsh Government (2017a)

In most socio-economic studies, peripheral places in Wales are considered to be those that have limited access to services and employment and include small settlements or sparsely populated areas that are proximately distal from larger urban settlements (Parry 2003; Wang & Eames 2010; Heley et al. 2011; Kitchen 2012). The Park is sparsely populated having 33,500 people living within its boundary equating to 25 people per km² compared to 148 people per km² in Wales (Office for National Statistics 2017a; Stats Wales 2017a).

The pattern of settlements within the park can be attributed to “a mix of traditional farming areas, mineral extraction, and more recent commercial, administrative and commuting areas” (Nathan Litchfield and Partners 2012, p. 11). The west is characterised by many scattered farmsteads and just a handful of villages, it holds a “secondary key settlement”, in the form of two small combined settlements of Sennybridge and Defynnog (Figure 5.2) (Nathan Litchfield and Partners 2012, p. 11). The eastern side holds the largest 4 settlements in the Park; Brecon, Talgarth, Crickhowell and Hay-on-Wye, these four settlements hold 46% of the total population (Nathan Litchfield and Partners 2012, p. 11). See Figure 5.4 for location of BBNP relative to ‘Built up Areas’ (BUA) and cities in Wales).

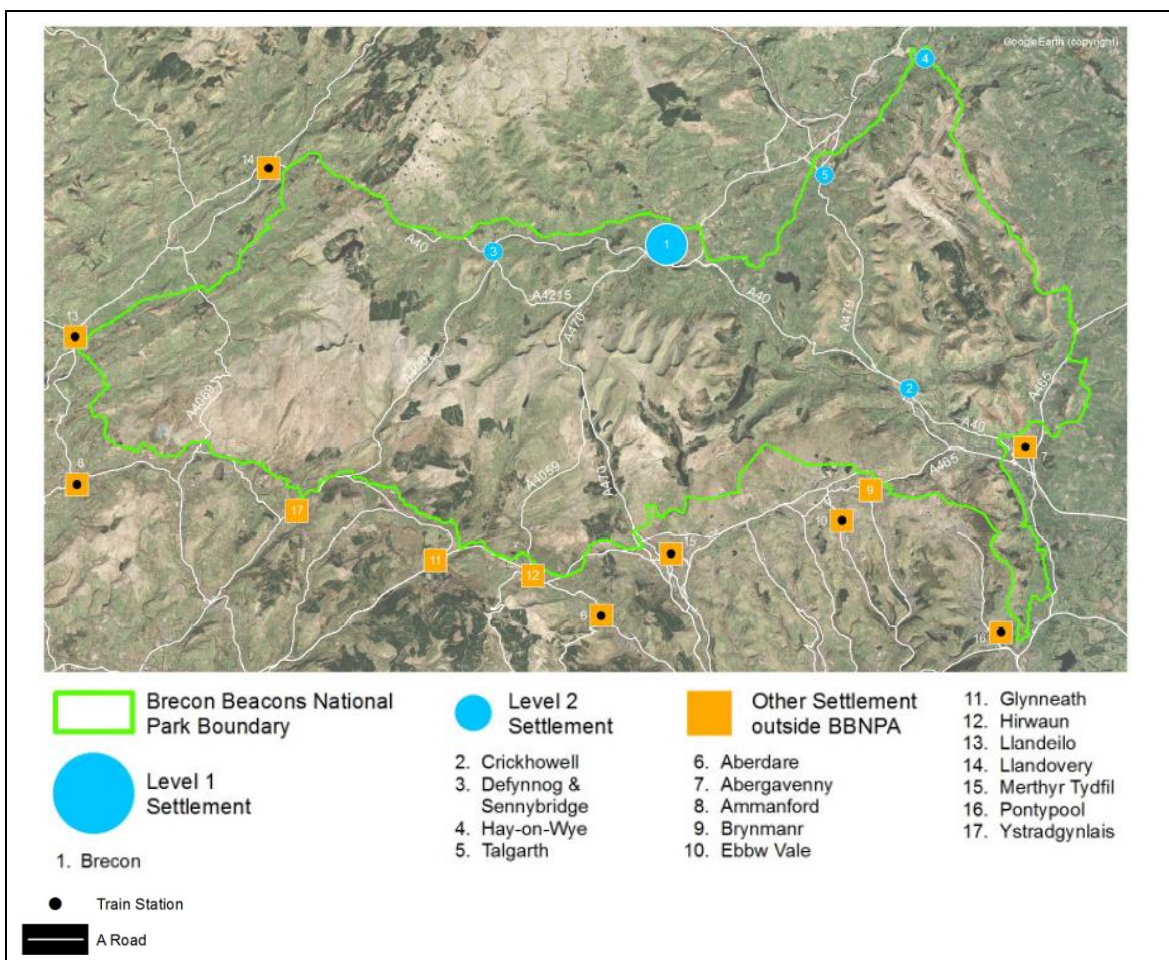


Figure 5.2. Settlement distribution in and around the BBNP
Source: Nathan Litchfield and Partners (2012)

Including the BBNP area within the case study meant that other potentially interesting aspects of peripheralization, energy vulnerability and transition could be investigated. For example, the Park as a recognised entity, has its own planning authority (the BBNPA) which potentially could influence how, where and when energy transitions are carried out within and close to the Park boundary. Additionally, the BBNP has additional funds in

the form of the ‘Sustainable Development Fund’ (SDF) which goes towards sustainable development projects and education in the park, again adding a potentially influential dimension on how, where and who is involved in energy transition. A national park, which is an area of protected land, whereby the landscape, ecology and biodiversity has to be conserved, it is possible that climate change issues and therefore the need to transition to low-carbon energy is more of a concern for Park communities and the BBNPA. Equally, conservation landscape requirements, for example, in maintaining the visual appearance of the landscape may alter the trajectory of transition. Table 5.2 demonstrates case study criteria and assumed fit with location selection.

Table 5.2. Criteria used to select case study area.

Bounding criteria and area theoretical/conceptual assumptions		
Peripheralization	<ul style="list-style-type: none"> · Wales occupies western fringe of UK and is politically and economically weaker than other devolved countries. · BBNP occupies Mid-south Wales, on the northern periphery of South Wales’ urban centres and centre of policy making. · Predominantly rural, the area has lower GVA than urban areas of Wales (National Assembly for Wales 2018a). · Rural Local Authorities in Wales typically receive less Revenue Support Grant than urban authorities²⁴ · Poor public services access; some settlements have no local services, e.g. access to schools, shops, recreation and leisure facilities, healthcare (Welsh Government 2015b). · Poor public transport links; many settlements within and around BBNP have no public transport provision (Public Policy Institute for Wales 2016). · Settlements in and around the BBNP area are a majority of sparsely dispersed settlements; rural villages, hamlets and isolated dwellings (BBNPA 2015). 	<ul style="list-style-type: none"> · The BBNPA presents an additional governance layer which may impact political representation and advocacy differentially to non-BBNP areas.
Energy Vulnerability	<ul style="list-style-type: none"> · Poor energy infrastructure in Wales and limited powers to alter this impacting Wales’ energy access, security, energy efficiency and affordability (Cowell et al. 2015; National Grid 2018). · Rural areas in Wales have some of the poorest energy infrastructure in Wales (National Grid 2018). Weaker electricity grid and approximately 50% of households not connected to mains gas (BBNPA 2013b). Further impacting energy access, efficiency, affordability and security of supply. · Energy costs more to those not on mains networks, and in instances of oil and LPG, can incur high upfront payments and delivery charges (Powys Public Service Board 2016). 	<ul style="list-style-type: none"> · In-migration of “affluent retiree(s)” (BBNPA 2013a, p.65). may mean energy affordability issues are less pronounced.

²⁴ For further Revenue Support Grant discussion see Chapter 6

	<ul style="list-style-type: none"> · Highest levels of the most energy inefficient building stock, and buildings that are hard to insulate are found in rural Wales, impacting energy efficiency, flexibility and affordability (Centre for Sustainable Energy 2015). · Cost of living can be higher in rural areas due to necessity of personal transport and energy costs, impacting household abilities to afford energy (Smith et al. 2010b). · Aging population in rural areas (Stats Wales 2017b) impacts energy ‘need’ i.e. more energy for heat, for longer periods of the day than other population groups. · The above implications on energy vulnerability drivers may also hold other impacts for energy needs and practices. 	
Energy Transition	<ul style="list-style-type: none"> · Local Authority in the area (Powys) has highest levels of low-carbon energy production (Welsh Government 2017a) (<i>at the time of research design</i>) · Evidence of low-carbon energy production at a household, community and institutional level in and around the BBNP (Ofgem 2019a; 2019b). · Evidence of energy conservation at a household, community and institutional level in and around the BBNP. · Low-carbon energy companies, including independent finance providers, have been established within and around the BBNP area. · RHI may be higher in rural area due to many homes being off-gas. 	<ul style="list-style-type: none"> · BBNPA holds sustainability team and SDF which help residents become more sustainable generally. Advice and project assistance have included energy production and conservation and contributed to the development of local companies. · Within the BBNP transition may be curtailed due to BBNPA conservation purposes; however, it may be encouraged for the same reason.
Pragmatic considerations	<ul style="list-style-type: none"> · Geographically viable for researcher. · Area somewhat familiar to researcher. · Satisfies funding stakeholders. 	

5.3 Getting to know the case: Pilot studies

To bound the study as above and to decide on research participants, “early understanding of the study contexts” was required (Richie & Lewis 2003, p. 67). An extensive literature review was conducted that involved the examination of academic literature, official documents with relation to energy production, consumption, accessibility and affordability, in the UK and Wales and also in reference to the BBNP specifically. Additionally, several pilot data collection activities were carried out, comprising document analysis and exploratory meetings and interviews. These pilot studies were carried out simultaneous to many of the decisions made regarding how the case study was bound, whether it was a single or multiple case(s) and who the main actors were likely to be were informed by the results of the pilot investigations.

Exploratory meetings were held with the BBNPA, and local energy consultants The Green Valleys (TGV) to ascertain the general context of the BBNP in relation to wider governance arrangements and funding and also in relation to park policies, socio-demographics and specific energy accessibility and needs. Pilot participant observation was carried out at TGV’s Annual Stakeholder Meeting (07.10.2015) and at a Powys Public Service Board consultancy project seminar (16.11.2016). Finally, pilot interviews were carried out between August 2016 and January 2017 with several staff members from BBNPA, from two households, different community renewable energy projects, Natural Resource Wales and Powys County Borough Council. Each of these interviews were carried out using the same procedures as the main data collection phase with interviews audio recorded, transcribed and analysed. A researcher journal was maintained for reflexivity and notes were taken during participant observations.

This pilot stage held multiple purposes, as well as making the case context more familiar, it also acted to identify key actors and specific research participants. It helped create relationships with some key gatekeepers, which is essential for the in-depth data needed for a single case (Creswell 2013). With regards to data collection it provided clarity as to which methods may work best for different interview groups and also offered an opportunity to trial interview questions. Finally, it also helped to solidify theoretical assumptions and confirm that the energy transition phenomenon was relevant to the case.

5.4 Data collection methods

A “multi-method focus” (Denzin & Ryan 2007, p. 65) was chosen as “relying on one source of data is typically not enough to develop [...] in-depth understanding” (Creswell 2013, p. 98), which is essential for a single case study. Additionally, it offered the opportunity to triangulate the data, whereby data collected via different methods can be compared to assess whether the answers being given align. Therefore, three different qualitative data collection methods were chosen out of the six put forward by Yin (2014), namely semi-structured interviews (including focus groups), participant observation and document analysis. Additionally, secondary quantitative data sources were used to supplement and triangulate the experiences and views emerging from the qualitative data. Each method is discussed in detail below.

Semi-structured interviews were chosen as the main research method as they can reveal evidence of the object of the investigation “including the contexts and situations in which they emerge” Miller and Glaser (2016, p. 51). The interviews involved asking open-ended questions aiming to explore the perception of participants and allowing them to express their point of view. For each interview, consideration was made as to which research questions could be answered by the participants and how the interview could form part of context building. This was influenced by who the participants were, whether from an organisation, community project or individual and also whether they were actively involved in energy transition or not. Following this, consideration was taken as to what type of interview was most practical and likely to get the most insights, whether that was a one on one or a group discussion. Again, this was tailored to the type of participant, for example, individual households were generally one on one, while community groups were highly variable, ranging from single person to a group discussion. However, while this was a consideration of the researcher, cues were taken from the participants as to which type of interview they would prefer. Table 5.3 details who the case study participants were and their appropriateness for research selection.

Interview protocols were devised for each interview (see Appendix 3). These were not followed rigidly, instead they were used as a point of reference to ensure that key areas of exploration were not missed. This allowed interviews to flow like a conversation, with interviewees discussing issues in the order and way that they wished. Additional probing/steering questions could then be asked as a particular subject arose in the

conversation, thus, keeping the flow but allowing some direction to be placed. The venue for the interviews, again was largely informed by the participant and where they felt most comfortable, although if potentially too noisy for adequate audio recording, alternative venues were suggested. Most individual household interviews took place within participants homes, community interviews ranged between participant homes and a community venue (such as a community centre), while organisation and institutional interviews took place at official buildings (i.e. civic centres) or near-by cafes. All interviews took between forty minutes and an hour to complete, were audio recorded and transcribed.

Focus groups are a form of interview method that involves a group of people participating in the same interview together. As with single person interviews, focus groups can be structured, semi-structured or unstructured, however whichever type of structure is used the role of the researcher is slightly different (Fontana & Fray 2005; Punch 2014). Within a group interview, the researcher “functions more as a mediator or facilitator, and less like an interviewer” (Punch 2014, p. 146) in this way, the focus groups did not have a to-and-fro of question and answer, instead a question or a statement was put to the group and a discussion ensued around that. In this research a semi-structured approach was chosen for the focus groups as with the interviews, that way the group discussion could flow in ways comfortable for the group but direction was given in the form of questions asked or comments made by the researcher. As a group discussion involves more than one person, each with different personalities and potentially different views, effort was made to ensure each of the group was given opportunity to voice an opinion on topics raised so that those more comfortable voicing their opinion did not dominate the discussion. As with the other interviews, all focus groups took between forty minutes and an hour to complete, were audio recorded and transcribed.

Document analysis includes searching, selecting and reading written material that was not produced for the purpose of this research. This was done during all stages of the research process, during the literature review, during selection of the case, during data collection and when interpreting the results. Bryman (2016) differentiates five main document sources; personal documents, official state documents, official private source documents, mass media outputs and virtual documents. Of these it was the last four that were analysed for this research for a number of different purposes. For example, during the literature review stage it was important to gather information regarding energy

vulnerability, this involved analysis of official state documents, official state sponsored documents (such as those from Ofgem), Official Private documents such as those of the Energy Trust, mass media documents such as news articles, and also academic papers. During data collection, documents included those passed on by interview participants such as newsletters from community groups, official regional governance documents such as county council research reports, government policy and statistics and also official BBNPA documents such as planning maps and strategic management plans. All documents accessed during the course of the research were critically appraised as to who had produced them, the purpose of the document, the intended audience and the context they were produced in.

Observation within qualitative research involves observing situations as they naturally arise and taking an unstructured approach to data collection whereby observations are made “in a more natural and open-ended way” (Punch 2014, p. 153). Behaviours, actions and events are recorded in the order they occur (Punch 2014). This method was used when visiting places and meetings in which energy related or contextual related topics were likely to be discussed. This included attending meetings and workshops facilitated by community groups; the BBNPA; Local Authorities; Welsh Government; National Grid; and third sector fuel poverty or energy production organisations (see Appendix 4 for list of observation opportunities). During these events broad field notes were taken, describing the places, who was there, what was discussed and how it was discussed. These observations were used during data analysis to add context to the interview data. This method was not adopted as the primary data collection method, it was used as a means of adding to understandings of the case context. It also allowed for deeper understandings of the activities taking place and process of making decisions in the natural setting, and also how energy vulnerability, transition or peripherality are positioned in discussions and actions relative to other contextual factors.

Secondary analysis was also used as a means of deepening understandings of the context of the research and thus providing further avenues or more detailed questions to be posed in interviews. It was also a means of data triangulation whereby claims made by interviewees could be checked against the secondary data, and evidence from secondary data could also be checked against evidence emerging from interviews. Thus, as with observations, this method is not considered the main data collection method, instead it acts to supplement the qualitative data gathered in interviews. There are advantages to

working with secondary data: it can contain large-scale data that would be beyond the scope of this research to obtain; the data is ready collected so analysis can be carried out immediately; and as long as care is taken as to the source of the data, it can be of high quality (Punch 2014).

5.5 Data collection considerations

The research strategy adopted was a qualitative case study which was chosen as it aligned with the interpretivist epistemology, constructionist ontology of the researcher and the type of research questions. While a qualitative approach reflects the grounded belief of “what constitutes acceptable knowledge” it also holds five main “preoccupations” (Bryman 2016, p. 392). These preoccupations can be understood as being key reasons why qualitative research is carried out generally and specifically for this research project. In addition, they can provide understanding for why qualitative data collection methods are chosen. Bryman (2016, p. 392) defines these preoccupations as “seeing through the eyes of the people being studied” (participant realities), “description and emphasis on context” (content specific realities), “emphasis on process” (social processes), “flexibility and limited structure” (loose research structure) and “concepts and theory grounded in data” (data driven theory), each will be discussed in relation to this research project.

Social research attempts to understand and explore social realities, from an interpretivist epistemology, these social realities are created by the people who live within them. As such, these realities are personal to each individual and are continuously changing due to a multitude of factors, including the history, beliefs and culture of the individual and also other people who share these realities. Social realities are created through the meanings that these people attach to everything, from behaviours and language to particular places. In order to gain access to these realities and attempt to understand them, social researchers need to try and ‘see through the eyes of the participant’, to try and understand what particular behaviours, language or places mean to them and why (Bryman, 2016). This involves attempting to put aside personal views of reality and meanings as these may be very different to those of a participant and could lead to incorrect assumptions and interpretations being made from observations or what participants say.

Social research places an emphasis on gaining thick descriptions of research in order to convey as fully as possible the context of a given social world. The reasoning behind this is that “we cannot understand the behaviour of members of a social group other than in terms of the specific environment in which they operate” (Bryman 2016 p. 395), the context that people live or access at different times, influences their behaviour, and that different contexts may invoke different data collected from the same person. For example, if interviewing a social housing tenant on their energy use and needs in their own home, or in their landlord’s office, the same questions are likely to get different results because the context in which they are being asked is different. Likewise, if interviewing members of a community energy group on their project, a group interview will be more influenced by group dynamics and social hierarchies than individual interview. Therefore, to correctly interpret a group interview, a researcher would need to understand that group’s internal social order along with the wider contextual environment that they live in.

As interviewing is “inextricably and unavoidably historically, politically, and contextually bound” (Fontana & Frey 2005, p. 695), consideration also has to be given to wider contextual influences that may inform interviewee responses. For example, when asking people about their energy concerns, during times of high fuel prices, answers may focus on financial costs of energy. Whereas during times of heightened concerns around climate change, focus may centre more heavily on the environmental cost of energy. During this research process, the price of oil has remained lower than in previous years (House of Commons Library 2016a) and the average cost of household energy decreased in 2016 compared to 2015 (Department of Business, Energy and Industrial Strategy [BEIS] 2016) in addition, the winter had been relatively mild (BEIS 2016). These current factors mean that for many people interviewed energy may not currently be a pressing concern, with other factors such as inflation increases affecting the general cost of living in the UK (Office for National Statistics 2017b) possibly taking a higher priority.

Additionally, politically, the UK is undergoing a transition, with negotiations ongoing in how it will leave the EU, and a new government (since 2016) that have indicated that their political agenda will not focus on climate change, renewable energy. Evident in the Department for Energy and Climate Change now changed to Department for Business, Energy and Industrial Strategy, indicating a shift in priority from the environment and carbon reduction to an industrial focus; and further reductions or ending of some of the Governments key climate change subsidy schemes (Environmental Audit Committee

2018). These political changes may impact on how people view the EU carbon emission targets and whether they will be relevant, and also possibly how favourably people view renewable energy in general. From a government and institutional authority perspective, these political changes will have direct impact on how different organisations work on a national and local level.

In 2016 in Wales business rates increased and previously exempt micro-hydro were included, demonstrating a tax increase of on average 300%, making many schemes loss-making (Messenger 2017). This was slowly rectified (not at the time of data collection), with an exemption reinstated for socially owned schemes and a cap on increases for other small-scale developments to 10% or £1,000 (Welsh Government 2018d). However, this was a topic of discussion within some of the interviews that no doubt influenced some of the perspectives of the Welsh Government and the economic vulnerability of smaller renewable energy schemes.

Also, in order to understand key events or social phenomena and why they occur in certain ways, in certain contexts, the events, actions and activities that lead up to the occurrence need to be taken into consideration and understood. For example, in order to understand why someone may self-ration their energy supply, and possibly live in a cold home, as opposed to installing a new energy efficient boiler or house installation, which may be state subsidised the interconnected processes that led them to take that decision need to be understood. It maybe they are suspicious of the state and state services due to past interactions with them, it may be due to the social context in which they live whereby taking advantage of subsidised assistance would lead to stigmatisation or it may be that they are simply unaware of their entitlement. Either way, their decision to self-ration would not have been made in a vacuum and each possible reason outlined, although hypothetical, would be the result of different social processes within a certain social context that proceeded it. Thus, without understanding and accounting for process, questions around why people say or do certain things will not be fully understood.

A qualitative research enquiry tries to avoid “imposing inappropriate frames of reference on people” (Bryman 2016, p. 397). This means that in order to ‘see through participants eyes’ and experience their social reality, as little structure as possible should be imposed on data collection because to impose structure and set direction would imply that assumptions had been made about what was likely to be encountered. These assumptions and would affect the ability of the research to capture wider or different perspectives and

therefore the truer reality. A looser methods structure and fewer assumptions about what will be discovered, means the research becomes more open to alternative realities and also remain flexible to change in line with what emerges from the data. While this preoccupation was adopted to a certain extent, and indeed is evident in the sample strategy which while directed by theoretical assumptions was also snowball and contingent, a theoretical framework was used and did impose some structure to data collection. Nevertheless, such theoretical framing provided a framework or foundation to the research enquiry (MacQueen & Narney 2012), however the data collection and analysis process were as 'loose' as possible within these frames.

Findings and theories from this research have been 'driven by the data'. This 'preoccupation' strongly links with flexibility and also grounded theory methodology, whereby, generally within qualitative research an inductive approach is taken that allows theory to be generated from the data instead of imposing a theory onto the data. This approach was taken for this research despite a theoretical framework being adopted and the case study itself being chosen in line with some theoretical assumptions and concepts. The data collection, however, was not carried out to prove or disprove any of these concepts. Instead the research aimed to explore what was happening within the case in relation to these concepts, whether these concepts were relevant within the peripheral setting and if so, in what ways, thus providing further meaning.

Finally, with regards to secondary data used within this research, as it is collected by other organisations, for other purposes which may conflict with this research purpose, care was taken to use official sources. For example, data was sourced from the Consumer Data Research Unit; the Department of Business, Energy and Industrial Strategy; National Assembly for Wales Research Unit; Office of National Statistics; Ofgem; and Stats Wales. In instances that secondary data was manipulated, for example, in weighting housing data at Lower Super Output Area²⁵ (or LSOA scale) to BBNP scale an official national park weighing tool was obtained from Welsh Government. The tool gave the proportion of dwellings in each LSOA within and without of the BBNP boundary and so other official data measured per dwelling at LSOA scale, such as FIT data from Ofgem, could be weighted. Additionally, the BBNPA shared a tool which weighted population

²⁵ Lower Super Output Area (LSOA) is an area measure based on postcode and population size. An LSOA contains an average of 1,500 people.

from a Local Authority level to a BBNP level, thus using this allowed Local Authority defined population data such as gender or GVA to be weighted to the BBNP.

5.6 Sampling and recruitment

Sampling involves selecting a set number of sites or people for study, this can be done in multiple ways, dependent on the overall research aims and methodology. A case study methodology can adopt a number of sampling techniques in isolation or sometimes combined, again dependent on the research aims. For the purpose of this research, the range of participants or units of analysis required for this case study suggested that different sampling techniques could be adopted. However, given the research focus on experiences of peripherality, energy vulnerability and low-carbon energy transition, the sampling strategy was aimed at households, groups and businesses within a material peripheral location, including those potentially energy vulnerable and those implementing some form of energy transition. These considerations were not singular and indeed there was cross-over between them (i.e. several households within the peripheral study location were energy vulnerable and had achieved some form of low-carbon transition).

Embedded data collection allows for multiple ‘types’ of actors perceptions and experiences to be captured and compared within a context of a case study area. It suits well investigation into processes or phenomenon such as peripheralization, energy vulnerability and low-carbon energy transition which involving multiple actors at varying scales of size and social, economic and political power that are connected in different ways. Therefore, “embedded units of analysis” (Yin 2014, p. 50) or interview groups were identified as: households; community group; third sector; businesses; governance institutions; and other experts (see Table 5.3). Then within the interview groups ‘sub-units’ or specific participants were identified that potentially may have different transition experiences, for example, within the household interview group are differential types of household tenure were selected, such as, privately owned, privately rented and socially rented. Embedded design also refers to the connection between units of analysis or in this instance different interview groups, Figure 5.3 conceptualises the links between the different groups of participants involved within the research.

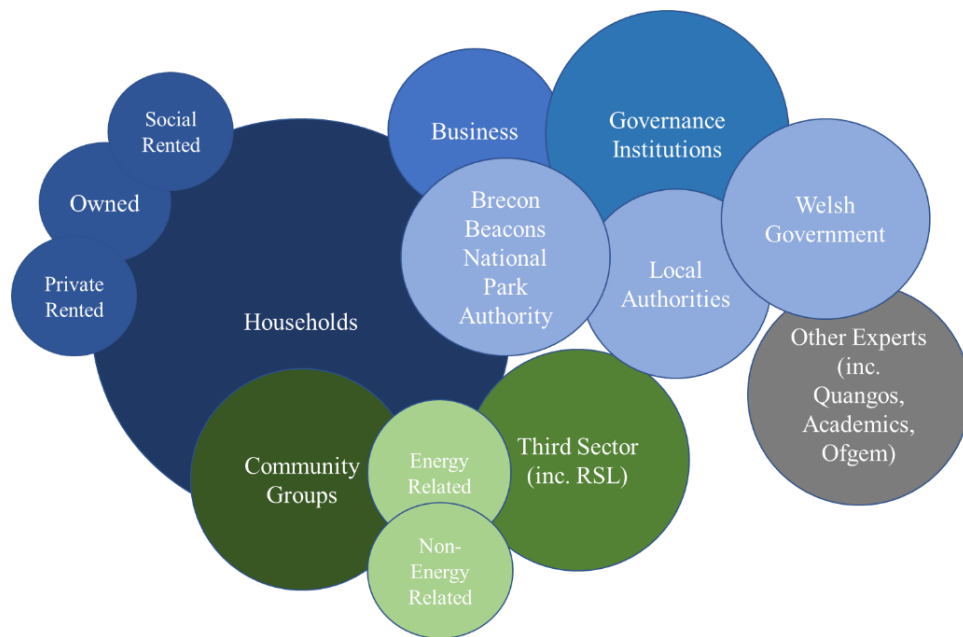


Figure 5.3. Conceptualization of interview group embeddedness.
Source: Author

A target sample quantity was not adopted in this research, instead a “guiding principle of saturation” was used (Mason 2010, p. 1). This is in line with grounded theory methodologies, whereby data collection ends when the results stop yielding new insights (Marshall et al. 2013). This also fits with the qualitative approaches more generally, whereby typically large volumes of data are generated and increasing sample size can mean data becomes “repetitive and eventually superfluous” (Mason 2010, p. 1). Additionally, in qualitative research the frequency of an occurrence of data (a statement, word or a code) is of less importance than the meaning of the data. Pragmatically, a large sample size in qualitative research is impractical in terms of researcher time and economic budgets.

While this research adopted the guiding principle of saturation, it did so considering the heterogeneity of the population and the number and range of embedded or nested groups. Thus, out of the interview groups within this research households had by far the largest sample size, this reflects the variegated nature of individuals tenures, building types, energy sources, socio-demographics and experiences of transition which took a larger sample to reach saturation of data than those of set organisations such as community groups or policy governance institutions. Undetermined sample sizes can be problematic for those unfamiliar with qualitative methodologies, and research credibility can be questioned (Marshall et al 2013). This has led to a proposition of qualitative research with either grounded theory or case study methodologies “should generally contain 20-30

samples” (Marshall et al 2013, p. 21), while this was not considered a necessary target in this research, the sample size did exceed the recommendation.

Factors that could influence both energy vulnerability and potentially ability to transition were also considered with household interview, thus, effort was made to sample households of various compositions (ages of residents, gender, number of people); various tenures (owned, privately rented and socially rented); building attachment (detached, semi-detached, terraced, flat/apartment); and building structure (solid stone walls, cavity walls or unusual construction). To understand the wider context and causes of each research focus, the sample also aimed to include policy governance institutions (those that make and carry out policy); third sector organisations and other experts with focus on one or more of the research areas. (See Figure 5.4 for mapped interviews with households, community groups and SMEs and Tables 5.4-5.11 breakdowns of household interview sample compared to Wales and where possible the BBNP).

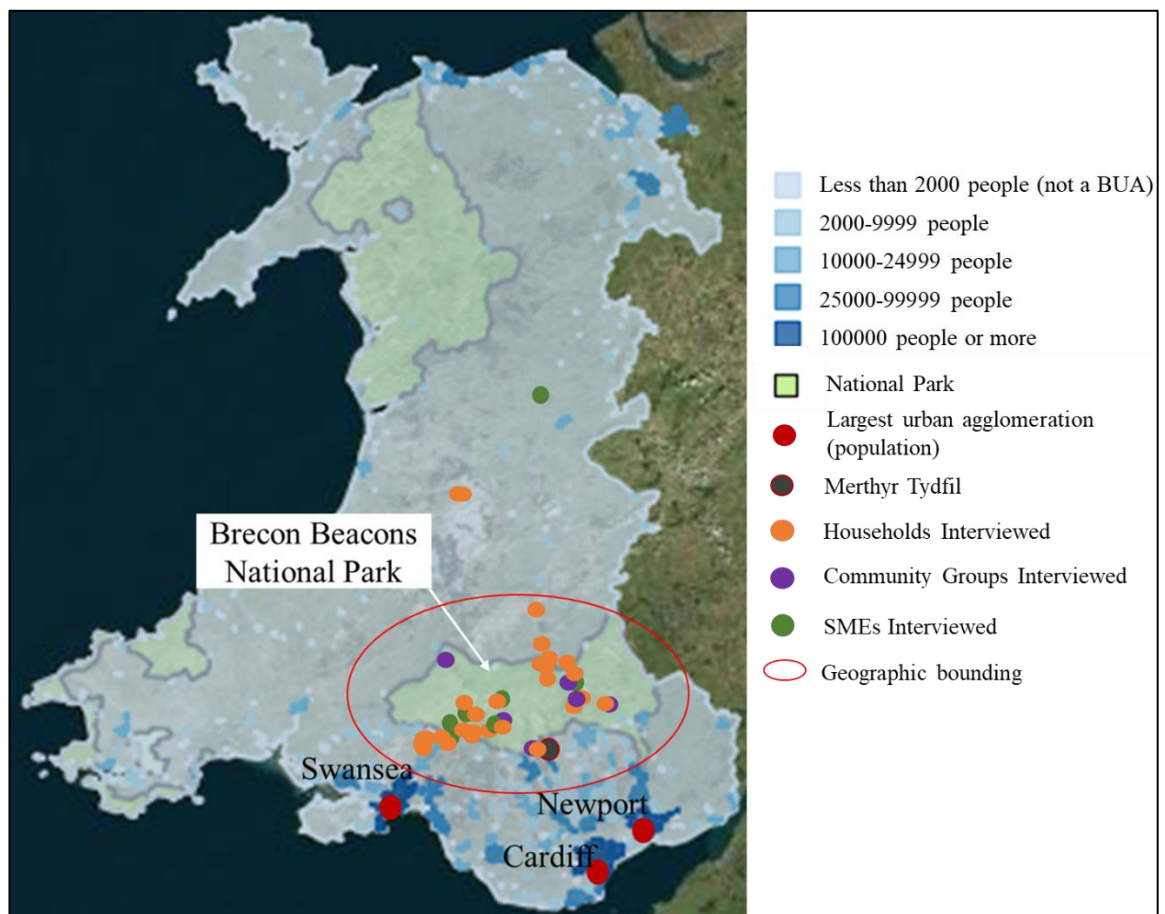


Figure 5.4. Wales built up areas (BUA), largest cities (population), national parks and locations of household, community and SME interviews (indicating study area)
Source: Lle.gov (2019)

As Silverman (2000) states, it is unlikely that case study sampling can be random, it is more likely to be purposeful and snowball due to the overall research design of

illuminating a set case. Additionally, the data collection and what participants and data are likely to be accessible “will be somewhat contingent” (Silverman 2000, p. 234). This is true of this sampling method whereby, following initial contact and data collection from gatekeepers such as BBNPA and TGV, further participants and avenues for data collection were illuminated and sometimes initiated by them. This included access to key players within the communities and the projects in hand. A further step for sampling was then meeting those key players who in some instances were gatekeepers for access to further community members. As such while sampling was initially purposeful, it was in most subsequent instances “opportunistic” (Creswell 2013, p.100) and highly “contingent” and “snowball” (Silverman 2000, p.234).

This type of sampling in some ways relied on the rapport built between the researcher and research participants and gatekeepers, as without good rapport snowball sampling would have been unlikely, or at least, more difficult. This was a potential weakness with this strategy as it meant that there was potential for the sample number to be affected by personal perceptions of the researcher or the research project itself. Additionally, this type of sampling strategy does have elements of self-selection and bias, whereby those most active or involved with energy transitions or connected in some way to the organisations involved are more likely to participate in the study. This may cause the results of the case study to be skewed towards the experiences of those within the communities who are possibly the least energy vulnerable or peripherally disadvantaged.

To address this and include as many different perspectives in relation to energy transition and community impacts attempts were made to seek out alternative or “deviant” cases (Creswell 2013, p. 158). Therefore, the sampling design became one of “purposeful maximal sampling” (Creswell 2013, p. 100) whereby different perspectives on the issue were sought out in addition to the ordinary and accessible cases, already built into the design. Thus, the sampling design overall was purposeful, this means people were selected “because they can purposely inform an understanding of the research problem and central phenomenon in the study” (Creswell 2013, p. 156). However, further to the initial sampling selection, sampling then became both purposeful and snowball/chain sampling thereafter, whereby initial participants suggested further participants that fit the purposeful criteria, or where they acted as gatekeepers and initiated contact with further participants.

Alternative recruitment methods were adopted to attract ‘deviant’ cases or interviewees that were not directly connected to those already interviewed. Such methods included: emailing community centres/village halls and community councils within the study area to ask to participate and to place poster advertising research; placing posters in shops, libraries and advice giving organisations within the study area (Appendix 5); advertise research to Local Authority housing groups via digital newsletter; advertise the research on-line via a Facebook page and using digital poster advertised by community groups within the study area; using organisation web-pages, Linked-in, and attendance at industry discussion groups to connect with other experts and pan-Wales third sector organisations.

Table 5.3. Case study participants.

Participant Group	Group Breakdown	Sample number	Method & area of exploration	Analysis
Household	Owned/mortgaged	34 (total)	<p>Interviews/focus groups: Personal experiences & perceptions of peripherality/ vulnerability/ transition within their own lives and within context of their lives</p> <p>Motivations for transition (or not);</p> <p>Transition barriers/enablers;</p> <p>Transition process;</p> <p>Transition (or not) outcomes.</p> <p>Review of secondary data: Policy documents; population demographics; socio-economics; household compositions; household tenancy; domestic FIT & RHI; housing stock; energy access; energy prices; transport.</p>	<p>Thematic analysis and cross-referencing between units.</p> <p>Secondary statistical analysis: comparative analysis between Wales, rural areas within case study and BBNP area. Cross-referencing between other data sources.</p> <p>Document analysis: Welsh, UK and BBNPA Policy (relating to domestic energy production and efficiency; domestic energy access and affordability).</p>
	Private rented	19		
	Social rented (inc. sheltered housing)	3		
Community	Geographic/politically defined community groups* i.e. Village Hall groups	7	<p>Interviews/focus groups: Community experience/perception of peripherality/ vulnerability/ transition</p> <p>Motivations for transition (or not)</p> <p>Transition barriers/enablers</p> <p>Transition process (ease, community inclusivity, aims, results)</p> <p>Transition (or not) outcomes</p> <p>Observation: How peripherality, energy vulnerability or transition is positioned in discussions and actions relative to other contextual factors.</p> <p>Review of secondary data: Policy documents; community group documents/websites; access to services; community groups in Wales.</p>	<p>Thematic analysis and cross-referencing between units.</p> <p>Secondary statistical analysis: Cross-referencing between other data sources.</p> <p>Document analysis: Community group documents; Welsh, UK and BBNPA policy (relating to community energy, public spending and services).</p>
	Communities of interest** i.e. community energy groups			

Third Sector*	Organisations associated with: Fuel poverty and energy efficiency; energy production; community development. Including RSL. E.G. Brecon Advice Centre; St. Johns Food Bank; National Energy Action; Nest, Melin Homes.	6	<p>Interviews: Organisation remit would dictate overall interview focus, experiences & perceptions of peripherality/ vulnerability/ transition within their work or client base; key problems faced in addressing issues; were there any links between peripherality, vulnerability and transition? state of play in terms of their work with regards to addressing particular issues?</p> <p>Observation: Gain understanding of the activities taking place and process of making decisions in the natural setting. Observe how peripherality, energy vulnerability or transition is positioned in discussions and actions relative to other contextual factors.</p> <p>Review of secondary data: Policy documents; organisation documents/websites; statistics referring to particular area organisation covers.</p>	<p>Thematic analysis and cross-referencing between units.</p> <p>Secondary statistical analysis: Cross-referencing between other data sources.</p> <p>Document analysis: Third sector organisation documents; Welsh, UK and BBNPA policy (relating to particular area: i.e. fuel poverty strategy or renewable energy projects in Wales).</p>
Business*	SME's (farming, tourism, education and finance industries) within study area that have attempted low-carbon transition	6	<p>Interviews: Experiences & perceptions of peripherality/ vulnerability/ transition within their local area and implications for their business; Motivations for transition; Transition barriers/enablers; Transition process; Transition outcomes</p> <p>Review of secondary data: Policy documents; business documents/websites; local economy statistics.</p>	<p>Thematic analysis and cross-referencing between units.</p> <p>Secondary statistical analysis: Cross-referencing between other data sources. Weighting economic data to rural and BBNP area.</p> <p>Document analysis: Business organisation documents; Welsh, UK and BBNPA policy (relating to energy transition; SME's; rural economy).</p>
Policy Governance Institutions*	BBNPA (Committee Members; Chief Executive Officer; Sustainable Communities Team; Planning Officer)	15 (total) 6 5	<p>Interviews: Experiences & perceptions of peripherality/ vulnerability/ transition within their remit area and implications for their constituents; Motivations for transition; Transition barriers/enablers; Transition process; Transition outcomes.</p> <p>Direct observation: Gain understandings of the activities taking place and process of making decisions in the natural setting. Observe how peripherality,</p>	<p>Thematic analysis and cross-referencing between units.</p> <p>Secondary statistical analysis: Weighting of any pan-Wales data to rural area/BBNP scale;</p> <p>Document analysis: UK and Welsh Policy (devolution of power, contestation/differing ideologies/ambitions; climate change; fuel poverty);</p>

	Local Authority (Powys & Carmarthenshire housing officers; energy officers; community development) Welsh Government	4	energy vulnerability or transition is positioned in discussions and actions relative to other contextual factors. Review of secondary data: EU, UK, Wales, Local Authority and BBNPA policy documents; Official research briefings; websites; statistics.	welsh economy; Local Authority settlements; access to services; area economy (employment, incomes; industry sectors); public transport provision; housing standards). BBNPA policy (relating to national parks/designated landscapes; BBNPA economy; BBNPA planning).
Other Experts*	Experts associated with: spatialization processes/regions; rural economy; energy vulnerability/fuel poverty; low-carbon energy transition. E.G. Energy Saving Trust; Cardiff University; Renew Wales; Institute of Welsh Affairs; Natural Resources Wales.	9	Interviews: Organisation remit would dictate overall interview focus, experiences & perceptions of peripherality/ vulnerability/ transition within their work or client base; key problems faced in addressing issues; were there any links between peripherality, vulnerability and transition? State of play in terms of their work with regards to addressing particular issues. Direct observation: Gain understanding of the activities taking place and process of making decisions in the natural setting. Observe how peripherality, energy vulnerability or transition is positioned in discussions and actions relative to other contextual factors. Review of secondary data: Research papers; expert organisation documents/websites.	Thematic analysis and cross-referencing between units.

**Specific interviewees within this group cannot be listed due to anonymity agreement*

***both with and without transition*

Table 5.4. Household interview group breakdown (demographics, home building structure, energy sources and vehicle ownership).

Tenure	Gender	Age range	Employment	No. resident	Building Age	Building material	Building attached	Energy 1	Energy 2	Energy 3	Energy 4	Insulation			Vehicle
												Roof	Cavity & Internal	External	
Owned	Male	65-74	employed and unemployed	2	Pre 1900	Solid Stone	Detached	Mains Electric	Oil	Solar Thermal	-	Yes	No	No	2
Owned	Male	65-74	Retired plus some B&B income	2	Pre 1900	Solid Stone	Detached	Solar PV	LPG	Wburner	Solid fuel range	Yes	Yes	No	2
Owned	Male	45-64	Self-employed	3	Pre 1900	Solid Stone	Semi-Detached	Mains Electric	Mains Gas	Solar PV	-	Yes	Yes	No	2
Owned	Male & Female	65-74	Retired	2	Pre 1900	Solid Stone	Terrace	Mains Electric	Mains Gas	Wburner	-	Yes	No	No	2
Owned	Female	65-74	Retired (early - ill health)	1	1980	Brick	Terrace	Mains Electric	Mains Gas	Wburner	-	Yes	No	No	1
Owned	Female	45-64	Self-employed	4	Pre 1900	Solid Stone	Detached	Mains Electric	Oil	Solar PV	Wburner & Solid fuel range	Yes	No	No	2
Owned	Female	75+	Retired	2	Pre 1900	Solid Stone	Detached	Mains Electric	Oil	Solar PV	Wburner	Yes	No	No	2
Owned	Male	75+	Retired	2	1960	Wooden frame	Detached	Mains Electric	Oil	-	-	Unknown	Unknown	No	1
Owned	Female	75+	Retired	1	post 1900	-	-	Mains Electric	Mains Gas	-	-	Yes	Yes	No	1
Owned	Female	45-64	Retired	2	post 1900	Wooden frame	Detached	Mains Electric	Oil	-	-	Yes	Yes	No	1
Owned	Male	45-64	Retired	2	1970	Brick	Semi-Detached	Mains Electric	Oil	-	-	Yes	No	No	1

Owned	Female	65-74	Retired	2	Pre 1900	Solid Stone	Detached	Mains Electric	Oil	Wburner	Solid fuel range	Yes	No	No	1
Owned	Female	65-74	Retired	2	Pre 1900	Solid Stone	Semi-Detached	Mains Electric	Mains Gas	Solar PV	-	Yes	Yes	No	1
Owned	Female	45-64	n/a	2	Pre 1900	Solid Stone	Detached	Mains Electric	LPG	-	-	Yes	No	No	1
Owned	Male	45-64	Retired	2	Pre 1900	Solid Stone	Detached	Mains Electric	Oil	Solar PV	ASHP	Yes	Yes	No	2
Owned	Female	45-64	Retired & Employed	2	Pre 1900	Solid Stone	Terrace	Mains Electric	Mains Gas	-	-	Yes	No	No	1
Owned	Female	45-64	Employed	1	Pre 1900	Solid Stone	Detached	Mains Electric	Oil	-	-	Yes	No	No	1
Owned	Male	45-64	Self-employed	2	Pre 1900	Solid Stone	Detached	Diesel generator	Solar PV	Wburner	Solid fuel range	Yes	No	No	1
Owned	Male & Female	30-44	employed and unemployed	4	Pre 1900	Solid Stone	Detached	Mains Electric	Oil	Solar Thermal	-	Yes	No	No	2
Owned	Male	65-74	Self-employed	2	Pre 1900	Solid Stone	Detached	Mains Electric	Micro Hydro	-	-	Yes	No	No	2
Owned	Male & Female	75+	Self-employed	2	Pre 1900	Solid Stone	Detached	Mains Electric	Oil	Micro Hydro	-	Yes	No	No	2
Owned	Male	45-64	Self-employed	1	Pre 1900	Solid Stone	Detached	Mains Electric	Oil	-	-	Yes	No	No	1
Private tenant	Male	30-44	Employed	1	Pre 1900	Solid Stone	Semi-Detached	Mains Electric	Mains Gas	Wburner	-	Unknown	Unknown	No	1
Private tenant	Female	15-29	Employed	2	Pre 1900	Solid Stone	Terrace	Mains Electric	Mains Gas	Wburner	-	No	No	No	1
Private tenant	Male	15-29	Employed	2	Pre 1900	Solid Stone	Terrace	Mains Electric	LPG	-	-	No	No	No	1
Social tenant (SA)	Male	65-74	Retired	1	1990	Brick	Flat	Mains Electric	Mains Gas	-	-	Yes	Yes	No	1

Social tenant (SA)	Female	65-74	Retired	1	1990	Brick	Flat	Mains Electric	Mains Gas	-	-	Yes	Yes	No	0
Social tenant (LA)	Male & Female	45-64	Employed	3	1950	Unconventional	Semi-Detached	Mains Electric	Mains Gas	-	-	Yes	Yes	No	2
Social tenant (LA)	Female	65-74	Retired	1	1950	Unconventional	Semi-Detached	Mains Electric	Mains Gas	-	-	Yes	No	Yes	0
Social tenant (LA)	Female	65-74	Part-time	1	1950	Unconventional	Semi-Detached	Mains Electric	Mains Gas	-	-	Yes	No	Yes	1
Social tenant (LA)	Female	30-44	Student	4	1950	Unconventional	Semi-Detached	Mains Electric	Oil	-	-	Yes	No	Yes	1
Social tenant (LA)	Female	65-74	Retired	1	1950	Unconventional	Semi-Detached	Mains Electric	Oil	-	-	Yes	No	Yes	0
Social tenant (LA)	Female	65-74	Retired	1	1950	Unconventional	Semi-Detached	Mains Electric	Oil	-	-	Yes	No	Yes	0
Social tenant (LA)	Male	75+	Retired	1	1950	Unconventional	Semi-Detached	Mains Electric	Oil	-	-	Yes	No	Yes	1
Social tenant (LA)	Male & Female	45-64	n/a	2	1950	-	Semi-Detached	Mains Electric	Mains Gas	-	-	Yes	Yes	No	2
Social tenant (LA)	Male & Female	45-64	n/a	2	1950	-	Semi-Detached	Mains Electric	Mains Gas	-	-	Yes	Yes	No	2
Social tenant (LA)	Male	65-74	n/a	1	1990	-	Flat	Mains Electric	Mains Gas	-	-	Yes	Yes	No	1

Table 5.5. Percentage gender in interview sample and Wales.

	Female	Male
Interview sample	54	46
Wales	51	49

Welsh data source: Office for National Statistics (2011)

The interview sample, Wales and BBNP percentages for gender are fairly consistent with a slightly higher sample in my data of females (54%) to males (46%).

Table 5.6. Percentage age groups in interview sample and Wales and BBNP.

	15-29*	30-44*	45-64*	65-74*	75+*	16-64**	65+**
Interview sample	5	8	35	38	14	45	55
Wales	18	17	27	11	9	62	20
BBNP	N/A	N/A	N/A	N/A	N/A	58	25

*Age ranges as per Stats Wales (2018a) no breakdown of this data is available at BBNP scale.

** Age ranges as per Stats Wales (2018b)

The interview sample has a higher number of older age ranges than representative of Wales or the Park, the biggest difference is in age group 65-74 where this data contains 38% but Welsh data is 11%. This is likely influenced by the increased availability of older, retired households for interview compared to those of working age. Additionally, the lower number of ages 15-29 will be influenced by the interviews only including householders over 18 years old.

Table 5.7. Household composition (number of residents per home) in interview sample and Wales and BBNP.

	No. Occupants
Interview sample	1.9
Wales	2.2
BBNP	2.3

Welsh data source: Stats Wales (2018c)

The interview sample consisted of a higher inclusion of households with fewer occupants than that of Wales more generally or in the BBNP. This may link with the higher percentage of interviews of older age groups.

Table 5.8. Percentage of different housing tenure in interview sample and Wales.

	Owned	Private Rented	Social Rented
Interview sample	60%	8%	32%
Wales	65%	10%	13%

Welsh data source: Stats Wales (2018d)

While the range of tenure is not exactly representative of Wales or Park data - the spread is similar with the highest levels of tenure being owned, followed by social rent then private rent.

Table 5.9. Building attachment and age, interview sample and Wales and BBNP.

	Detached	Semi-detached	Terrace	Flat	Age - Pre 1900	Age - Post 1900
Interview sample	40%	37%	14%	9%	54%	46%
Wales	28%	31%	28%	28%	63%	37%
BBNP	43%	28%	21%	0.3%	67%	33%

Welsh data source: Consumer Data Research Centre (2018) & BEIS (2015)

The interview sample consisted of 40% detached homes, this falls between BBNP and Wales (43% and 28% respectively) and is closer to the BBNP number. Interviewed semi-detached were higher than both the BBNP and Welsh average (37% to 28% and 31% respectively) while interviewed terrace sample was lower (14% to 21% and 28%). Interviews with households in Flats was 9%, higher than the BBNP (0.3%) and lower than Wales (13%).

While the percentages are not closely matched, the spread of building types between interviewed sample, Wales and BBNP is; the highest proportion being detached, then semi-detached, then terrace, with the lowest percentage of homes being flats.

The interview sample consisted of a similar spread of pre and post 1900 build homes as Wales and BBNP. It has a slightly lower percentage of pre 1900 homes, this may be affected by the higher percentage sample of socially rented homes (see table 5.9) who all lived within post 1900 buildings.

Table 5.10. Percentage building material, interview sample only.

	Solid Stone	Brick	Unconventional	Unknown
Interview sample	57%	30%	19%	16%

No comparable data is available for house building material.

Table 5.11. Percentage building material and mains gas access, interview sample, Wales and UK.

	Loft Insulation	Internal/Cavity wall Insulation	External insulation	% non-gas access
Interview sample	95%	32%	16%	54
Wales	91%	56%	N/A	32
UK	66%	69%	9%	52

UK & Welsh source: Statistics for Wales (2010); DECC (2012b); BEIS (2015)

Most of the interviewed households has loft insulation (95%) this is comparable with Wales (91%). 49% of interviewed homes had some kind of wall insulation, again, this is comparable with Wales (56%). Households interviewed without mains gas access is very similar to that of the BBNP (54% and 52% respectively).

5.7 Ethical considerations

As a social science research project, there was an obligation to ensure that research participants were protected, that risks are not created and existing vulnerabilities were not exacerbated. Therefore, ethical approval was obtained and granted from the ethics committee of the School of Planning and Geography, Cardiff University (Appendix 6). The Cardiff University Code of Practice also guided the ethics of the research along with the University's Research Ethics Guidance and following ESRC Key Principles for Research Ethics (2015).

These principles meant that participation in the research was voluntary and only conducted once informed consent was obtained, the benefits of the research were maximised where possible and any predicted harm was minimised. In the instances of joint interviews, the participants were advised on group confidentiality with regards to other participant's views and personal data. Additionally, the funding arrangements for the research was made clear to the participants, this was especially important in cases where people from the BBNPA or organisations and institutes connected to it were involved as it may have impacted upon what people were willing to share. In instances where people acted as gatekeepers to other participants, the intentions for the study were demonstrated to them and assurances were made regarding the use of data collected. This involved explaining what the study was about, how intrusive it would be to individuals, the types of questions and where the results would be shared.

As the research focus is a fairly benign topic, there were only minor issues around possible participant harm. However, risks were present, for example, when interviewees are chosen because of the organisation they are affiliated with, but their views are contentious towards their organisation or partnership organisations. In such instances, reassurance was given of anonymity or interviewees asked to be made explicit that their views were personal (i.e. not representative of the organisation). Additionally, there was

a possibility that people may find discussing issues of energy accessibility or affordability uncomfortable or embarrassing. In such instances participants were reminded to only disclose what they were comfortable with, they were also reassured of confidentiality and asked if they wanted anonymity. All interviewees were advised that if they wanted to leave the research they could do so without having to give an explanation and without ramifications towards them.

In the context of this project the most significant dimension relating to the privacy of participants involved was with regards to recording of data. Recordings and all other electronic data were stored in on the password protected personal computer with access restricted to that of the researcher. The hard data was kept in a locked drawer in a locked office. All the personal data was anonymized consistent with the Data Protection Act 1998. All care will be taken to ensure that quotations and other data is not individually attributable, and each participant was assigned a pseudonym. All primary data collection was carried out after informed consent was obtained from the individuals involved. Prior to this, each participant was sent an information sheet that described the purpose of the study, what it entailed, what will happen with data obtained and their right to withdraw from the research at any time. The information sheet contained researcher contact details and that of the project supervisors.

5.8 Thematic data analysis

An inductive thematic data analysis approach was taken, this is arguably one of the newest and yet most common data analysis approaches (Bryman 2016). This may be attributed to its similarity in process to grounded theory, whereby theory is generated from the data through a series of coding exercises. However, unlike grounded theory, thematic analysis can be used within research that adopts a theoretical framework and themes can be generated that tie in with theory as well as being able to generate new theory. Thematic analysis was chosen as it is well suited for larger data sets, the process is systematic and allows some quantitative analysis to be employed and it allows assertions to be made that are backed up by the text (data) (MacQueen & Narney 2012). The thematic analysis process adopted was based on that put forward by Yin (2014), Creswell (2013) and in part Bryman (2016). Such a process involves immersion in the data, the creation of codes that refer to relevant selections of text, the aggregation of codes into broader themes, then

the linking of such themes to generate an overall impression of the research findings. A code book was kept linking data, codes and themes through all stages of the analysis thus adding to analysis rigour and maintain an audit trail.

First the data was organised by interview group then “played with” this involved putting the data into different formats and orders and comparing different data with each other to search for “patterns, insights or concepts that seem promising” (Yin 2014, p. 135). Thus initially “within-case analysis” was carried out as interview groups were analysed separately from other groups (i.e. household interviews were analysed separately from community group interviews) (Creswell 2013, p. 101). To begin with both interview data that exemplified many others within its group and interview data that appeared to be different to those within the group were analysed. This stage allowed for immersion in the data, whereby transcripts and field notes were read and re-read and memos noting possible themes or new avenues of exploration that emerged (Creswell 2013). This initial strategy was especially important when analysing the initial interviews and documents that formed the pilot period of data collection as it acted to prompt re-focusing of the research questions prior to further data collection taking place. It proved to be an important stage in considering how groups were organised, for example, initially interviewees were placed in groups depending on their position as a householder or within an organisation (third sector, governance etc). However, after initial exploration of the data, it became clear that this grouping was not beneficial to analysis, for example, the third sector group was initially comprised of fuel poverty charities, RSLs and community energy membership groups, all of which have different organisational aims and thus, different interview focus. Therefore, interview groups were re-configured to represent the focus of the interviews: Households; Domestic Perspectives; Community Group Perspectives; Businesses (remained the same); Governance Perspectives; and Other Experts. The Third Sector interview group was removed as all interviewees fit within other groups.

The second data analysis stage involved coding and theming the all the interview data. This was carried out manually using Excel. NVivo was explored as an option for managing the data and coding, however, due to researcher unfamiliarity it proved time consuming and more difficult than Excel. Initially the data was kept within its new interview group. Text extracts from each interview were cut into smaller sections and attributed codes (Creswell 2013). The codes themselves were those that emerged from

the data and reflected their content and context, and the names were a mix of in vivo and researcher interpretation based on the data (see Table 5.12).

Table 5.12. Example of codes applied to a Community Perspective text extract.

Text Extract: *So, without the hall the life of the village would change quite a lot. I mean everybody would be much more remote and people tend to get in their cars and drive off anyway because the bus service is so shockingly bad. So, I don't know where else they would meet.*

CODE 1	CODE 2	CODE 3	CODE 4	CODE 5
Material peripherality	Community hall - essential	Community hall - social inclusion	Transport poor	Personal transport essential

Following this, the interview codes were “categorically analysed” within their groups and aggregated to themes (Stake 1995). The themes were made up of several codes that generally represented experiences or perceptions of peripherality, energy vulnerability and transition as these topics were the main discussions within the interviews. This helped order the codes for each group within similar themes, which enabled cross-group analysis to be carried out with limited confusion and retaining an audit trail from text extracts through to codes and themes so that backtracking can occur at later stages. However, while this step was helpful in retaining clarity over codes, themes and interview groups, and in a way, further emergence in the data, it was difficult as many codes that fit under the peripherality/area theme, could also fit under governance themes, likewise, discussions around energy vulnerability for example, poor infrastructure, also fit under the peripherality theme.

The main issue with this initial analysis attempt was that the codes and themes were too descriptive and were too heavily influenced by the theoretical frame. This was indicative of the need for more *thematic* themes to be developed using a heavier input of researcher interpretation, and a move away from too heavily describing or summarizing the text. Therefore, data was re-coded using the steps adopted in the first instance of coding but with a looser theoretical frame and more researcher interpretation. After this second analysis attempt codes emerged that were both descriptive and inductive which were then amalgamated into themes based on the codes themselves (as opposed to the theoretical frames). As per Table 5.13, the “themes and issues were then analysed across the embedded cases for similarities and differences” (Creswell 2013, p. 98-99) from this, the following themes emerged:

- Multi-scalar Political Peripheralization - perspectives on political representation of either themselves/social group (in the case of households or community groups) or organisation. Perspectives on other organisations, relationships between them and where interviewee may fit in this. Perspectives on political representation of their locale or the locale within an organisations' remit. Implications of non-political representation for various interviewees at various scales.
- Peripheral Economy and Income - perspectives of socio-economies (at various scales) including industry sectors, employment opportunities, incomes and living costs.
- Peripheral Infrastructure - perspectives of energy and transport infrastructures at multiple scales and the implications for households, businesses, public sector activities and energy investments.
- Peripheral Housing Stock & Tenure - implications of different building structures and tenures on daily lives experiences and efforts to reduce energy vulnerabilities and transition to lower-carbon lifestyles.

At the end of the process, despite being protracted due to rigid and descriptive codes being initially developed, each final theme represents the views and experiences of the research participants of peripherality, energy vulnerability and low-carbon transition. The consideration of each of the themes together creates a clear perspective on the wider political, economic and social contexts and processes at play in addition to the positionality and role of the interviewees within such processes and in relation to each other. Thus, overall, perspective is gained on the impacts of energy transitions on vulnerable peripheral communities within this case study context, as well as the impacts of peripherality and vulnerability on transition processes.

Table 5.13. Final themes and example codes for each interview group.

Interview Group	Themes				
	Political representation	Misrecognition	Economy and income	Infrastructure	Housing stock and tenure
Households					
Codes (example extract)	Governance - unrepresented	Governance - large population focus	Population decline - employment link	Poor infrastructure	Home - self ration
	Governance - focus on areas of industry	Decline in services	Limited employment	No public transport	Intervention - bill reduction
Domestic Perspective					
Codes (example extract)	Wales - UK political misalignment	Fuel poor - complex	LA - procurement bound to poor contractors	Oil - high cost	Insulation - only hard to reach buildings remain
	North and South divide	Area based selection	LA - grant pressure to spend	Critical mass - decider	Wales - hard to treat properties
Community Perspective					
Codes (example extract)	National park – negative	Rural communities - not wealthy	Farmers - poor	Infrastructure cost prohibitive	Village hall - poor building condition
	National park - planning hard	Regulation change needed	Cost of living – high	Energy costs - high	Village hall - running costs high
Businesses					
Codes (example extract)	National park - planning inconsistent	Third sector - negative	Transition - economic incentive	Contractors - poor	Building - solid stone walls
	National park - conservation bias	Grant regime - negative	Area - deprived	Oil - cheaper	Building - energy inefficient
Governance Perspective					
Codes (example extract)	NP - WG has high influence	Transport - perceived as personal issue	Economic viability a concern	Public transport poor	Buildings - old housing stock
	Inter-governance partnership working	Energy vulnerable – hard to reach	Grant funding – lever	Off-gas – high levels	Building - solid stone walls
Experts					
Codes (example extract)	WG & UK – misaligned politics	Presumed consent - needed	Money leaving Wales	Decentralisation - positive	Buildings – inefficient
	WG - poor track record RE	Small scale - discriminated	Cost prohibitive	Poor infrastructure	Buildings – old housing stock

5.9 Evaluating the research: A critique of qualitative inquiry

There are of course drawbacks to a qualitative approach. First, qualitative research can be regarded as too subjective, whereby the results and conclusions made about the data are interpretations of the researcher and are sometimes reached in open ended and illogical ways. This impacts upon two other critiques of qualitative enquiry which is that it is difficult to replicate and that the positionality of the researcher within the context of the research itself will influence the areas they feel are important and therefore the direction of the research. Finally, it can be difficult to generalise from a qualitative research enquiry. This is because the research is so context specific and detailed, also sample sizes are usually small and purposefully selected. However, Bryman (2016) argues that this is why qualitative findings are more useful for generalising to theory instead of populations. Additionally, “moderatum generalisations” can be made between similar groups of people within similar contexts (Williams 2000, p. 215).

This research, while taking a qualitative approach and the five preoccupations also takes on board its critique and approached the data collection process in a way that made the most of qualitative enquiry while attempting to minimise some of the negative impacts. Much of this was done by evaluating the research as it progresses in line with how “trustworthy and authentic” it was (Bryman 2016, p. 384). This approach to research evaluation is specific to qualitative research and although different to more quantitative approaches concerned with “reliability and validity” they are also parallel. For example, to ensure the research is trustworthy it has to be credible, transferable, dependable and confirmable, these are directly parallel with more traditional concepts of internal validity, external validity, reliability and objectivity. Additionally, attempts were made to reduce researcher bias and retain a balance of power between the participants and the researcher.

When gathering data from the social world there are multiple influences on what that data will be, or what people choose to impart. For example, participants can exaggerate stories or simply lie. Within different data collection contexts such as group interviews, people may be reluctant to say certain things or may feel social pressure to say things they don't really want to. Also, within documents, especially from un-validated sources such as social media, or even within official state documents, data will be positioned and imparted in different ways, sometimes making opposing claims. In order to give the data collected within the research ‘credibility’ a number of measures can be taken. Data should be

collected following principles of good practice (as outlined in ethical approval) whereby coercion, bribery and bias are avoided. Respondent validation can be sought, whereby data collected and analysed is then shown to the participants or new participants to authenticate that the inferences made by the researcher are true to them. Finally, a triangulation technique can be adopted whereby similar data is sought from multiple sources. This allows for “converging lines of inquiry” (Yin 2014, p. 120) to be compared with each other to check that similar perspectives are being given. Within this research all three credibility, or internal validity checks were adopted throughout the research process.

As the aim of case study research, along with most other qualitative research is to gain in-depth understanding of a particular individual, group, community or organisation, the findings are often “orientated towards contextual uniqueness” (Bryman 2016, p. 384). This means that transferability of results in comparison of other studies or wider generalisations can be more difficult. However, by detailing a thick description that holds rich accounts of the context judgements can be more easily made as to whether the research can be transferred.

This research has adopted the four principles of data collection as proposed by Yin (2014); use multiple sources of data, create a case study database, maintain a chain of evidence and exercising care over electronic data sources. This provides evidence and reassurance that dependability or reliability has been achieved and the results are reliable (Yin 2014). This is similar to what Bryman (2016, p. 384) describes as an “audit trail”. Therefore, this research maintained a case study data base, which was a separate collection of all the data collected for the duration of the research project. The database included all document evidence collected from the field, such as field notes, relevant documents, tabular material and narratives (Yin 2014).

As the data was both electronic (emailed documents, documents from web searches) and hard copy (field notes, memos or documents handed to the researcher from data sources), the database was made up of both electronically stored data and data kept in secure hard-file storage. All the data was organised by theme and then date making it easily accessible for data analysis and also for external verification. Compiling a case study database also assisted with the maintenance of a chain of evidence or audit trail, which is an easily followed trail of data, documents and notes leading from the research questions, to interview protocols, to the final analysis and conclusions. As such, adaptations to the lines

of enquiry and development of the data collection process and where evidence was sought from is easily explained and justified.

Finally, taking care with data sources involved two processes. First was setting boundaries for data searches so that the data collected was always relevant and not unnecessarily unwieldy. This included considering the actual places or websites that were being accessed and how much time was spent cross-checking the information's validity. Second, was remaining aware of possible bias in data collected from social media sources, such as Facebook and Twitter, as these are often considered informal settings, the same attention to authenticity and accuracy in the claims made on them is considerably less than those on professional organisation or state websites. Therefore, some caution was taken when utilising such data sources.

Qualitative approaches acknowledge there will always be some subjectivity in the research process and that just by being involved in the research, a researcher will bring at some level, their own values and assumptions. For example, an interpretivist worldview, as was taken with this research, assumes that all "knowledge depends on who its makers are" (Rose 1997, p. 307) and that knowledge and realities are only ever partial and mutually created between researcher and participants. Thus, as positionality can act to influence the knowledge gained, such knowledge has to be situated, meaning, researcher and participant positionality had to be a consideration for the whole research process, but most notably during data collection and interpretation stages. Conformability is concerned with ensuring that the researcher does not allow personal values, political views or theoretical inclinations to unduly or overtly affect the direction of the research. This concern is taken up by others as researcher positionality and is debated as to whether it is possible for social researchers to assume a completely objective position when carrying out research.

Therefore, while it is a somewhat impossible to know fully how researcher positionality would play out at any given encounter or even perhaps after or how objective a researcher can be, attempts were made to address these issues. First, researcher positionality is acknowledged: affiliated institutions (Cardiff University), gender, age, welsh nationality and distinct south-west Wales valleys accent. All these characteristics bore some influence on access to information, and interviewee and gate holder perceptions of the researcher, whether they felt empowered or disempowered during research encounters. Again, how these characteristics were viewed, whether positively or negatively would

have differed between individual people. Additionally, researcher background - of growing up in a post-industrial village in rural Wales, researcher social norms and culture - could have acted to influence assumptions of what energy justice should mean and what vulnerability may look like. Indeed, conscious effort was made to in some ways ignore these assumptions, to be as objective as possible and instead listen to the data.

In order to remain aware of personal assumptions and beliefs a reflexivity strategy was adopted which involved being reflective after data collection exercises by keeping a research diary and also through taking memos during transcription. Power distribution between participants and researcher were probably somewhat mitigated once the participant heard my accent, however, other steps were also taken to ensure that participants felt empowered. This included giving them power to turn off the audio recorder during interviews and leave the research process completely, without repercussions or explanation, should they so wish.

5.10 Conclusion

This research is aiming to understand the impacts of energy transitions on vulnerable peripheral communities, with the understanding that peripheralization, energy vulnerability and energy transition are all socially produced processes. As such, their existence is dependent upon social, economic and political structures and their impacts are likely to vary depending on the formation of such structures at a particular space and time, and the position of the affected individual, community, organisation, business or region within such structures and relative to each other. Therefore, to understand the impacts of the processes on one another and to communities within the structures and partaking in some form of the processes, the processes must be understood and the experiences of the 'impacted' communities must be illuminated.

In order to accomplish this a qualitative approach was adopted as this incorporates a broad view of social, political and economic contexts at any scale along with more narrow and defined personal experiences of set phenomena and processes within such contexts (which are all at once the wider landscapes individuals live in and their personal perspective on such landscapes, and their own and other positions within it). A case study methodology fit within the same remit and allowed for diverse and multi-scale

experiences to be uncovered, bound within a set space and time. Encompassing the three main theoretical concerns of the research: peripherality, vulnerability and transition, the case study location was selected to represent instances and deviances of these. Therefore, the case study was selected as the area in and around the BBNP in mid-south Wales. Here preliminary investigation evidenced that it could be considered a periphery in many aspects, that its peripherality coupled with poor energy infrastructures indicated energy vulnerabilities and Local Authority renewable energy rankings, take up of FIT and RHI along with knowledge that all energy consumers are subsidising transition indicated transition was occurring in different ways. Incorporating a national park within the case boundary also allowed for exploratory investigation into other spatialization processes and governance mechanisms on peripherality, vulnerability and transition.

After completion of a pilot study, data collection in the form of interviews, focus groups, observation and secondary data analysis took place between 2016 and 2017. The methods chosen fit well within the theoretical framework, research questions and overall qualitative approach. The multi-method approach also increased the rigor of data collection as it allowed data triangulation to occur, increasing credibility. Interviewees were recruited via purposeful maximum sampling with purposeful, snowball and contingent methods adopted that allowed instances of interviewees that fit well within research assumptions and those that deviated from them, allowing multiple perspectives on the same processes to be gained. Recruitment in a large part depended on participant recommendations, however, effort was made to gain a wider sample of participants, using direct emails, posters, RSL newsletter and using social media such as Linked in and a Facebook page.

Interview data was transcribed and then thematically analysed. While the analytical process was protracted due to rigid and descriptive codes being initially developed and starting out on NVivo before moving to Excel, at the end each theme represents the views and experiences of the research participants of peripherality, energy vulnerability and low-carbon transition. The consideration of each of the themes together creates a clear perspective on the wider political, economic and social contexts and processes at play in addition to the positionality and role of the interviewees within such processes and in relation to each other. Thus, overall, perspective is gained on the impacts of energy transitions on vulnerable peripheral communities within this case study context, as well as the impacts of peripherality and vulnerability on transition processes.

Chapter 6. Peripheral energy and spatial injustice: Representation, recognition, energy vulnerabilities and transition

6.1 Introduction

Political representation is a key element of a democratic political system, allowing the perspectives and opinions of constituent populations to be advocated during decision making processes that affect their lives. This safeguards to a certain degree that such constituents are not penalised or disenfranchised by decisions taken. However, for this to work effectively, political systems must recognise advocates, whether individuals or in this instance devolved governance authorities. In addition, advocates must recognise constituent needs. This research demonstrates that this is not always the case. Interviewees perceived their political representation to be peripherally regarded by core UK Government, resulting in fragmented devolution of powers and decisions taken that do not represent their best interests. This was evident in core-periphery relationship perceived between the UK and Welsh Government, regionally within Wales between rural and urban areas and then within the Brecon Beacons National Park (BBNP or the Park), between Park core purposes and Park communities. At sub-regional and regional scales, allocation of public spending and its strategic application, combine with and worsen declining public services to add to agglomeration effects, making visible to communities their relative peripheralization.

The context of this research, in and around the BBNP, adds another dimension to experiences of political peripheralization. Here, an additional layer of spatialization and the values it upholds via alternative governance, create altered, but nonetheless still present, political peripheralization. Such political peripheralization interplays with experiences of marginalization. Both of which are experienced in part due to governance institutions' priorities of environmental protection and tourism. This is felt by some to be to the detriment of community needs. Energy vulnerability and low-carbon transition within this space are also altered, whereby the type and scale of low-carbon interventions, both energy conservation and energy production, are customised within the Park boundary.

This chapter explores perceptions of political peripheralization informed by interviews. It starts by setting energy policy context, providing a foundation to explore political peripheralization, first in the core-periphery relationship perceived between the UK Government and Welsh Government, sub-nationally within Wales between peripheries and urban centres and then within the BBNP, between the Park purposes and Park communities. Building upon this, misrecognition of rural peripheries due to area-based measurement tools tailored towards measuring urban deprivation, result in mis-aligned public spending with need, this is to the detriment of those places.

These various experiences of political peripheralization have impacts on peripheral energy vulnerabilities and energy transition. Energy vulnerabilities can be recognised but are often politically ignored due to assumptions of population wealth and therefore ability to counteract vulnerabilities independently. Energy transition cost and benefits at multiple scales are unevenly distributed with peripheries unable to benefit from larger scale transition, but still bearing the costs of hosting developments. Additionally, peripheries can be discounted for assistance with domestic scale transition interventions, with the result that only individual households with financial means are able to transition. This situation is altered in the BBNP where environmental and conservation planning protections shield communities from the cost of large-scale energy development, however, the same protections can inhibit some smaller scale energy transitions. As energy transition holds opportunity for peripheries, both within and outside of the BBNP to counteract aspects of peripherality and some energy vulnerabilities, any barriers preventing transition occurring are detriment to this.

6.2 National political peripheralization

As highlighted in *Chapter 3*, the fragmented devolution of policy areas linked to Wales's potential economic development and continued peripheralization has been a source of continuing tensions between the UK and Welsh governments. However, policy devolution to Wales has gradually increased, most notably with the *Wales Act (2017)* (active from April 2019). Within the Act, Wales's energy policy remit was extended to include the licencing and granting of consent for onshore oil and gas projects; all onshore wind projects; renewable energy projects under 350 MW that are developed in the Wales inshore and offshore regions; and the promotion of energy efficiency. However, despite

enjoying greater power over its energy policy, limitations remain. As one interviewee pointed out, even with enhanced powers, there are limits to what the Welsh Government can approve and how much it can afford to fund itself without UK Government assistance:

We didn't have much control at all, but with the new Act now its 350MW and below we will have some control over, but above that will still go to the UK government so they can decide things. We can put our thoughts forward, but in the end, they decide. So again, it's a bit restrictive. So, in a lot of things that people want to do, we will not do it unless UK government helps (Welsh Government interview 3).

This is reflected in the reliance on economic incentives for renewable energy production in Wales being governed by UK government. For example, the Feed-in-Tariff (FIT) and Renewable Heat Incentive (RHI) are UK-wide renewable energy subsidies aimed at encouraging the development of low-carbon energy production. The subsidies make payments to renewable energy producers (domestic, public or commercial) for energy exported to the National Grid (FIT only) in addition to payments for energy produced even if consumed by the producer (FIT and RHI)²⁶. Since 2015 the UK Government has substantially reduced FIT due to unexpected high level of take-up. Critique of this decision in the media and by low-carbon advocates and link to the recent decline in new renewable energy production developments in the UK (see Figure 6.1) was reflected by interviewees:

Feed-in-tariffs were designed to produce stability and certainness in the market, and they never did, they just changed and changed and changed, cut, cut, cut, so actually the one thing they were supposed to produce, which was certainty in long-term decision making, didn't happen (Expert interview 8).

²⁶ See Chapter 3, page 47 for more detailed explanation of FIT and RHI

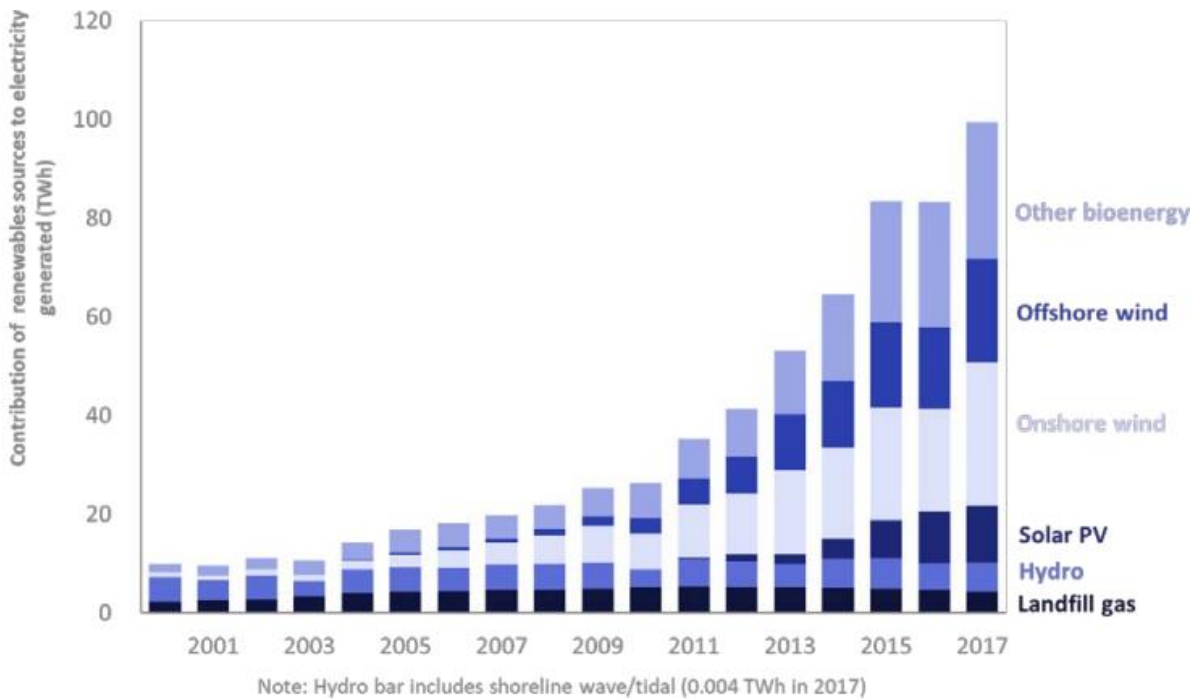


Figure 6.1. Renewable electricity production in the UK (2000-2017)²⁷
 Source: DUKES (2018, p.160)

Eighteen months ago George Osborne, Amber Rudd cut the subsidies to the renewable sector, which has devastated that sector in Wales, well in the UK. Which means there's far more risk[...]. Without that subsidy now, a lot of them are just no longer viable. A lot of would have been pumping money by now out of the rivers and off the hills into those communities, they just haven't happened. And what's happened as well alongside that is the zillions of small jobs, across Wales, like PV installers, they've just been hit. I think the figure is something like 18,000 jobs have gone across the UK, local electricians and builders and installation companies as a result (Business interview 2).

However, Wales retains a focus on renewable low-carbon energy and views transition as a means of diversifying and growing its economy. There is the ambition “to create a sustainable, low-carbon economy for Wales” and to be a world leader in low-carbon renewable energy production (Welsh Government 2017c). These misaligned priorities between the UK and Wales can cause further friction in energy policy. Welsh ambitions for the Swansea Bay Tidal Lagoon (SBTL) in contrast with UK ambition for Wylfa Newydd nuclear development²⁸, may be such examples of this. While this represents a conflict between the UK and Welsh Governments, others relate to it at a sub-regional

²⁷ Note the increase in onshore wind in 2017, this spike has largely been attributed to a ‘rush’ to complete renewable energy developments before the FIT decrease in 2015.

²⁸ See Chapter 4 for further discussion of Swansea Bay Tidal Lagoon and Wylfa Newydd

scale, where other more controversial renewable energy projects are proposed in peripheries within Wales by the Welsh Government:

I think the Welsh Government has certainly got much more of a green growth agenda than Westminster, I think Westminster has got an appalling record over the past five years and I can only see it getting worse. I think the big issue is the fact that Westminster still controls major energy projects, so things like the Tidal Lagoon being in the hands of Westminster, I can't really see any justification for that now, I think there's a big issue there (Expert interview 1).

[The Tidal Lagoon is] such an obvious winner, both from the point of development of industry and being at the forefront of technology and from the energy point of view. I just can't understand why we can't get a go-ahead on things like that, instead we have a suggestion that Powys has got to have these wind turbines (Community group interview 6).

While there is acknowledgement that Wales can only do so much with limited powers, there was a level of disappointment felt that Wales missed opportunities when they arose. This was raised mainly in expert interviews discussing renewable energy production, where planning processes had until recently created a barrier for larger scale developments (for example 1 Megawatt (MW) and above), and that Welsh institutions had not embraced the FIT while it was still available. As per *Section 3.2*, aside from Northern Ireland, Wales has the lowest number of renewable energy sites, installed capacity and production (Department for Business, Energy and Industrial Strategy [BEIS] 2018e). This was attributed by interviewees to a lack of ambition, foresight and leadership in addition to risk aversion:

We're the worst statistically, we're the worst of the four home-nations of the UK on per-capita basis and that's given the fact that we have a very good resource. We should be second behind Scotland because their resource is better. A lot of the reason for that is legacy, we [had] a crap planning system, that was a problem dealt with in the Planning Act... so the planning side in Wales is now more streamlined and has a clearer purpose, and that happened at exactly the same time as all the subsidies vanished. So, you've got a position

where it's easier to develop projects in Wales than any other part of the UK, but there's no money there (Expert interview 6).

They didn't see the opportunity when the FIT was there. Scotland saw the opportunity, that's why they're way ahead. They knew they could get loads of money in investment into Scotland. Wales for whatever reason is far behind and just didn't see that vision to take that opportunity, and I think they still don't see that opportunity. That actually, if a significant portion was locally owned it could have a significant impact on local economies in Wales. They just don't see it (Expert interview 3).

Risk aversion was attributed by one expert interviewee as “branch office mentality”, where the Welsh Government are perceived to lack confidence due to Wales’s centuries of being politically dominated from England:

[Welsh Government have] not got that flexibility, it's all a bit risk adverse. It's all still a bit of a problem, although things have changed a bit. Maybe that's the way in Wales as well – post-colonialism takes a while to shake off, doesn't it? (Expert interview 9).

Overall, energy ambition in Wales is at odds with UK-national scale plans. At the time of this research, contemporary examples provided by interviewees were of Welsh plans for SBTL and the perceived purposeful delay in decision making by UK Government, finally ending in disapproval. However, Wales’s subsidiary energy policy position is evident also in its reliance on UK level low-carbon subsidies. Additionally, Wales’s energy market and network are regulated and managed by UK-wide organisations, Ofgem and National Grid, this national-centric governance also poses issues for peripheries. For example, as will be discussed in further detail in *Section 7.4* rural areas of Wales have sparser mains energy networks than urban and pay more for mains electricity.

Frustration of low-carbon energy ambition was also noted to occur due to Welsh Government itself, whereby fast and widespread uptake of FIT was not carried out. Nor was it enabled via Welsh Government leadership or changes to planning policy for other actors in Wales to take advantage of. This slow response and perceived lack of initiative

by Welsh Government was attributed to risk aversion that prevented action being taken in Wales before UK Government initiation.

6.3 Regional and sub-regional political peripheralization

Political peripheralization was also discussed at regional and sub-regional scale. Being physically distal from the Welsh Government in Cardiff, or even from intra-regional governance offices was considered a significant contributor to being politically unrepresented. As such, political peripheralization was expressed at multiple levels, by 17 household, 5 business and 2 Local Authority interviewees (out of 34, 7 and 5 interviews respectively). At sub-regional and community scales, it was experienced due to limited understanding of the constraints of peripheral geographies, population disbursement or housing characteristics:

I had to laugh, I went to seminar in Cardiff and there were two guys there from DECC and I don't think they'd ever been anywhere near Wales. They stood there and said that there were no solid wall properties in Wales. We looked at each other and said, 'okay well you've not been to Ponty then have you? Been to Rhiwfawr?' So that was a farce (Local Authority interview 2).

Additionally, it appeared to some that Welsh Government focused policy and public spend on urban areas to the detriment of other non-urban areas (See Table 6.1 and Figure 6.2 for breakdown of rural and urban Local Authorities in Wales):

We do feel that, the further North you go, the more you're forgotten about in Cardiff [...] Because there's no investment around here, none at all. It's very poor, very poor. But we're very good for cuts, if there's going to be cuts then we'll get the cuts (Mark, social tenant, aged 45-64).

[The Welsh Government] concentrate on places where they've got industry and towns and they forget about the backwaters they do [...] So they want to wake up and see the nitty gritty (Megan, social tenant, aged 65-74).

It is easy to see why interviewees working or living within the periphery feel that national resources in the form of public spend are unevenly allocated. Such uneven allocation is made visible by the decline of public services. Of the household interviewees, 72% and 81% outside and within the Park (respectively) felt that the public services within their area were declining and limited. Services deprivation leads to an increased need to travel to access such services, increasing households' dependence on personal transport and possibly leading to "car-related economic stress" (Mattioli et al. 2017, p. 95). Services deprivation is a recognised issue in rural areas of Wales where there has been a continuous decline in "shops, post offices, leisure centres, police stations and health services" (Public Policy Institute for Wales 2016, p. 17).

The post office went, then the shops then the school and finally the pub. By 1996 all facilities had gone except for the hall (Community group interview 2).

The school is closed, we haven't got a village shop, our chapel's been sold off and has been made into a house and we get a post van up here twice a week, on a Monday and a Thursday for an hour a day. The man that's running it now has offered to bring if we need anything [...] which is making us feel not easy about it but more of an outcast really (Megan, social tenant, aged 75+).

Some communities have no local access to private or public services at all. Access to services deprivation is a recognised form of social exclusion and measured as a domain of the Welsh Index of Multiple Deprivation (WIMD) (Welsh Government 2015b). Despite its importance and impact on rural life, the *Access to Services* domain, which accounts for public and private travel times to grocery shops, GP surgeries, schools, post offices, libraries, pharmacies, leisure centres and petrol stations is only weighted 10%. As per Table 6.1, and Figures 6.2 and 6.3, rural areas in Wales experience the highest levels of access to services deprivation. In considering the data at Lower Super Output Area (LSOA) - which is based on postcodes and population size, containing an average of 1,500 people per area - of the 47 LSOA's within the Park boundary, 22 are the top 10-20% most deprived areas for access to services in Wales (Welsh Government 2015b).

Table 6.1. Breakdown of urban and rural Local Authorities in Wales.

	Context	Settlement type	Number of areas (LSOAs)	% population
Urban	Sparse	<=10000 people	37	2
	Less Sparse	>10000 people	1201	62.9
Rural	Sparse	Town & fringe	72	3.7
		Village & dispersed	167	9
	Less Sparse	Town & fringe	265	14.1
		Village & dispersed	154	8.3

Source: Wales Centre for Health (2007, p. 5) and Consumer Data Research Centre (2016)

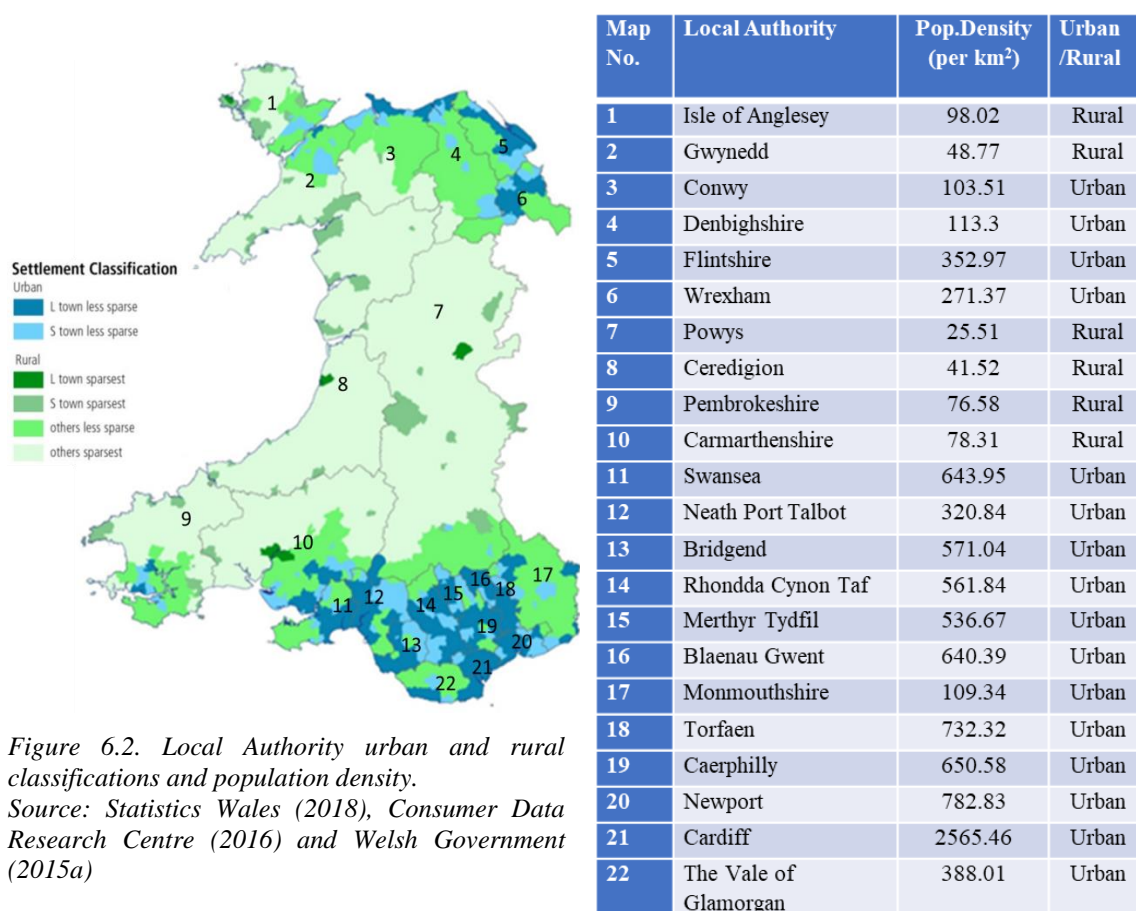
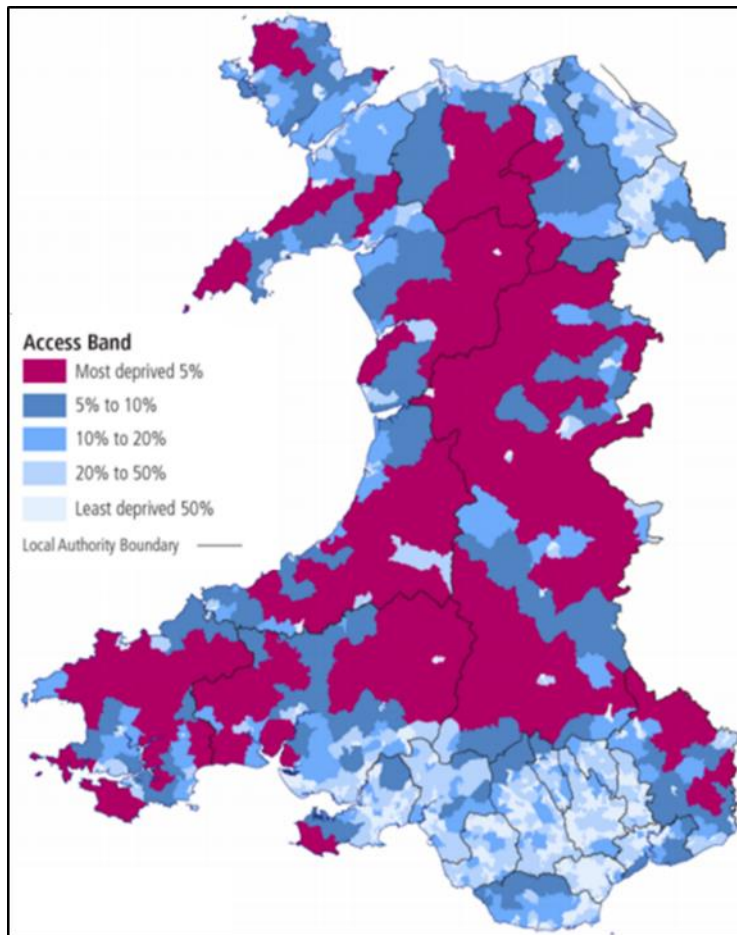


Figure 6.2. Local Authority urban and rural classifications and population density.

Source: Statistics Wales (2018), Consumer Data Research Centre (2016) and Welsh Government (2015a)



*Figure 6.3. Access to service deprivation in Wales.
Source: Welsh Government (2015c)*

Public spending on local services in Wales is largely carried out by Local Authorities, for example, many are responsible for social housing stock, social services and public facilities such as libraries, community centres and leisure centres. Such funding is distributed by the Welsh Government from a sum of money consisting of the Block Grant (as per *Section 4.3*) from the UK Government (and Welsh Tax revenues as of April 2019) via the Revenue Support Grant (RSG). The RSG accounts for 80% of Local Authority funding. The actual amount each of the 22 Local Authorities receives annually is determined by a needs-based formula that considers several factors that would possibly mean urban Local Authorities receive more than rural. Such factors include population (size, age, health), settlement size, number of benefit claimants, number of homelessness, urban road lengths, street lighting and number of businesses. However, the formula also considers the dispersal of settlement, which is meant to make allowance for increased costs and staff time associated with servicing widely dispersed settlements most common in rural Local Authorities.

It is understandable that rural Local Authorities may not appreciate this allowance as their settlement is nearly always lower than those of urban Local Authorities (Stats Wales 2018e; Stats Wales 2018f). In 2018/17 all Local Authorities except Cardiff experienced cuts to their settlement, with rural Local Authorities experiencing highest cut levels (BBC 2017). This year (2019/20) the provisional settlement follows the same pattern with urban Local Authorities of Cardiff, Neath Port Talbot, Merthyr Tydfil, Newport and Rhondda Cynon Taf receiving increased settlements while all others except Swansea (urban with unchanged settlement) are reduced (BBC 2018c). Additionally, even though allowances are made for settlement dispersal this doesn't necessarily translate into staff numbers, for example Powys, (the Local Authority with largest area and population within the Park boundary²⁹) is also the largest Local Authority in Wales, but employs the lowest percentage of staff (18%) (see Table 6.2).

Local Authority interviewees acknowledged the decline of services in their areas and their particular service needs, for example, in housing and energy for their populations. However, interviewees felt constrained by the limited numbers of staff compared to the geographic area they had to cover. Additionally, it was noted that procurement processes also did not reflect the context of geographically dispersed locations. Examples were given where non-local contractors are selected via a bidding process for contracts to upgrade housing or install energy measures. However, a lack of knowledge of place-specific geographies led to some contractors underestimating travel times between jobs. This led to rushed work so that contractors could make all appointments within their set time, resulting in work being incomplete or completed below standard. The Local Authority is then left with the cost of repair, while affected households are left with poor living conditions until such remedial work is completed.

²⁹ See Chapter 5, Table 5.1 and Figure 5.1 for breakdown of Local Authorities and populations within BBNP boundary.

Table 6.2. Local Authority staff size and area covered.

	Total in employment	Persons employed in the public sector	Persons employed in the public sector (%)	Area Size KM2	Rural/Urban
Powys	64600	11600	18.1	5180	Rural
Flintshire	74800	14300	19.4	438	Urban
Monmouthshire	43800	9700	22.3	850	Urban
Wrexham	69300	16500	23.8	498	Urban
Pembrokeshire	55300	13600	24.8	1590	Rural
Bridgend	63900	15700	24.8	246	Urban
Neath Port Talbot	59300	14900	25.6	442	Urban
Conwy	51400	13400	26.2	1130	Urban
Newport	70800	18400	26.2	190	Urban
Blaenau Gwent	30800	8000	26.4	109	Urban
Vale of Glamorgan	61800	16100	26.4	335	Urban
Torfaen	42800	11200	26.5	126	Urban
Rhondda Cynon Taf	106800	28900	27.3	424	Urban
Merthyr Tydfil	27600	7300	27.4	111	Urban
Caerphilly	78900	21500	27.4	278	Urban
Gwynedd	57100	15800	27.9	2535	Rural
Cardiff	176400	50100	28.5	140	Urban
Carmarthenshire	83800	23900	28.7	2370	Rural
Denbighshire	42600	12300	28.9	844	Urban
Ceredigion	33400	9800	29.4	1795	Rural
Isle of Anglesey	32400	9600	29.8	714	Rural
Swansea	107600	37100	34.6	378	Urban
Wales	1435100	379900	26.7	20723	

Source: Consumer Data Research Centre (2016) and Stats Wales (2018a; 2018b)

Sub-par work involving the installation of cavity wall insulation and Air-Source Heat Pumps (ASHP) was noted by Local Authority and social tenant interviewees, holding implications for energy vulnerability. Indeed, issues of incorrectly installed insulation have been a parliamentary concern for several years, debated in the House of Commons (c.f. House of Commons Hansard 2017) and having a support group created to assist those affected (c.f. Cavity Insulation Victims Alliance 2019). The non-recognition of rural area requirements was also noted by other interviews, for example third sector and expert interviews.

Look at the logistics of it, I lived in Powys for thirty years, it shouldn't be one county, and everybody that works in the Local Authority there says 'you can't do Powys in one go'. So, whenever they have a council event they have to do

north and south... and they get less funding. So, the biggest county in Wales gets the least funding. So they get toilets closing, libraries closing, leisure centres in trust now, the estate is shrinking, for Powys, really more than anywhere, the geography is a big thing (Expert interview 2).

Other interviewees noted pressures to demonstrate efficiency and strategy in the direction of their work efforts and spending. This is becoming more pronounced as all public funding becomes scarcer. Continuing UK-wide austerity measures in place since 2010 has meant that all Block Grants have been reduced (Gray & Barford 2018). Thus, interviewees noted that when implementing work, for example, in upgrading housing insulation or energy services, it is in the organisations' best interest to ensure that the most people are reached for the least amount of funding. This 'strategic' application means most often it is areas considered the most deprived, or with the greatest amount of deprived homes that are targeted for assistance:

I suppose I think we're afraid of failure. [...] So yeah, I would always try to hit an area where it looks as if we're likely to get a good return if possible. However, it's not as easy as that when you're working for an authority which has to be seen to be fair and above board [...] We've done a lot of work in Llanelli and we're doing more work in Llanelli but the council from Carmarthen comes on the phone and say, 'when are you going to do Carmarthen?' But it is unfortunate to a certain degree that the LSOA areas that we've been looking at, the highest scoring tend to be in Llanelli (Local Authority interview 2).

The comment above raises a further issue with regards to public spending in rural areas. In order to make 'strategic' decisions regarding where to implement public spend or particular projects, the public sector is increasingly reliant on area-based economic indices such as the WIMD in addition to population levels. However, WIMD is not fool-proof and contains some inbuilt bias towards understanding deprivation from urban perspectives (Fecht et al. 2018). For example, the index is made up of 8 domains; *Income, Employment; Health, Education, Access to Services, Community Safety, Physical Environment and Housing*, each is weighted according to their perceived impact on deprivation. Income and Employment are the highest weighted domains at 23.5% each. As per Figure 6.4, using these two domains, rural areas are the least economically deprived in Wales.

However, this is misleading as urban and rural deprivation are geographically different with rural deprivation being dispersed much wider than that of urban areas where deprivation tends to be clustered. Due to smaller levels of deprivation that register within area measurements of rural areas, they can be hidden in the overall count (Statistics for Wales 2015a; Gillard et al. 2016). Additionally (as will be explored further in *Chapter 7*) employment and income deprivation is based on benefit claims, in rural areas populations are known to under-claim for welfare benefits. Finally, while rural area statistics can appear to show high levels of employment, thus low employment deprivation, it does not indicate the quality of such employment, i.e. how many hours are worked, how secure or regular the employment is and what the wage-level is, all of which are likely to be poor in rural places.

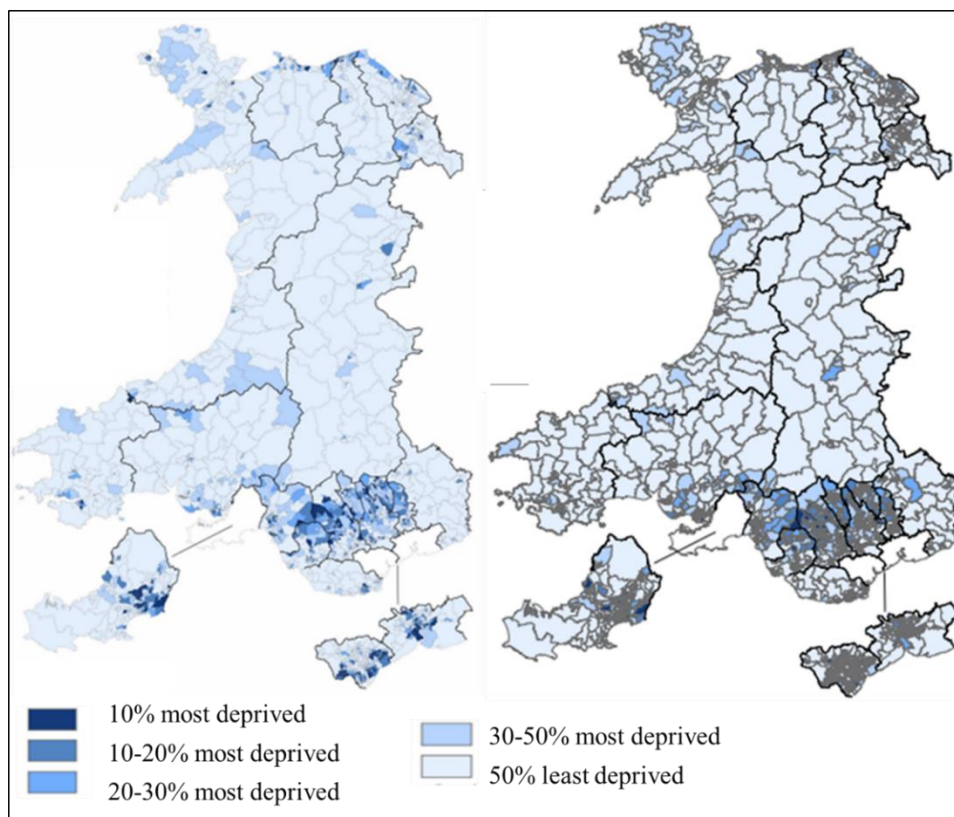


Figure 6.4. Income deprivation (left image) and employment deprivation (right image) in Wales.
 Source: Welsh Government (2014)

For many public sector interviewees, despite recognising that there are people living within least deprived areas, but are living in deprivation and require assistance, the need to gain maximum benefit from public spend and use of WIMD which characterises rural places as homogeneously less deprived limits their activities there. Thus, this has real impacts for rural populations and all public services (c.f. Fecht et al. 2018). Subsequently,

this application of public spend adds to agglomeration effects, further centralising public assets and services and “hollowing out” peripheral areas (Marsden 2018, p. 2).

The application of the Welsh Government Arbed scheme is an example of how rural areas are overlooked for public spend if area-based indexes are adopted. Arbed is area-based and assists Registered Social Landlords³⁰ in providing energy efficiency measures, including in some cases, installation of renewable energy to social tenants. The scheme started in 2009 and has impacted over 12,000 households in its first two phases (Eco Energy Centre Wales 2012; Ricardo Energy and Environment 2017). Being area-based, the scheme aimed at highly deprived areas, thus homes in non-deprived areas are often overlooked. As Figure 6.5 demonstrates even though there have been some Arbed interventions in rural Local Authority areas (Isle of Anglesey, Gwynedd, Ceredigion and Carmarthen) the majority has been actioned in deprived urban Local Authorities. Powys and Pembrokeshire, two rural Local Authority areas have received no assistance, likewise no households in the BBNP have been targeted. This urban-centric application of fuel poverty/low-carbon interventions is reflected at a UK scale via the Energy Company Obligation (ECO) criticised for focusing on easy-win urban areas over harder to treat rural homes³¹.

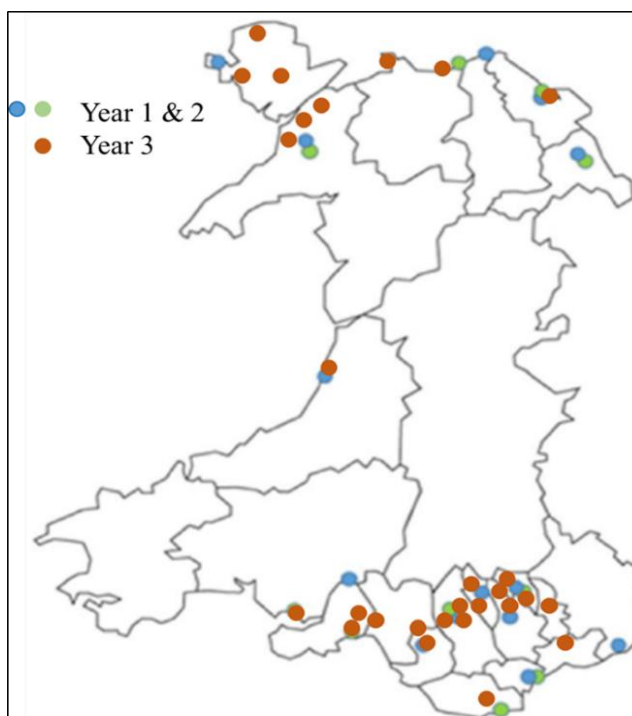


Figure 6.5. Areas in receipt of Arbed Years 1, 2 and 3.
Source: Welsh Government (email)

³⁰ Registered Social Landlords include Local Authorities with housing stock and Housing Associations.

³¹ See Section 2.2

In addition to Arbed, the Welsh Government has funded Nest since 2011. This scheme is aimed at improving energy efficiency and offering advice to owned homes and privately rented households that are extremely energy inefficient, where one resident is in receipt of a means-tested benefit. This scheme has aided over 61,000 households (Welsh Government 2015a). While households can access the service via telephone, there is also a small team of Nest Advisers who visit areas in Wales to promote the scheme, the large geographic areas they cover means that they focus their activities to places where it seems assistance will benefit the most households. This leads to visits being focused again by deprivation levels, therefore, targeting similar areas to Arbed and possibly missing deprived households in apparently less deprived areas. Research by Walker et al. (2014) found similar issues with geographically based fuel poverty schemes, they estimate that such schemes can miss between 40-60% of households who need assistance. Both Arbed and Nest schemes offer perhaps the only means for low-income, benefit recipient, and in the case of Arbed - socially rented homes - to reduce energy vulnerabilities and participate in low-carbon transition. However, it should be noted that the aims of such schemes are to mitigate fuel poverty, thus, transition outcomes are not guaranteed, for example, in some non-gas areas oil-based central heating systems are still installed as oppose to low-carbon alternatives.

Political inattention felt by some in peripheral locations contrasts with attention given to the same areas for renewable energy projects. The Welsh Government's *Technical Advice Note 8: Renewable Energy* (2005) which identifies seven Strategic Search Areas (SSAs) for renewable energy production. SSA's have been critiqued for encouraging large-scale developments to locations, politically convenient, but that disenfranchise local population. As Figure 6.6 demonstrates many large scale (over 1 MW capacity) renewable energy projects are indeed within rural areas and some are close to area-based deprivation. However, the positioning of such developments, aside from wind turbines, more strongly correlates with grid access points³².

³² See Chapter 7, Figure 7.10 for Welsh mains electricity grid access points

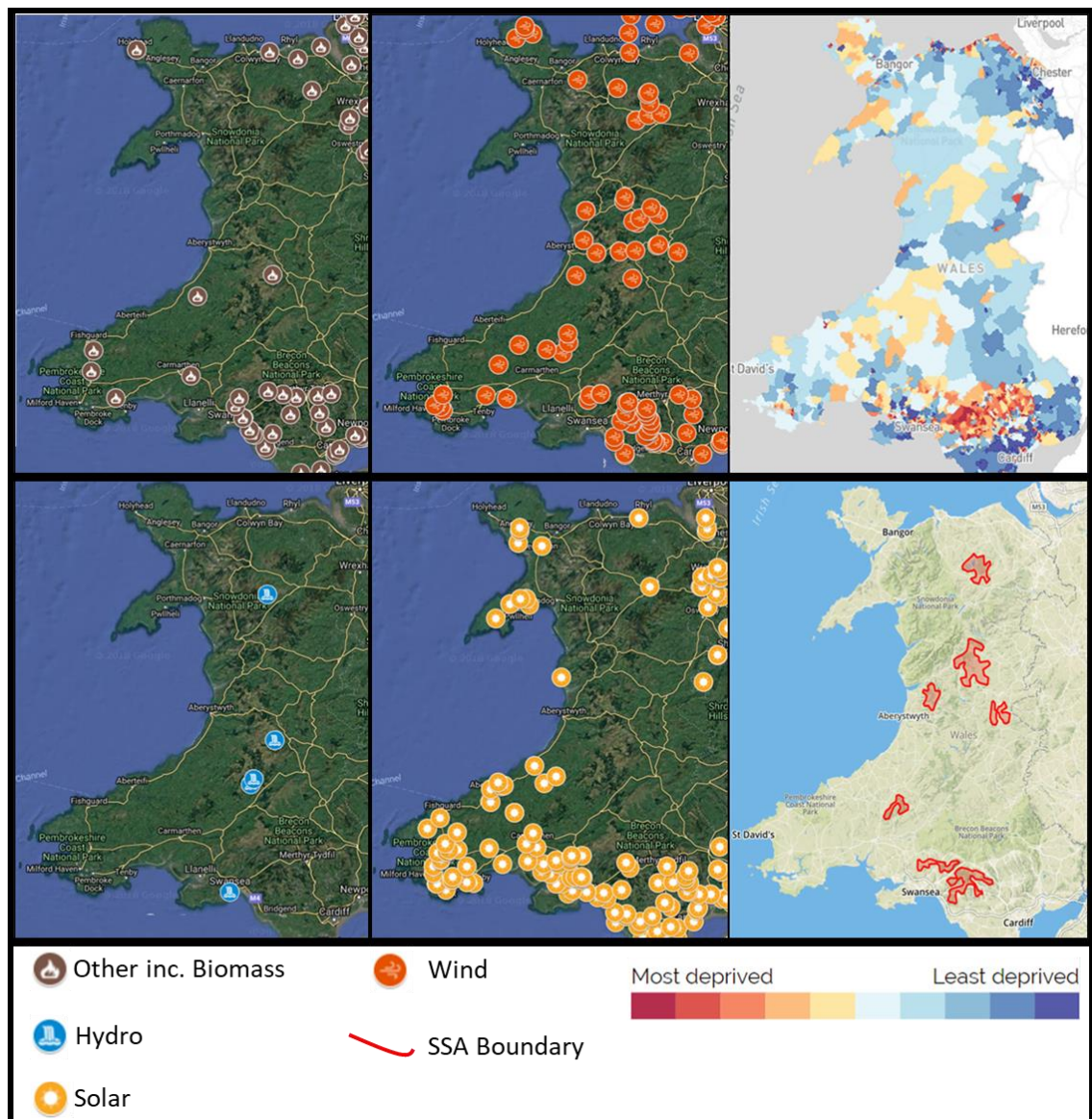


Figure 6.6. Location of renewable energy developments (1 MW and above), areas of deprivation and Strategic Search Areas (SSAs).
 Source: Google Maps (2018), Trimble (undated) and Welsh Government (2018a)

Two SSA's were within or close to the study location and had commercial wind farm developments established (Maes Gwyn windfarm and Pen y Cymoedd). The households interviewed living closest to the windfarms developed there talked about them being 'undemocratic' and feeling powerless to influence what decisions either over the type of development itself, the end-use of the energy generated or if and how monetary benefits arise:

We look over at the wind farm over there. When we first came here I took a picture looking out, there are only four in the picture. Now we can see thirteen [...] Maybe they're paying too much for the people whose land it's going on, because one of the farmers over there, he's stopped farming because he's making enough money from having the wind turbines on his

property [...] Well, maybe they want to cut down a bit what they pay him and pay other people who are trying to do things because a lot of people could do more [about renewable energy], but it's the cost [that prevents them doing so] (Robert, homeowner, aged 45-64).

I don't know if you know about the controversy in Powys? But they're doing their local development plan and at the last minute the Welsh Government has insisted on them putting in these search areas for renewable energy, in other words solar panels and wind turbines. And this is really undemocratic the way it has been thrust on Powys at the last minute without proper consultation (Community group interview 6).

In other interviews it was noted that such forms (scale and business model) of low-carbon energy production may not be the most beneficial either for Wales as a country or for the local areas the developments are sited within. Instead, other forms of energy production ownership, such as partnerships between public sector or third sector organisations with commercial developers or smaller scale developments with increased local ownership were discussed. Such options increase the level of power for communities or organisations with social ethos, which was felt to increase the connection between places, energy produced and include a wider range of local actors. This was felt to be indicative of the retention of economic benefits (whether community funds, or profits) closer to the site of production, growing local economies or used for local benefit. These perceptions are supported by some research (c.f. Hanley & Nevin 1999; Okkonen & Lehtonen 2016; Benedek et al. 2018), however, other research suggests more limited benefits (Bere et al. 2017) or point to the need for development of wider economic supportive industry which adds value along with local ownership (c.f. Bryan et al. 2017; Institute of Welsh Affairs 2018). However, Welsh Government energy policy is supportive of positive perceptions, and now stipulate that new renewable energy developments in Wales must have “an element of local ownership” (Welsh Government 2017b).

Going forward, if another Pen y Cymoedd [was developed], that's great but actually, should we be looking for most of that to be owned by people in Wales? So, should we set a minimum level of ownership of new energy developments so that people in Wales? The money goes where the ownership is, so how do we actually make more of that stay in Wales? Those are the sorts

of questions that we're asking at the moment (Welsh Government interview 1).

You've got a foreign owned energy company - power or coal or whatever ... if you can keep some of that energy in the local economy, have ownership and responsibility for generating it, then the cash. You can have more say about where your energy is sourced from, so local sources. But we can also keep more of our money within the [local] economy and that's better for everyone in that economy (Expert interview 8).

The interviews illuminated that not only communities close to commercial developments felt unjustly treated, during transportation of very large component parts (for example wind-farm blades) other communities are inconvenienced by road closures. Also, other and the same communities may need to have new energy infrastructure erected (i.e. pylons) to distribute the new energy production. However, interviewees from such communities were unaware of any benefits gained:

We've had up all the hassle with the wind turbine farms, with the transport, but that all gets piped away, were not even getting the electric out of it. You wouldn't mind if you had the benefits, because I'm a supporter of windfarms. But you would like some of the benefits of it as well. Why it all has to go to England I don't know. Hundreds of pylons we're going to have, to carry the electricity and that spoils our quality of life (Mark, social tenant, aged 45-64).

Undemocratic decision making, and perceived unfairness was not confined to large scale energy developments. Community energy schemes, whilst being promoted as more inclusive ways of developing renewable energy and also a means of enhancing community cohesion can in some instances have the opposite effect. Two of the seven community projects interviewed spoke of some opposition to their plans from some of the local community:

There's been quite a divide between the community council and the not-for-profit energy companies. You know, the people on this group are not members of this, and not over there, and there's been a lot of antagonism between the two. It gets all personal and nothing to do with the facts and it becomes

another expression of community fractionalism and in-fighting (Expert interview 8).

There was very little backing, there was a lot of contention at the time, because that's what happens in communities, there was a bit of um friction, or fraction actually, there was friction in the community with the local county councillor[...]The community council as well is another thing, you know because we fell out big time with the community council as an organisation, there was a group of people on there that were very, very against what we were doing (Community group interview 4).

Unfortunately, during the fieldwork, perspective from those against the developments was not ascertained. However, in both instances the community groups felt that eventually any antagonisms had passed and generally most people in the wider community were accepting of the developments.

Sub-regional political peripheralization was expressed within Wales due to distance from governance centres and relatively weaker economies. These two factors complement each other where areas proximately distal from governance centres are the same areas with weaker economies. Larger scale low-carbon energy production appears to embody and reinforce such perceptions. New energy production developments, whether commercial or in some cases community led, can to some appear imposed and in the case of windfarms in particular, harming the local landscapes, with benefits that come, including the energy produced, holding little meaning for affected communities. As spatial justice calls for the “fair and equitable distribution in space of socially valued resources and the opportunity to use them” (Soja 2009, p. 3) this is a sign of injustice. Peripheries can have little influence over what technologies are pursued, in what locations, and what impacts there may be on local landscapes and economies. The next section continues the exploration of peripheralization and the influence this has on energy vulnerability and low-carbon transition, narrowing the focus to experiences within the Brecon Beacons National Park (BBNP).

6.4 The Brecon Beacons National Park: Further political peripheralization?

The BBNP is managed by the Brecon Beacons National Park Authority (BBNPA), which is a local planning authority and holds the same statutory planning functions of other planning authorities in Wales (see *Planning (Wales) Act 2015*). The BBNPA, as a public body has obligations within UK legislative framework of the *Environment Act (1995)*. As a Welsh national park authority, the BBNPA also has a responsibility to consider the *Environment (Wales) Act (2016)* when making strategic plans and planning decisions. Additionally, the *Wellbeing of Future Generations Act (Wales) (2015)* places a statutory duty on all public bodies in Wales to work in a way that upholds the sustainable development principle which is comprised of five main elements: Long term, Prevention, Integration, Collaboration and Involvement. This includes creating and working towards wellbeing objectives designed to maximise its contribution to the seven well-being goals (a prosperous Wales, a resilient Wales, a healthier Wales, a more equal Wales, a Wales of cohesive communities, a vibrant culture and thriving Welsh language, a globally responsible Wales). It also includes participation as a partner in Public Service Boards which consult, create and monitor wellbeing objectives and plans for Local Authority areas. In doing so public bodies in Wales will improve “the economic, social, environmental and cultural well-being of Wales” (Future Generations Commissioner for Wales 2018).

The BBNPA is predominantly funded by the Welsh Government and levies obtained from the seven Local Authorities the Park overlays. 75% of Park funding is from Welsh Government via the National Park Grant, the remaining 25% is raised via the levy. For 2016/17 the BBNPA received £3,936,000 from the National Park Grant and £942,000 from the levy (BBNPA 2017b). In addition to this the BBNPA generates income from other “grants and contributions” and “Fees, Charges and Other Service Income” which together for year 2016/17 generated £2,238,000 (BBNPA 2017b, p 4). This money goes towards running the BBNPA including the direct employment of 98 (fulltime equivalent) staff, in addition to indirectly supporting sub-contractors, suppliers and café franchise operators involved in other activities involved with managing the park (Parsons 2019). However, as a planning authority the BBNPA has no remit for housing, health and social services or public services, these remain with Local Authorities. Thus, in many ways the

BBNP is subject to the same issues around public services deprivation and being identified as least deprived as non-Park areas.

However, recognition as being least deprived is perhaps more pronounced within the BBNP than outside due in-migration of retirees and number of second homes both of which influence house prices and can disperse lower-income groups more widely within surrounding areas (c.f. Gallent et al. 2003). Within the park, house prices are on average £28,279 higher than those in the same Local Authorities outside the Park boundary (see Table 6.3). High house prices, whilst being an indicator of economic prosperity, hold issues for people on incomes below the amount required to be able to afford accommodation, this is “a particularly difficult problem for young, local people wishing to remain living and working in the National parks” (BBNPA 2010, p. 46). The ratio of house price to wage is now 8.3 within the BBNP (Lloyds Bank PLC 2017) but Banks and Building societies typically only lend to a 4.5 ratio. This indicates that income for people living in the Park, even for those on above average income, are not high enough for them to afford to purchase a home.

Table 6.3. Average house price in BBNP compared to weighted average of Local Authorities within its boundaries.

Average BBNPA House Price 2017 (£)	Average Local Authority House price 2017	Premium of BBNPA to County (%)	Premium to County (£)	Average Price 2007 (£)	10 year change increase (%)	Price to earnings Ratio 2017
222,631	194,355	15	28,276	204,925	9	8.3

Source: Lloyds Bank PLC (2017)

Within its planning authority role, the BBNPA holds authority to grant or decline permission for building or environmental developments within the BBNP boundary. This is different to areas outside of the Park where planning permission is sought from Local Authorities. The planning authority function of the BBNPA is meant to ensure that any developments support the Park’s core purposes and duty. These represent its overall goals and are outlined within the *Environment Act (1995)*. The two core purposes are: To conserve and enhance the natural beauty, wildlife and cultural heritage of the national parks; and to promote opportunities for the understanding and enjoyment of the special qualities of national parks by the public. The BBNPA duty is to "seek to foster the economic and social well-being of local communities within the national park, but without incurring significant expenditure in doing so, and [to] co-operate with local

authorities and public bodies whose functions include the promotion of economic or social development within the area of the national park" (Law Wales 2016, n.p.). The core purposes hold greater weight than the duty, additionally, the first core purpose retains priority over the second core purpose. Should conflict arise between the two purposes a 'Sandford Principle' is applied, placing "greater weight to the purpose of conserving and enhancing the natural beauty, wildlife and cultural heritage of the area comprised in the national park" (BNPA 2018; Law Wales 2016, n.p.).

The core purposes of national parks act to conserve landscapes, biodiversity and cultural heritage, inadvertently, they also conservation the landscape as it was at the point in time national park designation took place. For the BBNP its conservation was initiated in 1957 and represents the "slice in time" (Foucault 1984, p. 6) that it is required to maintain. Conservation in time as well as space also conserves idealised visions of rural life, a mythical "golden age" where life was simpler, and society conformed to an "idyllic...old order" (Moore-Colyer & Scott 2005, p. 506). This idealization of rural life is strengthened by the links made between national park landscapes and national identities which together create sacred spaces increasing their social importance and also their attractiveness to tourists. But this idealization can be problematic for populations of people living within the parks in current times, whereby modern needs can conflict with the traditional ideology.

The core purposes of the Park can mean that gaining planning permission for any developments (including energy) within the Park involves the satisfaction of more nuanced criteria. These criteria centre around environmental protection and visual impacts that developments may hold, impacting type and size. It also can increase the cost and timeframes involved with compiling planning proposals. Of the 71 (non BBNPA) interviews, 24 had direct interactions with the BBNPA (15 from the business, community groups and policy governance interviewees; and 9 households), these interactions centred around developing existing buildings and developing independent energy developments. There was acknowledgment amongst interviewees that as a conservation area, the Park required environmental protection. However, in attempting to carry out developments 16 expressed that the BBNPA appeared over-zealous in its application of planning criteria. This resulted in extended planning processes and planning decisions that to the applicants appeared unfair:

There were so many hoops to jump through, the amount of surveys you had to do, you had to do visual impact surveys, bat surveys, you know? It was all put there I think just so we'd give up (Business interview 1).

It also affects the reputation of the BBNPA, whereby to some developing in the Park is not worth the effort of trying to gain planning permission. The perception of the BBNPA, in terms of its planning remit as difficult, reflective of meeting its core purpose at the possible cost of socio-economic benefits that developments could hold for its communities. This includes low-carbon energy developments around energy production and increasing domestic energy efficiency:

They [the BBNPA] need to be more open to developments as the people in the area are the ones looking after it. You can see why people get frustrated by them. We are just trying to improve properties for the people who live in them (Local Authority interview 5).

The aesthetics associated with low-carbon energy production and buildings energy efficiency interventions do not marry with the primary purpose of the BBNPA. Low-carbon developments whether energy production or efficiency are permitted as long as their presence is visually discrete and doesn't adversely affect wildlife habitats. This results in low-carbon interventions being restricted in scale and technology type. In some instances, for example in the case of listed buildings, interventions may not be permitted at all. The need for installations to be visually discrete can also increase their cost, for example, should external wall insulation not be permitted, installation of internal wall insulation may be sought as an alternative, however, this costs on average £6,500 more in addition to being highly disruptive to the building's occupants (see Table 6.4 for home insulation costs). Thus, conforming to Park planning can increase the cost of low-carbon transition. As low-carbon transition costs can already be prohibitive to some, further increases limits further the range of domestic actors able to take it forward.

Further, low-carbon transition is driven in part by the need to conserve existing environments by limiting the effects of climate change. This is a key concern for the BBNPA, indeed all national parks, where conserving landscape and habitats is their main priority. The effects of climate change are likely to see summer temperatures increasing, summer precipitation decreasing and winter precipitation increasing (BBNPA 2009). The

effects of climate change are already present within the BBNP. Coupled with factors such as; air pollution and acid rain, nitrate deposition, declines in upland cattle grazing and aging of farming populations, climate change has led to 55% of the Parks biological Sites of Special Scientific Interest (SSSIs) suffering unfavourable condition (BBNPA 2009). Biological SSSI's include areas of peatland, considered highly important for their global rarity (and decline), ability to store carbon, filter water and aid river management. However, the environment needed to sustain peatland is especially vulnerable to climate changes, posing wider impacts on carbon emissions and water supply to South Wales.

Table 6.4. Domestic insulation types, economic cost and savings.

Insulation Type	Detached	Semi-Detached	Terrace	Flat
Cavity Cost (£)	725	475	370	330
Annual saving (£)	245	145	90	70
Internal wall* Cost (£)	Between 4,000-13,000	13,000	13,000	No estimates available
External wall* coat (£)	Between 8,000-22,000	7,400	7,400	No estimates available
Annual Saving (£) (either internal or external wall)	415	250	155	155

*Cost and savings for internal and external wall insulation vary on size of building and amount of insulation installed (in the case of internal insulation single rooms can be completed at a time and in the case of external insulation part of buildings can be completed at a time).
Source: Energy Saving Trust (2018a; 2018b); Which? (2019)

Additionally, increased instances of flooding have been predicted in some areas of the Park, affected by summer droughts and heavy winter precipitation (BBNPA 2019). Indeed, these predictions may already be evident as the effects of Storm Callum in 2018 demonstrated, flooding many areas including parts of Brecon and the village Crickhowell, and causing landslides in other parts of the Park (BBC 2018b; Edwards 2018). As sourcing energy from low-carbon sources and reducing energy consumption via increased energy efficiencies form part of wider measures to address climate change, through limiting where and who can take up low-carbon transition within the Park, the BBNPA is inadvertently hindering the uptake of such interventions. Thus, is also inadvertently working against its core purpose of conserving and enhancing the natural beauty and wildlife in the Park. While some low-carbon interventions may not blend with the current aesthetic of the Park environment, in the longer term they will actually contribute to wider efforts that help to conserve the same environment.

A second perception of political peripheralization for interviewees was identified as the BBNPA's second purpose - promote opportunities for the understanding and enjoyment of the Park – which is interpreted as encouraging tourism. This perception was most pronounced in interviews with businesses, but also with some households where discontent with the BBNPA was noted. Interviewees noted that the priority given to the Parks tourism economy by the BBNPA took precedence over their wellbeing, and in some instances to their detriment, whereby “the countryside is becoming a place for living, not for making a living” (Lowenthal 1997 cited by Antrop 2005, p. 30).

They are all for tourists, they are not for the local people, I think they see local people as a nuisance. We are neglected. They are supposed to support the social and economics of the local communities, and they don't.... [tourists] are more of a drain on the local area than an asset (Business interview 5).

This is in alignment with views that “landscape and rural life are becoming ominously disjoined” (Lowenthal 1997 cited by Antrop 2005, p. 30) whereby rural life, as the means of creating and managing the landscape are not recognised as such. In the BBNP, agriculture utilises 85% land area and is recognised as an “important influence upon the national parks’ landscape and wildlife”, occupying “a vital social and economic role within the local area” (Nathan Litchfield & Partners 2012, p.107). Many argue that without the land management provided as an outcome of agricultural activities the BBNP would not have the same visual appearance or levels of biodiversity which would likely have negative impacts on both its first core purpose and the tourism industry (BBNPA 2010). Indeed, the agriculture sector is regarded as playing a vital role within Wales as a whole:

With 83% of Wales’ land surface being managed for farming and 14% for forestry, a separation between the management regimes for ‘environment’ and ‘agriculture’ is at best artificial. A crisis in Welsh farming would pose huge risks for maintaining the environmental resources of Wales. The countryside and coastline are essential to the heart of Wales and an asset for all our people. (Welsh Government 2017d, p. 21)

Thus, national parks’ core purposes; first to conserve the landscape (and associated habitats and culture) and second to encourage its public use, result in the well-being of

people living and working within them, is assigned to a subordinate ‘duty’, placed below the first two ‘purposes’ in priority. Here lays a conflict between the wants and rights of the wider nation and visitors to national parks with lived experiences of the rural communities who inhabit them. Thus, perhaps unsurprisingly some inhabitants feel marginalised by the BBNPA.

This conflict was recognised in a recent *Review of Designated Landscapes in Wales* (Marsden et al. 2015) where, amongst other recommendations, it was recommended that national park’s duty was promoted to a purpose. That purpose would focus on sustainable resource management and “promote sustainable forms of economic and community development based on the management of natural resources and the cultural heritage of the area” (Marsden et al. 2015, p. 11). However, after consideration the Welsh Government decided against this as National Park Authorities “have a particular opportunity to help realise the economic potential of their communities and to exemplify and promote green growth. There is no barrier to them doing so within the remit of their existing purpose” (Welsh Government 2018b). As such, community needs within the BBNP will remain a secondary priority.

Political peripheralization for communities within the park has very different manifestations of energy justice and energy vulnerability than areas outside of it. Strict planning controls means that communities are somewhat protected from the negative impacts of larger scale commercial developments that are purposely positioned elsewhere. However, the same planning controls mean that community needs, including the need to mitigate energy vulnerabilities via energy production or increased energy efficiency can be obtrusive. Considering the perspectives of both communities within and outside of the Park, both are limited in what low-carbon developments they can pursue themselves, at all scales, including some energy efficiency interventions. These limitations create energy vulnerabilities and are a form of energy injustice.

Within and without the BBNP, low-carbon transition has provided the means for some public services and community assets to increase their economic viability by reducing running costs on public buildings and/or producing an income. This offers some protection against area decline and ongoing public spending reductions for services and local amenities. Community assets, such as community centres, are important for community cohesion and social inclusion, perhaps especially so in peripheral places that have little alternative for social activities. In some instances, these public assets can be

transferred to the communities, whereby, the community will take over ownership and maintenance of the asset. The Local Authorities assist communities where possible, but the process can still be difficult for communities to navigate. Communities within the BBNP may be better positioned to counteract some aspects of peripherality as the BBNPA employs a Sustainable Communities Team who as well as managing a Sustainable Development Funding (SDF), also assist communities within the Park with the Asset Transfer process. Part of the process involves the creation of management plans and demonstration of economic viability of the asset for the community. One way of making an asset, economically viable is to limit where possible its running costs (see Figure 6.7).

This village hall is owned and run as a charity by the local community, managed by the volunteer committee and with 1 employee. The costs of running the hall were becoming prohibitive and much of this was attributed to the inefficiency of the building and the high cost of LPG.

“We don’t have main gas in the village so, we have a big propane gas tank outside which is very expensive and not very green, and then we’re using electricity. So, between the two things, our energy bills were huge, we were paying probably about £5000 if not more a year on our gas”

In the same village a community energy group has been established. In 2006, the group developed a 36 KW micro-hydro on a nearby reservoir with the profits generated being re-invested into other community developments. Since 2010, the group funded two electric vehicles for a community car share scheme and in 2011 and 2014 the volunteer committee and energy group worked together to install Solar PV on the hall’s roof (8 KW in total) and a new ASHP for part of the hall. The close relationship between the two groups means that repayment of the cost of installations has been fairly flexible and done primarily so that the energy group can re-invest in other community developments:

“We’re working quite closely over the last eight-nine years with [the energy group] ... And that has been generating quite a reasonable amount of money that comes back into the village for community green projects.”

The installation of low-carbon energy generation also spurred the village hall into increasing their energy efficiency. Overall, the benefit to the hall has been substantial:



Image. Solar PV on the Village Hall Roof

“We had the PV panels in the hall for a couple of years and it was starting to show an impact on our electricity bills...[the ASHP] actually reduced our dependence on gas by probably 75%. It was unbelievable and one year our bill for gas was only about £100... it has meant that we aren’t chasing our tails quite as much... hopefully it will guarantee the future of the hall because it was looking very dodgy at one point.”

This demonstrates how low-carbon measures can be utilised to counteract multiple aspects of peripherality and also energy vulnerability. It reduces dependence on high cost and insecure energy supplies, increases energy efficiency and helps create and maintain assets that are important to social inclusion. The continual re-investment in further projects also shows how one initial project can grow to have many wider impacts.

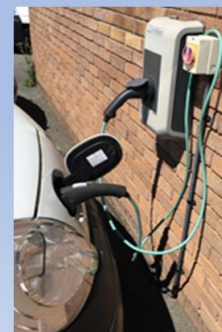


Image (right). Electric Vehicle charging point

Figure 6.7. Community based low-carbon transition

The BBNPA SDF is available for a variety of uses and can be applied for by communities and organisations in the Park for development and demonstrator projects that contribute towards more sustainable ways of living. For 2018/19 five main project areas have been identified as Energy, Business, Natural and Built Heritage, Rural Transport Solutions and Health and Wellbeing (BBNP 2018). The funds are made available in grant form to groups and projects that can demonstrate social, economic, environmental benefit to the Park. Projects supported by the fund counteract peripherality in the park in various ways, either through sustaining community assets, resources and services; making community buildings more efficient to run and therefore more likely to remain open; providing alternative training and employment for people.

We always emphasise the added value of the sustainable development fund, we emphasise that it's not just spending £200,000, it's about leveraging in funding, so typically we'll lever in 4 or 5 times that. So, although you're spending £200,000, the benefit to the area is £1 million (BBNPA interview 4).

While these outcomes can indirectly reduce situations of energy vulnerability, some do so more directly. Possibly one of the most impactful projects on energy vulnerability that the SDF and BBNPA have supported is the creation of The Green Valleys (TGV). TGV was established in 2009 as a community support organisation, assisting communities in organising themselves, finding funding and planning and delivering projects that benefited the environment. After two BBNPA employees successfully won the NESTA (National Endowment for Science Technology and the Arts) Big Green Challenge competition, the prize money awarded funded an initial demonstrator project focusing on social, economic and environmental aspects of climate change. This took the form of TGV, which was further supported by the BBNPA with £20,000 SDF grant and the allocation of one BBNPA staff member for a year.

We emphasise the seed corn funding idea so there are a lot of projects we have funded, £20-30,000 as a first phase pilot whatever, but then they go on to get something much bigger, more substantial external funding. So, it's a sort of small investment to start with (BBNPA interview 4).

The organisation is a good example of the ‘seed corn funding’ approach the BBNPA adopts where it has grown to branch into a business TGV Hydro which also assisted private projects and businesses in developing micro-hydro projects. Both organisations are still running today and have assisted other communities and landowners in increasing energy efficiency and/or developing energy production. Additionally, as a CIC all profits from TGV go back to its member communities to further assist in environmental projects. Thus, income generated from low-carbon energy production offers community groups, within and without the Park, an opportunity to direct spend on areas that meets specific local needs, whether that is further low-carbon measures, social inclusion or transport poverty.

6.5 Conclusion

At national scale, interviewees identified a lack of synergy in energy policies of Welsh and UK Governments which appeared problematic for Welsh ambition as it can require approval and/or assistance from the UK Government. This relationship epitomises key core-periphery dynamics, whereby Welsh (or peripheral) autonomy is limited as key policy levers are retained by UK Government (distant core authority). As with core-periphery dynamics, decisions taken by the UK core may not have the best interests of the Welsh periphery in mind (Schneider & Ingram 1993; Fischer-Tahir & Nauman 2013). Political peripheralization and misrecognition can directly impact energy vulnerabilities. At a regional scale, political peripheralization restricts ability of the periphery to harness indigenous energy resources - in ways that is most acceptable to the periphery and to the benefit of the periphery. The lack of Welsh Government influence over SBTL and Wylfa Newydd Nuclear development decisions epitomise this dynamic. Additionally, despite being a net exporter of electricity in the UK (Welsh Government 2017a; 2018a) Welsh regions experiences higher domestic electricity and gas costs compared to most other UK regions (The House of Commons Library 2017). This resonates with the three tenants of energy injustice whereby Wales is unrecognised in decision making processes, so decisions are made in others’ best interests and the costs of such decisions are experienced in Wales while the benefits are experienced elsewhere. This holds implications for national-scale energy vulnerability as without autonomy to control its energy sources, Wales’ security of supply or access to energy, and energy affordability is precarious.

Political peripherality was also experienced within Wales, indicating that even though occupying a peripheral position at a national scale, similar core-periphery dynamics regarding political decision making are maintained at a lower regional scales. The effects of peripheralization were felt most readily by interviewees in terms of public spending or more accurately where spending cuts may occur. Consequently, perceptions from the periphery are that Welsh Government priorities are centrally focused, as opposed to equally spread across core and peripheral regions. Further intensifying this perception is that peripheral-rural budgets must stretch across large geographic areas, increasing staff travel times and constraining actual work time, limiting budget effectiveness. Furthermore, strategic application of funding and staffing resource using area-based measures can result in peripheries being miss-recognised as less-disadvantaged and thus, in less need of assistance. This is exacerbated by continued decreasing funding levels which force strategic decisions to be made that benefits the most people as opposed to those who need it most. Accordingly, sparsely populated peripheries are less likely to be chosen for such measures. In terms of energy vulnerability this can have direct outcomes as fuel poverty interventions are directed at the same, mostly urban areas, to the detriment of peripheral rural areas that are frequently overlooked. Peripheral households are left without assistance in increasing energy efficiency, changing energy source and increasing energy affordability, ultimately more easily meeting energy needs.

While all the above issues were identified both within and outside of the BBNP, additional governance arrangements in place to manage the Park add a further dimension to political peripheralization and misrecognition. Political peripheralization within the park was evident by perceptions of communities, businesses and non-BBNPA governance organisations that community needs were marginalised first due to environmental protections and second through emphasis placed on tourism activities. This manifest in difficult to navigate, stricter and more expensive planning processes. In terms of energy vulnerabilities, increased complexity and costs mean that low-carbon energy transition within the Park will be limited to those able to navigate the planning process and afford additional expenses. Misrecognition was experienced in the park very similarly to areas outside of the Park, especially when area-based tools are used to allocate spending. However, the prestige associated with the Park in addition to the focus on tourism can exacerbate this issue by increasing living costs, abilities to afford to buy homes and altering demographics so that lower-income households are further dispersed and thus harder to recognise and benefit from low-carbon interventions.

Chapter 7. Peripheral economies, infrastructures and living costs: Embedded energy vulnerabilities and disparate transition opportunities

7.1 Introduction

A key element of peripheral disadvantage is an absence of agglomerative advantage relative to cores (Copus 2001). Businesses tend to be smaller, consisting mostly of self-employed/sole-traders or Small Medium Enterprises (SME's). Additionally, dominant employment sectors within the sparsest of settings, such as tourism and agriculture typically hold irregular and low-paid opportunities - contradicting impressions of rural areas as being broadly affluent, or at the very least, not economically deprived. High levels of employment in unsecure, seasonal or low-paid work implies that energy affordability may be compromised all or part of the time and that energy needs may not be met. Within the context of the BBNP, the influence of governance can encourage the development of these employment sectors.

To gain more-skilled employment or higher wages some commute out of the periphery. Additionally, distance between peripheral settlements means even those who are not employed, still require vehicular transportation. Poor peripheral public transport networks necessitate a heavy reliance on personal vehicles or 'forced car ownership'. As such, commuting incurs a penalty in the form of travelling time and costs, reducing what may already be a small household disposable income. Adding to the financial cost of peripheral living is the high cost of energy. In peripheries this is attributed to higher administrative and distribution costs for mains sources and higher fuel and distribution costs for traditional non-mains sources. Traditional non-mains energy sources such as oil and liquified petroleum gas (LPG) which are more expensive than mains supplies are utilised where there is no access to gas mains. This is a particular historical problematic of peripheries which persists as they do not have population levels to make mains extension economically viable. Traditional non-mains sources hold additional vulnerabilities due to the need for manual monitoring of energy supply and ordering, with vehicular delivery that is vulnerability to adverse weather conditions.

Such precarious access to energy supplies has encouraged some homes to adopt energy practices, such as the installation of solid fuel heating equipment which offer more secure

energy supplies but can often incur a high financial cost. Combined with this, high numbers of traditional solid stone buildings, which are hard to heat, hard to keep warm and hard to insulate means that many households are required to consume more energy to attain a comfortable heat. These characteristics hold direct impacts on energy vulnerability drivers such as, access, affordability, flexibility, energy efficiency and needs.

So peripheral households can experience lower incomes combined with a greater strain on their incomes due to travel costs, high energy costs and the need to consume excessive energy to warm inefficient homes. These additional peripheral living costs are rarely considered in analysis of income or deprivation. Such costs and priorities interplay with energy needs, impacting energy consumption. However, combined with these peripheral specific issues are more general influences of payment type and housing tenure, both of which impact energy price and ability to choose energy sources or modify energy efficiencies. Such additional influences can further compound peripheral energy vulnerabilities.

Low-carbon transition has been harnessed by some businesses to stabilize and increase reliability of income, allowing for re-investment or increased working hours for employees. Likewise, for households, it has been harnessed to directly counter elements of energy vulnerability, where production can secure income, secure access to energy and make it more affordable. However, there are some risks involved in transition if carried out incorrectly for businesses, households and the public sector whereby additional costs can be incurred. Additionally, low-carbon transition is inaccessible for some, the high cost of peripheral living combined with high cost of transition placing it out of reach despite ambition.

This chapter unpacks these interwoven aspects of peripherality, energy vulnerability and transition. Focus is first placed in peripheral economies and incomes followed by explanations for the necessity of personal transport. Following this peripheral energy infrastructures are explored, highlighting restrictive access, weak structure and additional costs associated with it. Finally, the influence of peripheral housing stock type and energy efficiency on energy vulnerabilities is highlighted, linking the combined influence of this with energy consumption and high energy prices. This last section also briefly explores the influence of housing tenure on abilities to alter such living conditions and thus energy vulnerabilities. Within each section links are made with low-carbon energy transition and

how this is utilised to counteract energy vulnerabilities, but also where it is unobtainable for some.

7.2 Peripheral economy and income: Unaffordable energy and transition?

As detailed in *Chapter 4*, Wales's economic outputs are the lowest per capita out of all UK countries. This economic peripherality is also evident at an EU scale where Wales is also one of its weakest economies (Eurostat 2017). Within Wales the highest levels of GVA are in the South-East, urban Local Authority areas of Cardiff and the Vale of Glamorgan, while the lowest are in the rural West, mid-Wales, and post-industrial southern Valleys (Figure 7.1). This pattern of GVA distribution has remained stable for decades (National Assembly for Wales 2018a). Areas with higher levels of GVA are predominantly larger urban agglomerations, which concentrate employment, capital and value production.

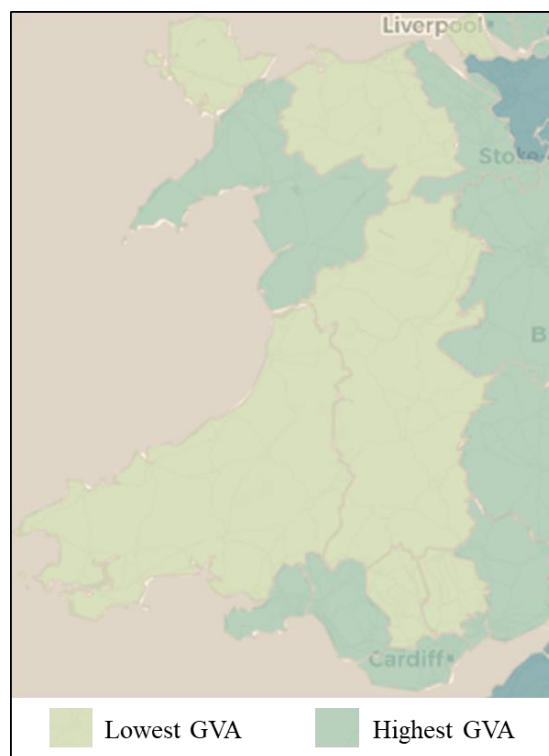


Figure 7.1. Welsh gross value added (GVA) per head for NUTS3 local areas, 1998 to 2016.
Source: Office for National Statistics (2017a)

Narrowing focus further, while GVA data is unavailable at Park level, considering GVA per capita with population levels within the Park a rough estimate of the GVA per capita at Park level can be gained. The seven³³ Local Authority areas overlaid by the Park hold a mix between some of the highest and lowest levels of total GVA and GVA per capita in Wales, and a mix of rural and urban areas (although in terms of land area and park population are predominantly rural). As Table 7.1 indicates GVA within the Park boundary is higher relative to the Local Authorities it overlays and BBNPA GVA per capita is mid-range compared to all Welsh Local Authorities.

This may be in part attributed to national park designations as all national parks are credited with having economic benefits for their local areas (Annett et al. 2006) attributed to four main areas: tourism economy, increased employment for Park management and tourist services, government funding and increased ability to draw on more funding and increased property prices (Annett et al. 2006). In 2013 the three Welsh national parks contributed “£557m of GVA, representing 1.2% of the Welsh Economy” (BBNPA 2014, p. 76). The tourism economy is broadly regarded as a key industry for rural areas where GVA is below those of urban areas (The House of Commons Library 2017). In the BBNP, the tourism economy is worth around £206m and includes around 4.1 million visitors per year (BBNPA 2014). While an important industry for the economy of the Park, it also directly links to the BBNPA core purposes and is one of the ways that the economic impact of national parks is measured.

Table 7.1. Local Authorities within the BBNP boundary GVA and relative rank in Wales.

Local Authority	GVA in 2015 (Million £)	Total GVA Rank in Wales*	GVA £ per capita (2016)	Per Capita Rank in Wales*
Blaenau Gwent	764	22	11640	22
Carmarthenshire	2806	6	15774	19
Merthyr Tydfil	915	21	16672	15
Monmouthshire	1888	15	20861	4
Powys	2251	11	17296	10
Rhondda Cynon Taf	3663	3	16667	16
Torfaen	1492	18	16875	13
BBNPA	-	-	17933	9

Adapted from: Office for National Statistics (2015 & 2017a) and BBNPA (2012)

**Overall Local Authority Rank does not include BBNPA. Scores of 1 = highest GVA and 22 = lowest GVA.*

³³ The Park also overlays the most northerly points of Caerphilly and Neath Port Talbot Local Authority areas, these are usually disregarded as combined they only cover 4 hectares of land and 0% of population

While such economic benefits are evident in the BBNP, they only form part of the picture of the Parks economy and taken at face value can be misleading. Some of the economic benefits associated with a ‘Park economy’ can manifest into disadvantage for residents by lowering incomes while increasing the cost of living. This in turn impacts upon economic resources available to purchase energy, creating situations of energy vulnerability.

The ratio of employment across all industrial sectors in rural and urban areas is fairly similar, with Retail, Health, Manufacturing and Education employing the most people (Statistics for Wales 2015b). There are exceptions to this when considering the most sparsely populated areas, such as those within the Park. In such areas, Construction and Agriculture (10% and 9.8% of employment respectively) are larger employment sectors than Manufacturing (7.1%) (Statistics for Wales 2015b). Additionally, Construction, Agriculture and Hotel and Catering employ a higher percentage of people within the most sparsely populated areas than all other areas in Wales, however, even within these areas, they employ fewer than Retail, Health and Education (14%, 12.7% and 10.8% respectively) (Statistics for Wales 2015b). This suggests that in the most peripheral areas the dominant industries are Retail, Health, Education, Agriculture, Construction, Manufacturing and Hotel and Catering; with Agriculture, Construction and Hotel and Catering being more significant employers here than in more populated settings.

The significance of these employers may explain in part the lower GVA in sparsely populated peripheral areas compared to more populated areas. The tourism sector, where the Hotel and Catering and perhaps to a lesser extent Retail industrial sector are key employers, is regarded as “commonly seasonal, part-time, low skilled and highly feminized, with limited opportunities for promotions or pay rises” (Zampoukos and Ioannides 2011, p. 27). The construction industry in the UK has the highest levels of self-employment than any other industry sectors (Office for National Statistics 2017b). While usually an “indicator of enterprise”, self-employment can offer precarious income revenue and inadequate pensions (Public Policy Institute for Wales 2016, p. 16; in the UK as a whole around half of self-employed jobs are low-paid (Lloyd undated). Finally, wages in the agricultural industry can be low and as with tourism can also be seasonal. In Wales net farm income is on average around £17,000 per year (Allen et al. 2014 cited in National Institute for Economic and Social Research 2017, p. 6) with many farms relying on subsidies for up to 100% of their income.

Rural economic structures can create employment in casual or seasonal, lower skilled and lower paid roles (Public Policy Institute for Wales 2016). Poverty rates for part-time rural workers are above national averages (Public Policy Institute for Wales 2016) with part-time employment generally being lower paid than full-time employment. In addition, overall employment rates can exceed GVA produced due to increased levels of labour working fewer hours within such jobs (Office for National Statistics 2018b) and/or due to industries in the area being primary producers in the supply chain and thus generating less value for produce. This research found that the limitations of a peripheral economy were noted or experienced by many of the interviewees from all interview groups, who commented on limited employment opportunities and a propensity of low waged and low skilled employment within rural peripheries;

The average wage in rural areas around here is £17-18,000.00 if that, if the youngsters get their degree... not everyone does (Business interview 7).

There're no opportunities for people [...] You could get a high-skilled job if you got one in Neath or Swansea but the travel time, it would cost [...] I feel people who were born up here and have lived up here their whole life are not skilled: they don't have the money to invest in a car. And even if they did, what job would they get? I feel like they are just stuck in a rut (Rachel, private tenant, aged 20-29).

Other research in Wales has demonstrated that in-work poverty, whereby part or all the adults in a household are working but are still achieving less than 60% of the national median income, is most prevalent in rural areas (Joseph Rowntree Foundation 2013; National Assembly for Wales 2018b). Those in work may be suffering from in-work poverty due to the low wages associated with many rural jobs (Public Policy Institute for Wales 2016), these are typically in retail and hospitality sectors (46%) and education, health and social work (20%) (Lloyd *undated*). As Figure 7.2 demonstrates rural areas hold some of the highest proportion of jobs that are lower than the Real Living Wage³⁴.

³⁴ The Real Living Wage is based on the cost of a basket of goods and services needed by people in the UK. It is created by The Living Wage Foundation. Currently the National Living Wage is £7.83 while the Real Living Wage is £8.75.

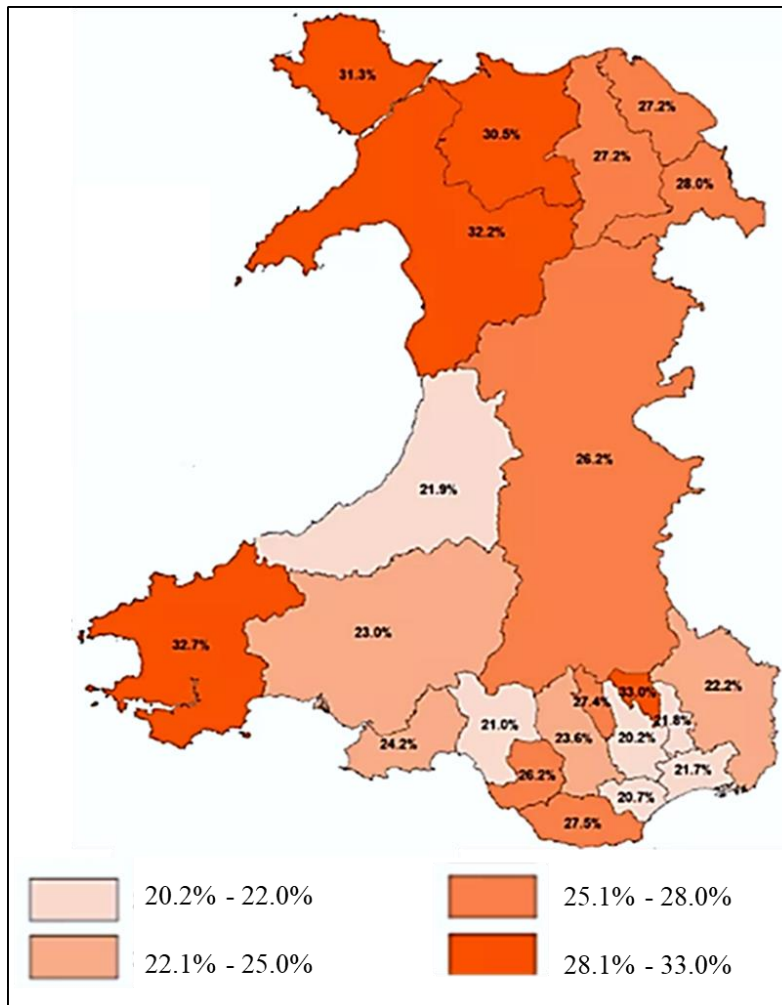


Figure 7.2. Percentage of jobs lower than the applicable Living Wage Foundation living wage. Source: National Assembly for Wales (2018b)

Rural areas of Wales also have low levels of income deprivation, this appears to contradict the dominant industry types and the wages offered. Other research has demonstrated that within rural Wales there are high numbers of people who are self-employed or who are employed and work from home, additionally there are high proportions of employed people in higher managerial and professional jobs (Office for National Statistics 2012). Taking employment and income data together suggests that within rural peripheries there is an income or wealth gap between those in lower paid, unreliable, part time roles and those in higher paid professional jobs. This corresponds with commuting data that suggests rural Local Authorities in Wales have lowest levels of in and out commutes for work - the highest percentage of out-commuting is 29% in rural Local Authorities and in-commuting is 22% (Stats Wales 2017c). This compares lower than non-rural Local Authorities where the in-commuting is 52% and out-commuting is 51% (Stats Wales 2017c). This suggests that household income and GVA for rural Local Authorities is a more accurate reflection of incomes and value added within the area. Finally, income deprivation measures themselves can be misleading as they do not account for the true

cost of rural living, thus while incomes may appear high, after the cost of living are deducted, they may become much lower.

Low-carbon transition can offer a means of supplementing peripheral income via reducing outgoing energy costs by reducing energy consumption and/or generating an income.

I genuinely feel since having the solar panels we don't spend as much on oil.... We both work from home. I've got two computers on all the time. I've got the telly on; the lights are on. In the summer, we'll get back per month about £200 on top of our free electricity (Lydia, homeowner, aged 45-64).

Domestic energy production offers households opportunity to reduce their energy bills indefinitely and a secure income for at least 20 years. Thus low-carbon transition was viewed by many of the household interviewees as a long-term investment. This investment was mostly taken up by households who planned to remain in their current property long term and who were generally in an older age group currently retired or with plans to retire in the near future. Income from energy production could then supplement a fixed pension income (whether private/public or both) in addition to reducing outgoings.

We wanted to make sure we can manage [...] because you never know when you're going to die you don't know quite how long you've got to plan for. You also don't know how decrepit you're going to become [...] it's a tricky balancing act (Leon, homeowner, aged 65 – 74).

The economic benefit of low-carbon transition was recognised in all interview groups. However, of those who had installed low-carbon measures, their motivations were multiple: around environmental concerns; an opportunity to reduce bills; income generation; financial investment; and security of energy supply. In terms of energy vulnerability, these outcomes counteract certain drivers, for example, by increasing affordability, increasing access and security of supply and reducing consumption via increased energy efficiency. For many of the interviews these multiple outcomes were highly interlinked:

Our priority is definitely triple bottom line. It's equally environmental, social and for profit (Expert interview 3).

If you can reduce your bills, you use less energy so that's better for the environment. So, it's a win-win situation. But it's not consciously, I didn't do it for the planet, it was a consequence afterwards of me saving money (Kalvin, homeowner, aged 45-64).

There were slight differences in the importance placed on each of these between interview group. Households, business and local governance institutions were more focused on the economic benefits, while community groups and experts related to this field had an overall stronger environmental focus but still needed to ensure that their costs were covered.

Our main purpose has always been to deliver renewable energy and that's what we're going to end up doing... because the people who invested in our cooperatives, invested on the basis that they were investing in an ethical project, which I think for the most of them is the most important thing (Community group interview 4).

Low-carbon transition can offer increased economic viability for small-scale businesses (Small, Medium Enterprises [SMEs] including farms and/or self-employed) which are more common in rural areas. It can secure an income that is reliable for 20-25 years, perhaps evening-out seasonal income troughs experienced in some agricultural and tourism businesses. It can also offer reductions in energy bills, as some of the energy produced can be utilised by the business itself. Additional income and bill reduction allow investment in other business opportunities, increased employment or increase staff hours, re-investment in further renewables or overall an increased chance to take financial risks (see Figure 7.3):

The business focus is on its historical and geologically significant attractions, in addition to farmland, woodland and overnight accommodation. While the site has had a micro-hydro in place since the 1930's, they installed a more modern micro-hydro and roof-top solar PV more recently. This cost the company around £300,000, but now generates £1,000 per month in energy savings and income for the business. The business is now totally energy self-sufficient.

"We're saving £1000 per week. We've managed to do a lot more because that money paid for the solar panels on our roof, so we put that back but also because that's an SSI and a natural nature reserve, it's enabled us to do a lot of things along those lines... it's enabled us to do lots more on the environmental side of things. On the business side of things, it's also made the business more viable because we're not having to spend £4,000 a month on electricity. That's made us able to open a little more... because you realise that £1,000 is a lot of money it also allows us to keep staff on for longer because we've got the power which is free and we don't have that huge worry of having to find £4,000 before we do anything,"



Image: Micro-hydro turbine 'house' with micro-wind turbine and waterwheel

This is an example of the financial security renewable energy can provide for businesses. Offering a secure energy source and a reliable non-seasonal income for 20 years. Security of income reduces the risk of other financial investments, which could be the installation of additional low-carbon measures or expanding the business opening hours and employing further staff.

Figure 7.3. Low-carbon measures as a means of securing supply and increasing business viability

For small businesses run by just one or two people, taking time off due to ill-health or just for annual leave can be problematic as it can mean a break in income supply. Low-carbon energy production has been used by some to ensure that in these instances there is still some income being generated (Figure 7.4). Additionally, some industrial sectors are high energy consumers, thus, producing their own energy instead of purchasing it can be a substantial economic saving:

If you look at our dairy sector, it's really struggling. Their biggest cost is electricity, for heating and cooling water [...] If you talk to our neighbours, they've got a dairy farm up the road and their electricity bill is about £1000 a month, and they're really efficient. A lot of places would spend a lot more than that. Through investment in renewables, if they weren't paying for that electric, they suddenly become more viable. It means they can actually sustain

a living there on a smaller unit. The whole rural economy could be really helped out by that I think (Expert interview 1).

Now in their early 80's, the farmers have lived and worked the same farm for 38 years having grown up in farming families. The topography of the land necessitates Sheep Farming and managed woodland. Hill farming has provided uncertain income over the years and the couple have had to take on other jobs to supplement their income or to re-invest in the farm. Farming is hard physical work and also a lot of responsibility, as taking time off for anything, even ill health means the animals are not tended and the household loses income.

"Before, I used to worry about the weather, would there be enough food for the sheep? If I don't get enough food for the sheep, can I afford to buy stuff in? With the farm, you worry."



Images: Micro hydro 'house' and turbine

Aware of other farms diversifying their income using renewable energy, in 2008 they were introduced to TGV Hydro who helped them develop a micro-hydro on a stream running through their farm. TGV helped with the surveys and planning permission, and the farmers had the skills and machinery to dig the trenches for power cables and pipes. Initially a 5 KW hydro was installed, later replaced by a 10 KW hydro. The hydro's qualified for generation tariffs and Feed in Tariff. This new venture had a high capital cost of around £50,000, but has paid for itself as it earns as much financially as the farm.

"Keeping 200-250 sheep, including the subsidies and all you get - because the subsidies of the sheep are about half and half - put those two together and the turbine is equal to that."

The reliable income generated by the micro-hydro has been of immense personal benefit to the farmers, providing a means of staying financially viable during periods of ill-health or should they decide to retire.

"It has been a life changer for us hasn't it? Definite. Looking back, all the slogging I did in the previous years. If [only] this had happened say twenty or thirty years ago..."

Figure 7.4. Farm based micro-hydro offering security of supply and security of income.

However, low-carbon transition can also represent a risk, this is due to difficulties in gaining advice and information regarding different renewable technologies and reliance on non-local and therefore relatively unknown and dubious contractors combined with the relative high-cost of some low-carbon technologies (see Figure 7.5).

The business is an education and event provider, established over 20 years ago by a local businessman. It employs 23 people, most of which live locally to the business.

“I would say probably over 80% of our staff are all recruited from Seven Sisters, Ystradgunlais and Abercrave. We’ve always recruited locally wherever we can.”

The business has a strong environmental ethos. However, attempts to install energy generation have not always gone to plan. In the first instance it proved difficult to find information on the technology type to invest in and how to qualify for Renewable Heat Incentive (RHI). Even after consulting Welsh Government websites and contacting advisory quangos it was unclear:

“We did try to look, but again it’s very hard to work things out whenever the government is involved it’s just reams and reams and reams of paperwork that you’ve got to go through and it’s not easy to find out.”

After gaining some advice, they selected Air Source Heat Pump (ASHP) (and later installed Solar PV). Finding a contractor for the ASHP was problematic:

“The vast majority of the people in this [renewable energy] marketplace are cowboys, they’re in it for the quick buck... By the time people start having problems with the kit, they’re long gone.”

However, the business they found out that the type of ASHP ordered would not qualify for RHI, this meant that they would struggle to get the return on their £18,000 investment. Worse still was that the ASHP was installed incorrectly. This has left the business with higher energy bills than when it used an old oil heating system. To compound the problem, the contractor ceased trading and seven years on, it has proved extremely difficult to find another to rectify the problem:

“We’ve basically got immersion heaters on the wrong side of the system, so we’re using vast amounts of electricity when we shouldn’t be... the £18,000 we spent at the, we should have had that back over eight years... so really we’ve paid for all the machinery and we’ve paid extra on our bills. It’s a double whammy really. Commercially it’s been a disaster for the company...yeah, not a good taste in the mouth.”

This is an example of the difficulty in gaining information and sound advice around renewable energy technologies, their suitability in individual circumstances, qualifying for subsidy and finding reliable contractors. This difficulty manifests into financial risk, that can be more pronounced for SME’s which have few avenues to gain advice and smaller financial margins to take risks. In this instance, the investment of £18,000 alone could have been spent on a full-time employee wage.

Figure 7.5. Low-carbon installation financial risk and cost for an SME.

There can also be risks when it comes to gaining planning permission for some production technologies, as feasibility studies must be conducted prior to planning consent being gained. If consent is not given then the cost of the feasibility studies would have been incurred for no reason. While this is predominantly a risk for businesses, public sector and third sector who are more likely to develop larger scale energy production, the risk can remain for some households.

A hydro scheme might cost £100,000 to build, then yes up to £10,000 or more can be spent [...] I mean people can't afford it, so you go to a farmer and say 'it will probably take you twenty years to get your money back, oh and by the way it's going to cost you £10-12,000 to find whether it's feasible [...] And the answer to that [planning] question might be 'no' and then you can't get your £12,000 back, do you want to go ahead?' (Expert interview 8).

At a domestic scale, the relative high cost of transition, combined with an already high cost of living, due in large part to 'car-related economic stress' and the cost of domestic energy³⁵, meant for some it was not possible. It is interesting that of the homes who didn't have renewable energy production but that aspired to do so, as they appreciated that it could be cost saving, were in lower age ranges and had commutes to employment. This suggests that while low-carbon transition can offer economic benefits to households, it is also economically unobtainable for some:

If I had money, I would change [the oil heating system]. But again, we are still limited to what we can heat our house with. Like you can get those biomass burners and we looked into that as well, because you can get a bit of income with that. But, again, the initial layout would have been thousands to get the return (Joan, homeowner, aged 45-54).

7.3 The necessity of personal transport: A periphery-specific energy need

Scarcity of employment and services in addition to population sparsity and spread means vehicular transportation is perceived as a necessity for living in a periphery (Public Policy Institute for Wales 2016). However, this can be challenging in peripheries where travel networks are poor and travel by any mode can take longer and cost more (Moles & Radcliffe 2011). In Wales, road and rail transport networks are poorer than in other parts of the UK, for example, Figure 7.6 demonstrates that many areas of Wales have travel times of 1 hour or more to reach main settlements compared to that of England and to a lesser extent Scotland. The Welsh Government has limited ability in altering this³⁶.

³⁵ See sections 7.3 and 7.4 for further transport-cost discussion

³⁶ See Chapter 4 for outline of Welsh Government transport devolution.

Additionally, public transport costs within Wales are higher than UK averages (see Figure 7.7), with equivalent travel distances via bus costing three times more than via car (The TAS Partnership Limited 2015).

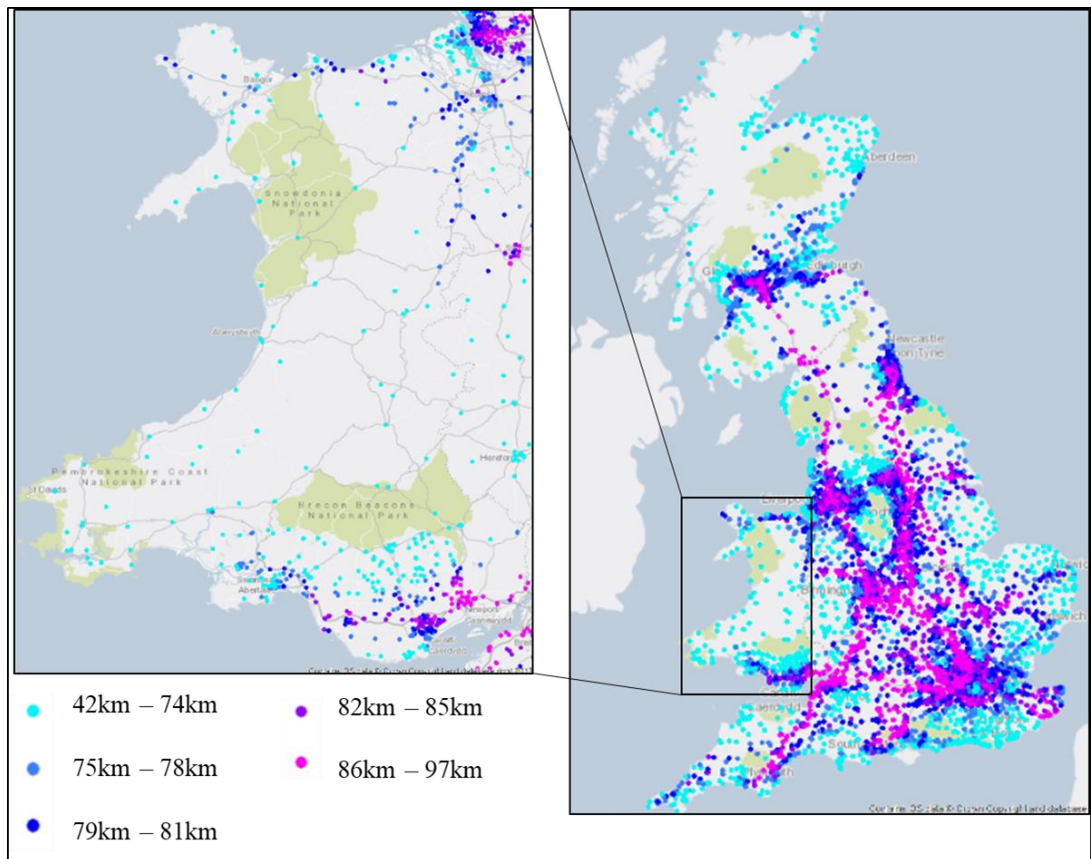


Figure 7.6. UK & Wales travel distances achievable within 1 hour (by car).
Source: Cooper et al. (2016)

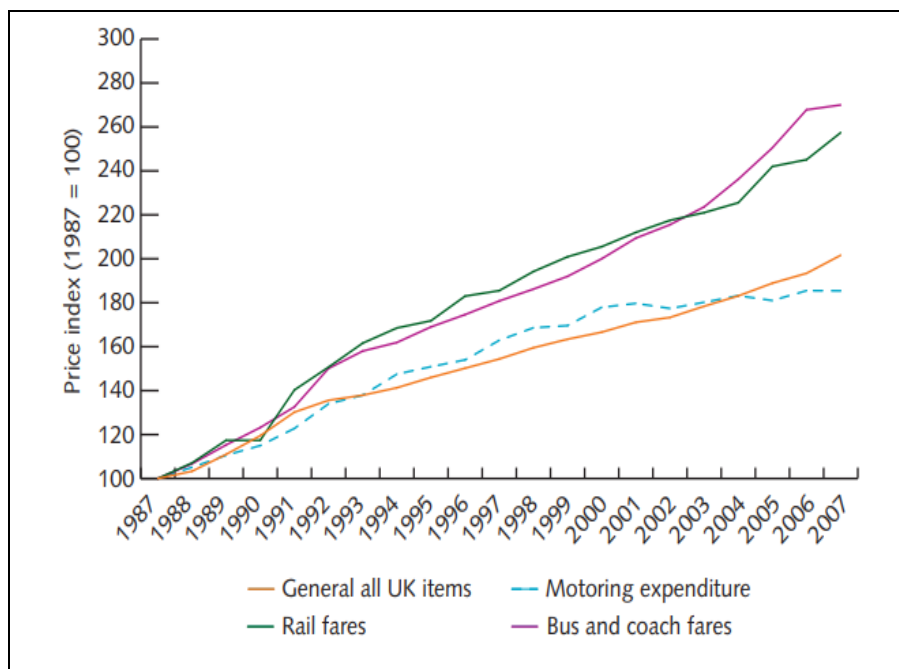


Figure 7.7. Index of UK retail prices and cost of transport in Wales.
Source: Welsh Assembly Government (2008)

Within Wales transport infrastructure is also unevenly spread, the most numerous and well-connected transport links are those of the urban areas mostly in the South, which is the only part of Wales with a motorway. Even if just considering transport using personal vehicles by road, rural road networks create longer travel times than those in urban areas (Figure 7.6).

Bus services in the UK have been de-regulated since the passing of the *Transport Act 1985*. As many bus routes in rural areas are economically unviable, Local Authorities have subsidised such routes (Disney 2016). In 2017/18, 82% of Welsh Local Authorities reduced or spent nothing on bus service provision, of the four who increased their spending, three were rural Authorities (Ceredigion, Pembrokeshire and Powys) (Campaign for Better Transport 2018). While this is perhaps an indication of the recognition of the importance of bus services to rural areas, it comes after seven years of reduced bus funding by all Local Authorities, resulting in 259 Welsh bus services being reduced, altered or withdrawn (Campaign for Better Transport 2018). For approximately 5 of the households interviewed, there was no public transport available in their area at all. Of the interviewed households, 92% noted local public transport was infrequent and not at times suitable for access to work. All bar 3 households cited personal transport as an essential part of peripheral living. This is in line with wider research that suggests lack of public transport services can lead to “forced car ownership” (Currie & Senbergs 2007, p. 1). This can result in ‘car-related economic stress’ and “transport poverty” (Mattioli et al. 2017, p. 95) especially for households that may already be socio-economically disadvantaged:

There aren't even any buses, not a single one. I would say really the biggest energy issue for rural communities is transport, it's an energy issue and a social issue. It's the same in any rural community if your children want any kind of social life which of course is essential, not to mention education and everything else. There is no public transport at all (Jill, homeowner, aged 45-64).

They are just having to pay for transport to get to ordinary facilities that for [urban areas] are accessible on foot or on relatively inexpensive travel. They're having to keep a car on the road to access schools, after school activities, leisure facilities and of course work, which, sometimes

it's to access reasonably well-paid work, but sometimes it's just to access poorly paid work, a car is essential for a lot of people (BBNPA interview 4).

The BBNPA recognises that transport is a major issue for its communities, but it has no authority over public transport provision, as such it is limited in addressing this issue within its purposes. While some efforts have been made to provide public transport services such as bus services, these often prioritise tourism activities and times of use (weekends), and therefore may be limited in benefit to communities and usual commuting times.

It was also noted that juggling multiple personal responsibilities such as caring responsibilities or hospital appointments singularly or in combination with employment commitments meant public transport was not a viable option. Additionally, public transport seems especially hard to negotiate if in ill health, disabled or with dependents such as children:

The most negative thing about living here is the lack of transport. I haven't been on the buses for a long time, I don't know if they would take the wheelchair, I'm a bit afraid of falling to be honest (Olive, social tenant, aged 75+).

If you've got a family, two or three children, your husband was out working and you needed things, you know, shopping, obviously you would shop more with families, it must be difficult then for them [...] some people have to get back home for children or whatever, you can't always depend then that the public transport is convenient. I think if they're a carer or things like that there's only a certain amount of time you can spend out of the house. Things like that could be awkward (Marie, homeowner, aged 65-74).

Poor public transport networks increase the time taken to travel and can also have limited operational hours; this means that quite often they did not operate at times suitable for employment. Other research has demonstrated people who cannot drive or do not have personal transport may opt for low paid or unskilled jobs that are local in order to avoid trying to use public transport (Public Policy Institute for Wales 2016):

We have got a bus service at present that's coming through but it's not sufficiently regular for people really to use it for going to work, it's difficult to work a full day's work and get back and forth using the bus (Eliza, homeowner, aged 75+).

How would I work if I didn't have a car? There are no buses early enough for me to get there for 9 o'clock. There are no buses, I'd have to start walking, I'd have to walk there! (Rachel, private tenant, aged 15-29).

Personal transport can be costly as households have to purchase a vehicle, pay annually for road tax, maintain the vehicle and buy fuel for it. These costs contribute to a higher cost of living in the periphery. While this is not unusual per say as recent surveys have found that in the UK a whole households spend the highest percentage of their disposable income on transport (Office for National Statistics 2019). Other studies have demonstrated that for rural areas this expense is notably higher (c.f. Smith et al. 2013) and that as many of the costs associated with vehicle ownership are fixed this expense disproportionately affects low-income households (Currie & Senbergs 2007; Chatterton et al. 2018) (see also Figure 7.8).

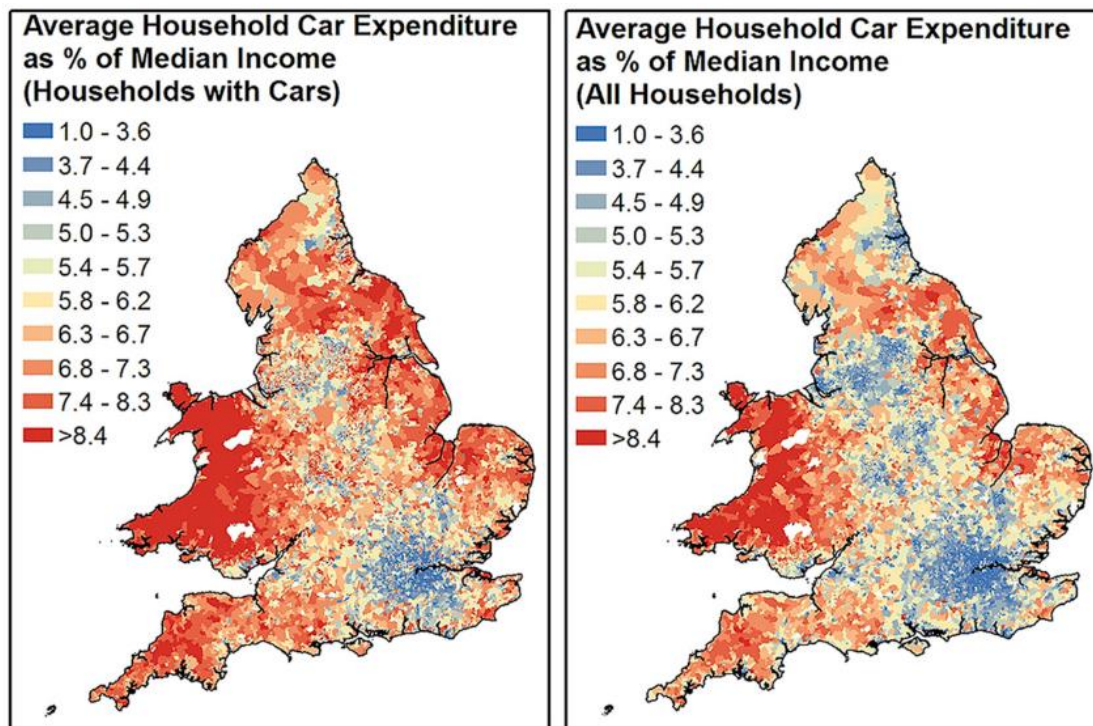


Figure 7.8. Household vehicle expenditure to income.
Source: Chatterton et al. (2018)

One of the households interviewed was able to explain their vehicle fuel (for one of their cars) and their energy (mains electricity, solar thermal and LPG) expenditure per year,

with both costs averaging £1,200. However, this amount does not include vehicle maintenance costs or tax, which would increase the overall vehicle running costs in total higher than the domestic energy costs. While this is only a single measurable instance, and doesn't account for lifestyle or commute, it is indicative of the relative costs between rural household energy and transport.

The remoteness from core-urban areas also plays a role in creating situations of fuel vulnerability, as more constrained incomes, combined with vehicle running costs, contribute to a precarious ability to afford energy. Self-rationing of energy consumption is, for example, one of the consequences of the need to retain mobility (cf. Mattioli et al. 2017 and Figure 7.14).

7.4 Peripheral energy infrastructure: Precarious energy access, affordability and security of supply

Energy infrastructure in the UK has traditionally developed as a centralised structure, thus as a physical periphery the energy infrastructure in Wales does not have the same network coverage as England (see Figure 7.9).

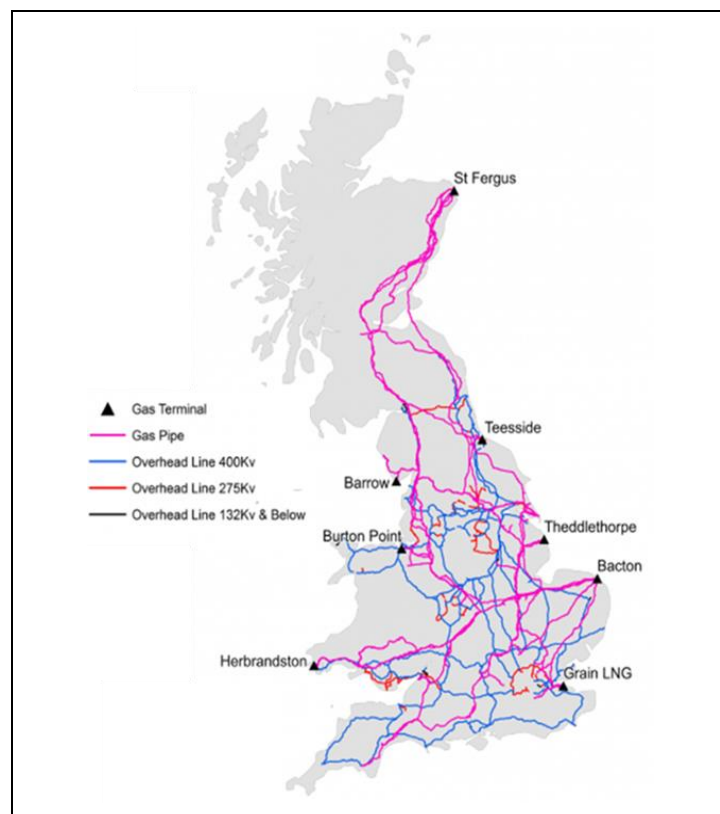


Figure 7.9. Main gas and electricity network structure of the UK.
Source: National Grid (2018)

Within Wales, the energy network and main power stations are usually located close to densely populated urban areas so that they may be used to their maximum potential and therefore maximum profit (Soja 2010). As per Figure 7.10, within Wales electricity grid access points and those points with existing capacity to take additional production are predominantly clustered in the south, with a large expanse of mid-Wales having few points. Not only do sparse networks indicate limited access to ‘mains’ energy supplies, but they also incur additional costs attributed gas and electricity accessed via the mains. In these instances, while not applicable to peripheries within Wales, Wales overall experiences some of the highest energy prices in the UK (see Figure 7.10) where most notably mains electricity costs are only higher in Northern Scotland and London (House of Commons Library 2017a; Ofgem 2015; 2019d). This is in the most part attributed to the distance of distribution along networks which requires more energy to be completed and is less efficient due to losses of energy as it travels (USwitch undated). In addition, economies of scale mean that areas of smaller populations incur higher costs as energy companies cannot buy in large quantities from generators and therefore negotiate overall lower prices (USwitch undated). Finally, costs are associated with consumption, so in places where there are high consumption levels, there are higher distribution costs (USwitch undated).

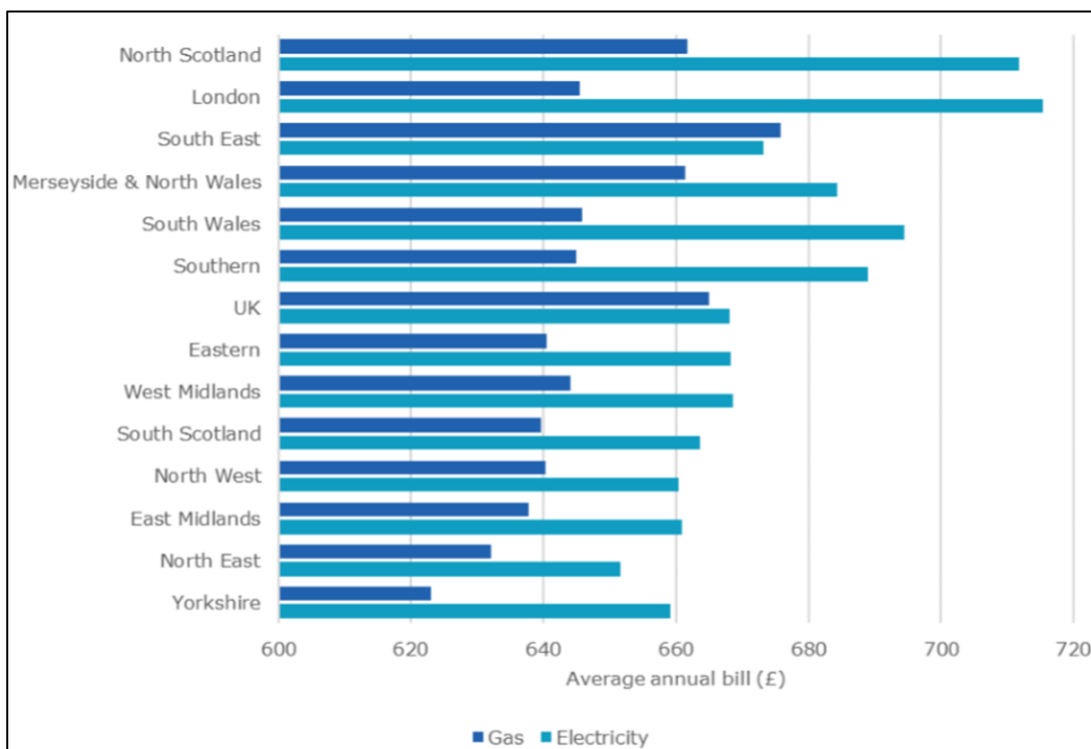


Figure 7.10. Annual domestic bill for gas and electricity in 2018 across UK regions.
Source: Ofgem (2019d)

Non-mains connection also impacts the price of energy, as alternative energy choices are limited and less competitively priced (Office of Fair Trading 2011). Approximately 46% of rural homes in Wales are still off-gas (compared to 34% in England and 32% in Scotland) (see Figure 7.11), most of these homes are heated using oil or LPG, which are priced higher than mains supplies (Citizens Advice 2017). Within the BBNP the number of off-gas homes rises further to 52% (BEIS 2015). Oil and LPG rely on households monitoring their own supply which is stored in an oil or gas tank (Figure 7.12) and ordering more prior to depleting the supply. While most (but not all) homes have access to electricity networks, electricity traditionally has not been widely used for heating due to its high daytime costs (Energy Saving Trust 2018c).

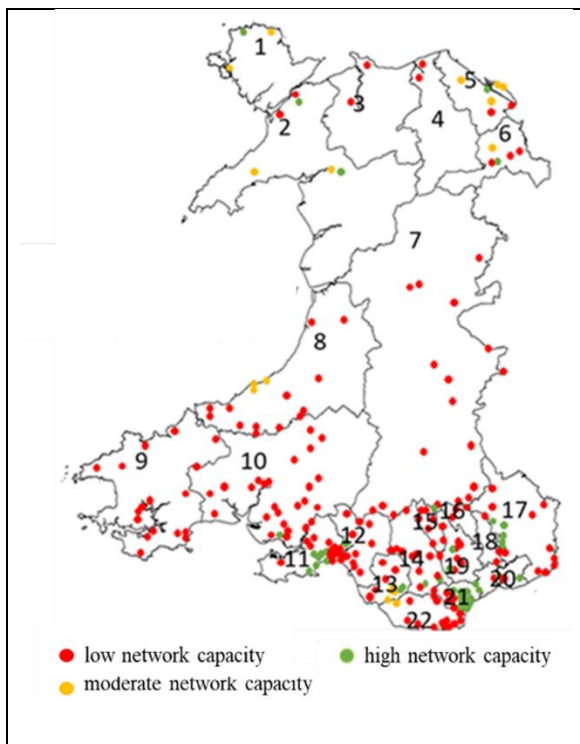


Figure 7.11. Welsh Electricity sub-station location and capacity. Adapted from: Western Power Distribution (2017) and Scottish Power Energy Networks (2017)

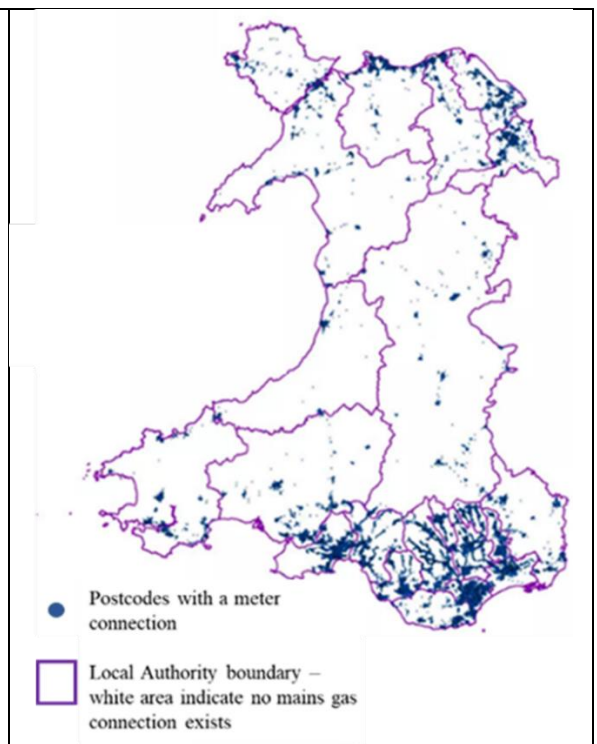


Figure 7.12. Off-gas areas in Wales. Source: National Assembly for Wales (2014)



Figure 7.13. Outdoor tank used for oil storage
Source: Author

Overall, many peripheral households are confined to the most expensive energy sources. 54% of interviewed households highlighted their lack of choice over their heating source due to the undeveloped local infrastructure, resulting in higher cost for their energy:

One of the additional costs of living in the countryside is that there is no gas, so that's one less option we have. You can have a tank in the garden but you're restricted with your supplier and the price (Business interview 5).

We sort of were forced into LPG or oil because clearly were never going to get gas up here, so we were forced into that, but we minimise the use of that as much as we can (Melvin, homeowner, aged 65-74).

This domestic perspective was supported by interviews with third sector, expert and local governance interview groups who also spoke not only of how limited choice of energy supply can 'trap' households in more expensive energy sources, but how that compounds vulnerabilities in rural areas by coinciding with poor energy efficient housing stock and low incomes:

[If a home doesn't] have access to mains gas so there's two big problems with fuel poverty, one is obviously you've got to buy a different form of fuel, then your choices are limited. So, for example an oil system, you can't change suppliers so readily, you might have one or two suppliers in your area. Or with LPG, I think there's two suppliers in West Wales, Calor or

Flowgas. You're getting tied to what the Monopolies Commission would say "oh, hang on, this is a sort of a cartel" you know that can fix prices and there's no competition. But then the other thing is that you have to buy your fuel before you use it and you've got to buy it in bulk. We meet a lot of people who can't get that £300 together to fill the tank. [...] So, the budgeting is a big deal [...] your choices are limited, you have to buy in bulk in any circumstances, then you've also got the sort of perfect storm of poor housing stock... And then you've got the wages. So those three things, it's the low income, poor energy efficiency in the home and price of fuel (Expert interview 2).

Combined high energy costs and high transport costs create a higher cost of living in peripheral places. This has also been recognised in other research such as that carried out by Smith et al. (2010b) (Table 7.2).

Table 7.2. Additional weekly rural costs for 4 illustrative household types, compared with UK urban Minimum Income Standard.

	Rural Town	Village	Hamlet
Pensioner Couple	£2.26 1%	£43.00 19%	£48.08 22%
Single working-age adult without children	£15.98 9%	£32.92 18%	£41.37 24%
Working-age couple with 2 children	£46.67 12%	£59.52 15%	£72.20 18%
Lone parent with 1 child	£21.98 9%	£33.65 14%	£36.81 16%

Represents rural cost cash difference and % increase on corresponding urban budget (excluding housing costs and childcare)

Source: Smith et al. (2010b, p. 8)

Smith et al. (2010b) research, furthered by Smith et al. (2012) compared findings of the cost of living in rural homes with living in urban homes. They found, as the table demonstrates, that the financial costs of living in a rural home are higher than urban homes in all three of the different rural homes categories they researched. Finding that the more remote the house, the higher the cost of living. So, a working age couple, with 2 children would need to spend 12% more per week living in a rural town or 18% more per week living in a hamlet than urban counterparts. But when this is translated to income, in order to get the £72.20 needed living in a hamlet, they would have to earn an extra

£241 per week to account for income tax, national insurance and loss of tax credits. To reflect the difference in urban and rural living costs it is argued that an ‘Rural Minimum Income Standard’ should be set between 80-90% of the UK’s median household income, a difference of between 20-30%.

Cost of living can be further increased for some, due to the use of ‘pre-payment meters’ which only allow energy in-flows to the homes once advance payment has been made. Prepayment meters are considered the most expensive method of paying for energy in the UK, costing a household on average between £260 to £320 per year more than other payment methods (Competition and Markets Authority 2016). This is because energy companies claim that the administrative costs for the service are more than alternative payment methods, while prepayment customers have a restricted choice of energy tariffs. Paying for energy they use in advance is done by applying credit to the meter either with coins or a top-up card/key; if the credit is depleted, the energy supply is switched off.

There needs to be more regulation of the energy companies because they seem to play on those that can't afford particularly when you look at the cost of a top up card to what we can pay on direct debit. I think that's just absolute madness. In effect they're paying for their energy up front, the companies have got their money before they've even given it to them (Third Sector interview 1).

Wales has the highest numbers of prepayment meter customers in the UK, excluding Scotland (Ofgem 2017). While not a specific periphery issue, as pre-payment meters are installed in both rural and urban areas, their occurrence within peripheral places, where energy is already more expensive than other areas can make energy affordability precarious.

Even though prepayment meters are more expensive, for some households they are a preferred option to keep control over their energy bill, i.e. as “a budgeting or lifestyle tool” (Citizens Advice 2014). However, they may be also forcefully installed by ‘warrant’ in households where energy debt has been accrued (Ofgem 2017). A warrant often incurs a further charge, on average £400 in the past (although it was capped at £150 in January 2018). Combined with higher tariffs, this further indebts those households (Ofgem 2017). While prepayment meters are installed in both peripheral and non-peripheral homes, the high proportion of them in Wales indicates that there is a high proportion of homes over-

paying for their energy and as such are in precarious affordability situations. Given the high numbers of households using expensive energy, either due to their energy source or payment method, combined with less energy efficient homes, personal energy needs and specific energy practices leading to increased energy consumption, accessing the energy needed can be very difficult. Households experiencing one or more of these situations are already energy vulnerable.

Non-mains connection means security of supply can be problematic for a number of reasons. For example, it relies on households monitoring their consumption and ordering replenishment in good time and in some instances is highly dependent on the weather conditions and whether fuel deliveries can even reach the buildings:

It is a real risk because we do prepare to be snowed in, because it could very easily happen. It's a one-track road so I can't imagine anyone is getting in whatsoever. So we do make sure we've got stuff in for the dogs and we've got a little gas burner so we won't be relying on electricity [...] In the winter you have to think of [oil deliveries] in advance because there's no point letting your fuel run down and then they can't get to you (Michael, homeowner, aged 45-64).

Poor electricity infrastructure in rural peripheries also means that those networks are also more likely to be adversely affected by extreme weather conditions such as snow. As Michaels comment highlights, for households in these places without mains gas supply consideration has to be given to alternative sources of both heat and electricity at these times. During February and March 2018, the UK experienced severe weather conditions due to “the Beast from the East” (National Energy Action 2018, p. 5). Red and Amber weather warnings were issued by the MET Office for snow and ice, with the highest levels of snow occurring in South Wales. Daytime temperatures fell as low as -4 °C and “some rural communities were entirely cut-off and had to receive supplies by helicopter” (National Energy Action 2018, p. 5).

To counteract precarious energy supplies, some households adopt alternative practices, such as the installation of Rayburns, Agas and wood-burners. Rayburns and Agas are types of traditional cooking and heating systems that are more common to rural Wales and are also often seen as part of the character of rural living. They work on the principles of heat storage whereby they are run continuously by slow-burning fuel. Traditionally

they comprised ovens and hot plates and burned coal and wood, but later they were developed to use kerosene, diesel, biofuel, gas or electricity. While also adapted to heat household water, the Rayburn was later developed with central heating capabilities. Their use of solid fuels meant they were considered appropriate and efficient for homes without electricity and /or mains gas connection. However, the energy efficiency of such traditional range cookers is poor, using as much as 30 times the UK annual average for cooking (Lightfoot Energy Service 2018). Nevertheless, the high cost of changing to a new modern range cooker or alternative cooker and heating system can be prohibitive.



*Figure 7.14. Solid fuel Rayburn
Source: Author*

Cultural practices also have impacts on energy consumption, reflected in how and why energy is used, or in the lack of knowledge how to use energy efficiently (Simcock & Petrova, 2017). Interviewees noted the energy practices specific to peripheral places that increase their energy demand. The use of range cookers continuously generates heat; householders typically reduce excessive temperatures by opening windows and doors. While this is not energy efficient, this is part of households' larger strategies to cope with limited energy options and demonstrates how the "materiality of a home", including the physiological contributions energy makes to such materiality, "shapes the lifestyles (and consequent energy consumption) of those who dwell within them" (Roberts & Henwood 2019, p. 3):

I have oil for heating, a Rayburn, it's the old type. It was put in about 25 years ago, before that it was a coal one. We changed it as we were starting to struggle with coal, plus we often get power cuts in the winter, so I wanted it to work should we not have electricity. It's probably not as efficient as the new ones it's a two-burner and it's either on or off. It's not cheap to run, but it is warm all the time (Business interview 5).

Choosing an energy source that would not be affected by power cuts is familiar to many households who sometimes have three or four sources of energy (see Figure 7.14). Most common is having electricity with either mains gas, oil or liquified petroleum gas (LPG) in addition to a wood-burner. This is the same even for households with domestic renewable energy production, whereby a wood-burner is retained either for comfort and ambiance or as a safety device should the main energy system fail. Wood-burners are also considered cost-efficient; many households have their own wood-supply or feel that purchasing extra wood is relatively low-cost. Of the households interviewed 24.3% had a wood-burner in addition to other energy sources.

Access to mains networks or the lack of the same can have varying impacts on the economic viability of low-carbon transition. For example, lack of access to mains-gas network makes low-carbon heating more attractive. As low-carbon heat production is typically expensive to install, the Domestic Renewable Heat Incentive (RHI) was initiated by the UK Government in 2014 to mitigate some of these costs³⁷. While not limited to non-gas network homes, the scheme is particularly aimed at them, and is unlikely to be economical for homes with access to the gas mains. However, on comparison of RHI take up in Wales and the BBNP, only 1% of households in either had accessed the scheme (Ofgem 2019b). This could indicate low popularity overall either of the scheme itself or of renewable heat technologies which aside from solar thermal, require large space to house the equipment and high levels of building energy efficiency (Figure 7.15). Thus, there is little variation between Wales overall and rural Wales in RHI take up.

³⁷ See Chapter 3, page 47 for details of RHI

Samantha is a retired professional and lives in a 1980's brick-built end of terrace. She lives off a limited pension budget and is unable to work to top-up her income due to ill-health. Due to the geographic spread of her family and friends Samantha depends on her car. Her home only has part-double glazing and insulation to the ground floor, making upstairs very cold in the winter.

“Do you remember the really bad winter? 2010 I think it was. I'd just had the new boiler and the [external] condensing pipe... well it froze up, didn't it! and no condensing pipe meant the boiler wouldn't work. It got close to Christmas and it was icy cold. I thought the toilet's going to freeze! I was at my wits end... I must admit, I was in an absolute state. So, I called on a plumber and he came out and disconnected the condensing pipe and he said 'keep that bucket under the boiler, you'll have to empty it, but you will be able to run the boiler'. So that's what I did. I phoned mum and dad, said 'I can't come home for Christmas, because I have to keep emptying this bucket two or three times a day'. Anyway, it was a rotten Christmas. So I thought, 'right I'm never going to be stuck with just one source of heating', with a wood-burner, I've always got that, it won't freeze up, as long as I've got wood, I can get warm... and if I'm really pushed I might be able to heat water on it.”

Samantha talked about the coldness of some parts of her home, of self-rationing energy due to cost concerns and due to keeping her car running.

“The wood-burner is just to keep one room warm. The gas central heating will do the whole house and the hot water. I do use the gas, but mostly I'll just put an extra woolly jumper on. A lot of it now I'm retired, does come down to saving money, which is a big concern... I think the car is the expensive bit. The heating and hot water, and I've got an electric shower and I read somewhere how much an electric shower costs per shower, so I've cut down on the amount of time I spend in the shower.”



Image: Wood-burner

Samantha is an example of a household that would not readily identify as fuel poor and living in a less deprived area, is unlikely to be selected for area-based assistance. However, her situation demonstrates the precariousness of many households' situations and the distress and disruption caused when things go wrong and thermal comfort can't be reached. Samantha also exemplified the priority placed on maintaining personal transport over domestic energy needs, due to physical distance from places of importance.

Figure 7.15. Household solution to energy vulnerability (access and affordability) installing wood-burner.



*Figure 7.16. Domestic Ground Source Heat Pump (GSHP) Condenser (left) and necessary plumbing (right)
Source: Author*

Alternatively, households with access to the mains electricity grid can participate in the UK Government Feed-in-Tariff scheme (FIT)³⁸ whereby payment is made to the producer for energy exported to the National Grid in addition to payments for energy generated even if consumed by the household itself. In this case, having access to mains electricity networks and producing electricity, as opposed to, or in addition to heat production, is of greater benefit. In comparing FIT take up in Wales and the BBNP, 20% of households in Wales and only 6% of household in BBNP had accessed the scheme (Ofgem 2019a). Compared to RHI, the FIT scheme has proven more popular overall. The difference in FIT up-take between BBNP and Wales is interesting and could be attributed to a number of factors. In some instances electricity production is limited due to grid capacity so that even households with the ability to generate renewable energy can have the benefit of the export tariff restricted. In peripheral places, grid capacity can be restricted due to the limited numbers of grid sub-station or access points compared to numbers of consumers each access point serves. The socio-economic context of households in the Park may also influence abilities to afford low-carbon technology in the first instance. Additionally, there may be issues within the BBNP as to whether technologies are suitable within the conservation setting.

Accessing the electricity grid can perhaps be more of an issue for larger scale developments such as those over 1 MW most typically taken on singularly or jointly by non-domestic actors such as communities, third sector, governance institutions and

³⁸ See Chapter 3, page 47 for details of FIT

commercial organisations. As highlighted in Figure 7.10 electricity grid access is most restricted in rural peripheries in Wales due to the weak coverage of the electricity network. To install new production in an area without grid connection, or with grid connection but no capacity to accommodate new production, incurs cost of installing network between the production and the grid.

Part of the problem is the grid in mid-Wales is not great, certainly some parts of it. In south Powys, there were some [community] schemes that basically needed to upgrade the whole [electricity] line to enable any more connections, even for a very small hydro. It just meant that the project couldn't happen [...] It was just ridiculous, this 15 KW hydro had to develop £2,000,000,000 for the grid connection (Expert interview 3).

The cost is levied to the proposed development, regardless of the development size or organisation (i.e. commercial or community). The grid up-grade will then benefit all developments that follow without having contributed to the cost. A number of expert interviewees discussed how these seemed unfair to small scale developments, such as those planned by communities, whereby the cost of any upgrades are beyond such groups and their small production size (MW) means that even if they could afford the cost, they would not generate enough income to re-coup it.

In summary, poor energy infrastructures associated with rural peripheries are a result of continued concentration of investment in energy networks in core urban areas due to the demand by and economic benefits of population critical mass. Poor energy infrastructure in peripheries creates situations where energy cost, whether accessed from mains or alternative sources, are higher. Access to mains networks offers a relatively secure energy supply at lower cost, for those without mains network connection, access to energy can be more precarious as it depends on household monitoring of energy consumption and ordering re-fuel as opposed to being constantly supplied. This along with the higher cost associated with non-mains energy supplies means for many in the periphery energy access and affordability are more uncertain.

Additionally, alternative energy supplies offer less competition, creating energy vulnerability in terms of energy flexibility. Finally, while mains energy in peripheries experiences higher frequencies of cut-off due to a combination of poor infrastructure and adverse weather conditions, due to the need to transport non-mains energy via road, it can

be at even higher risk of cut-off. In combination with this, older, harder to heat building stock, more common in peripheral places also has energy vulnerability implications whereby inefficiency can lead to the need to consume more energy to maintain thermal comfort, while building fabric can make increasing energy efficiency more difficult and/or more costly.

Mains energy access plays an important role in the viability of low-carbon transition in the form of energy production. At smaller scales, poor energy access to the grid can make transition more attractive as low-carbon energy production in addition to some subsidies still available can be more cost-effective than remaining on traditional non-mains energy. However, at a larger scale non-grid access poses difficulties as without such access the higher levels of energy produced cannot be distributed and at present cannot be stored. Mains access in these instances is still needed, however upgrading the electricity grid to take new capacity or to physically meet the new production is very expensive, and so at present only the largest energy developments can afford such costs.

7.5 Peripheral housing stock & tenure: Inescapable inefficiencies

Building structure, size, age and state of repair influence how energy efficient a building is affecting the level of energy required to make a home comfortable and meet personal energy needs. The households interviewed lived in a range of building structures and included detached (40%), semi-detached (37%), terrace (14%) and flats (9%), of these 57% were solid stone walls, 30% were brick and 19% were non-standard construction. Their homes also varied in age, from pre-1900, 1930-40, 1980 and post-1990; however, the majority were pre-1900 solid stonewall builds (54%), which are particularly difficult to keep warm and also to insulate (see Figures 7.16-7.18).



*Figure 7.17. Row of stone-built terrace cottages (circa 1890s), most with external wall insulation cladding (mix of privately funded and Arbed).
Source: Author*



*Figure 7.18. Row of stone-built terrace houses (circa 1890s)
Source: Author*



*Figure 7.19. Semi-detached stone and brick-built houses (circa 1900) with external rendering
Source: Author*

Solid stone walled homes are also some of the most energy inefficient in the UK, holding 30% of overall housing stock but responsible for 50% of domestic building carbon

emissions (Roberts & Henwood 2019). These types of domestic building are characteristic to peripheral areas in Wales; indeed, research has indicated that Wales has the lowest levels of energy efficient homes and highest levels of most energy inefficient homes in the UK (Staffell et al. 2018). As Figure 7.19 demonstrates within Wales, the highest levels of the most energy inefficient homes are within rural Local Authority areas. Scaling down further, in the BBNP 43% of homes are detached, 69% of homes were built pre-1900 and 34% have EPC ratings of D and below, compared to 38%, 28% and 31% in Wales respectively (BEIS 2015). As building structures, size, age and state of repair influence energy efficiency and levels of energy required to meet personal energy needs, this indicates that a high proportion of houses in rural peripheries, and in the BBNP in particular, are harder to heat and insulate than in other areas.

We have a really high percentage of inefficient properties and a really low percentage of efficient properties... we've [also] got the highest number of off-gas properties in Powys (Local Authority interview 3).

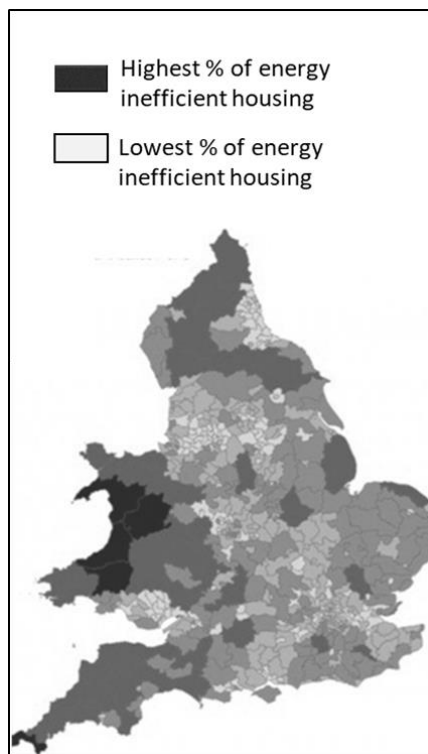


Figure 7.20. Percentage domestic EPC Bands F or G.
Source: Centre for Sustainable Energy (2015)

The house I was in before was a stone house and there was no insulation, just in the attic. I was spending a fortune on oil because there was no gas where I was living, I used to go to bed about half past seven in the winter because it was so cold no matter how many heaters I had on. And because I was on my

own, I couldn't afford to have it running twenty-four hours (June, social tenant, aged 65-74).

Physical building structure can also present an insurmountable obstacle for some households, meaning energy efficiency was limited or unachievable, and also making renewable energy production at a meaningful scale impossible. For example, the majority of owned households interviewed were in pre-1900 solid stone wall houses, in these instances loft insulation is the easiest and most cost-effective form of insulation. Reflecting this 95% of households interviewed had loft insulation, which is comparative to Wales at 91% (Stats Wales 2010). Additional insulation to walls can comprise cavity insulation where wall cavities are filled with insulation or internal or external cladding, where walls are covered with insulation blocks. For solid stone buildings, only cladding insulation is suitable as they do not have cavities. Internal cladding causes great disruption to households (Vadodaria et al. 2010) and requires re-decoration. External cladding changes the look of the exterior of a home, so restrictions apply as to whether it is permitted in national parks and conservation areas (Welsh Government 2013). Furthermore, insulation cladding of solid stone walls is controversial as in some instances it has worked against the building structure in increase dampness in the home “negatively affect[ing] occupant’s health and comfort” (Vadodaria et al. 2010). Again, suitability of wall insulation with building structure was reflected in the household interviews where approximately 48% had some form of wall insulation, which is also similar to Welsh statistics where 56% of homes have wall insulation (Stats Wales 2010)³⁹. However, this figure is likely to be higher in reality, as cladding is not included in this statistic.

It's the mess that's involved you know, one room out of use. Because, everything, the skirting boards got ripped up...carpet needs re-laying, it is, it's a massive job (Sarah, homeowner, aged 65-74).

Many domestic scale energy production options have specifications that contradict the building structure of people’s homes. For example, solar PV and solar thermal both require roof space or land that is not North facing to generate meaningful levels of energy (see Figure 7.19 for example of roof-mounted solar-PV) and both ASHPs and Ground-Source Heat Pumps (GSHP) require space to hold the large condenser units (see Figure 7.15). Of the nine households interviewed who had changed their energy system to

³⁹ Wales Stats does not include external or internal wall cladding as data unavailable

renewables or who had installed internal wall insulation five completed such works during other planned renovations or during periods away from the home to avoid lifestyle disruption.

Recently you know, since I've been doing renovations it's been more in the fore-front of your mind (Kelvin, homeowner, aged 55-64).



Figure 7.21. Roof-mounted solar-PV.
Source: Author

Even though building structure can be incompatible with low-carbon measures, all the owner-occupied and socially rented homes interviewed had also some form of energy efficiency measures. Most frequently this included energy-saving light bulbs, loft insulation, and double glazing. Less often, but perhaps most effective, it included internal wall insulation, cavity wall insulation or external wall insulation. All households with these measures praise them for increasing comfort levels of their homes while at the same time reducing energy consumption:

The year before last they put the external cladding on. It's the best thing they did. I've moved the room around since then because I couldn't put the chair by the window before because of the draught, but I can now [...] The insulation has made a massive difference. Normally by this time, I'd have to put more oil in again but I have half a tank left now (Olive, social tenant, aged 70+).

We've had insulated from the inside, the main house, because its solid wall, so we had insulation put on the inside and oh, that's wonderful! Yeah, not only in retaining the heat, but on the cold walls, we used to get big black

patches of mildew, condensation that was on the walls, so, yeah, that's made a big difference (Sarah, homeowner, aged 65-74).

Energy efficiency measures are not accessible to all. First there is a cost implication, even the lowest cost low-carbon measures can be more expensive than higher-carbon counterparts (for example energy efficient lightbulbs cost more than traditional lightbulbs). There is also a question of compatibility of more intrusive and larger scale measures with building structures; cavity wall insulation obviously requires cavities which are absent in solid stone buildings, leaving external or internal insulation as the only viable option for such buildings. However, these come at a higher cost, external insulation cladding can completely alter the appearance of homes, making it undesirable and in some areas prohibited by planning authorities. Internal insulation cladding is very disruptive to households and involves complete re-decoration of affected rooms. With the majority of peripheral homes being solid stone wall, it appears that only the two most intrusive and expensive insulation measures are compatible.

Finally, household tenure can influence autonomy in choosing energy source and altering building energy efficiencies, therefore, tenure holds implications for energy vulnerability:

Because we're renting the properties we do as were told, we've got no choice over it. If you don't like it, you can get out (Catherine, social tenant, aged 45-64).

Lack of control over such aspects can increase vulnerability in several ways; first tenants' living conditions and elements of energy efficiency are subject to their landlords' choices and obligations. For social tenants, they are protected to a certain degree from having inadequate and inefficient homes in policy (Welsh Housing Quality Standard (WHQS) 2002). With regards to energy, the standard requires that all properties must be "capable of heating the whole of the dwelling to a comfortable level in normal weather conditions" and "reasonably economical to run" (Welsh Assembly Government 2002, p.15). This is reinforced in the Revised Guidance for Social Landlords on Interpretation and Achievement of the WHQS (2008, pp.18), where it is specified that properties must be "adequately heated, fuel efficient and well insulated". However, private tenants are not protected in the same way and there is only a requirement for private landlords to ensure their properties are energy efficient to at least an EPC level E (Department for Business, Energy and Industrial Strategy [BEIS] 2017a). This is arguably still very cold and from

the perspective of the private tenants interviewed meant they were currently or had past experience of living in unhealthy conditions:

It was just damp throughout the whole place. And it's not even sometimes in the walls and stuff, it's in the air. It's the moisture in the air, so it gets on all your things, and the bedding smells crap... Where I'm living now, you get damp mites (Noel, private tenant, aged 30-44).

Second, a lack of autonomy in choosing energy source or internal technologies can mean households have to use perhaps more expensive energy sources or technologies that do not meet their personal needs. Again, social tenants are offered slightly more autonomy in this regard where they have the right to decline certain measures and during upgrades to their energy systems, are given some choice, even though it is constrained, over energy source.

We have a lot of properties in off-gas areas, they are on oil or solid fuel. When their system goes down, we will offer them the choice of an ASHP or to remain on oil [...] With all our planned works they have the right to refuse people entry into their home, because it is their home first and foremost (Local Authority interview 5).

Factors such as a household tenure also play a determining role in inclusion in transition. Social and privately rented homes can install domestic production or energy efficiency measures and benefit from lower energy bills, but this is at the discretion of their landlord. Socially rented homes have greater opportunity of participating in low-carbon transition thanks to policy protections in the Welsh Housing Quality Standard (WHQS) (2002) and the Arbed area-based energy efficiency scheme⁴⁰. However, such participation is not the choice of the household and while lessening some aspects of energy vulnerability, most often focus is on increasing energy efficiency alone as opposed to decarbonising the household. Privately rented households, while having an option to take up the Nest energy efficiency scheme⁴¹ (subject to meeting certain criteria) have much less policy protection. Additionally, participation in such schemes, or alterations of any kind to their rented property are at the landlord's discretion and outside tenant control:

⁴⁰ See Chapter 5 for outline of the Arbed scheme

⁴¹ See Chapter 5 for outline of the Nest scheme

I'd love to have solar panels or what else can you have? I'd love to be completely renewable; I'd love it. But because we rent, it's not really our decision, we can't make the decision (Rachel, private renter, aged 15-29).

Homeowners with higher incomes or wealth are best positioned to participate and benefit from low-carbon transition. Of this group, homeowners with access to mains electricity grid benefit most by accessing FIT. Following this group are social tenants, who due to policy protections experience low-carbon transition mostly through increased energy efficiency with a smaller number via renewable energy production (any FIT would be attributed to the landlord). These two groups also highlight how policy interventions are still likely to favour households either with access to electricity networks (FIT), or with critical mass of certain criteria (Arbed and Nest). Thus, households without access to mains electricity, in non-deprived areas or with sparse populations, are less likely to be able to take advantage of such schemes. Furthermore, homeowners on lower incomes or with higher living expenses and privately rented households are least able to either generate renewable energy or increase their homes' energy efficiency. For owned homes this is mostly due to the financial cost of such measures and for private tenants this is due to their lack of ownership over their home.

7.6 Conclusion

Many instances of energy vulnerability found in the periphery, while being compounded by more widespread factors such as housing tenure, can stem from elements of peripheral disadvantage. These include, low incomes, the tyranny of distance, poor energy infrastructure and energy inefficient housing stock. Either directly or indirectly such elements can impact upon energy affordability, access, energy efficiency, flexibility, practices and needs. Together, these peripheral-specific energy vulnerabilities can, in some instances, lead to the adoption of peripheral energy practices to mitigate energy insecurity or in reaction to other peripheral pressures, such as maintaining personal vehicles. However, mitigation practices themselves can create further energy vulnerabilities, for example, accessing alternative energy sources can be more expensive increasing the risk of unaffordability.

Rural peripheries have the highest levels of service deprivation within Wales, with a trend of ever decreasing services, both public and private, vehicular travel is a necessity for all peripheral households whether economically active or not. Public transport is more expensive in Wales than other non-Welsh regions of the UK. Additionally, as highlighted by interviewees, public transport can be incompatible with employment times or in some instances non-existent. Together these issues feed into an ever-growing need for peripheral households to run their own vehicles, effectively being forced into car-ownership (Currie & Senbergs 2007). Even though not routinely considered as part of domestic energy requirements or costs, for peripheral households, personal transport provision is high on household budgeting list. Peripheral households spend proportionately more on running vehicles than other areas, indicating less income to spend on household energy, possibly resulting in trade-off's between transport and heat.

Adding to the financial cost of peripheral living is the high cost of energy. In peripheries this is in the most part attributed to higher fuel and distribution costs for both mains and non-mains sources. With regards to mains energy (gas and electricity), additional costs are incurred when the energy must be transported further, during which additional losses occur (USwitch undated). In addition, smaller populations incur higher costs as energy companies cannot “bulk buy” from generators whereby lower prices can be agreed (USwitch undated, para. 1). Finally, costs are associated with consumption, so in places where there are high consumption levels, there are higher distribution costs (USwitch undated). In these instances, while not applicable to peripheries within Wales, Wales overall experiences some of the highest energy prices in the UK, most notably mains electricity whereby costs are only higher in Northern Scotland and London (House of Commons Library 2017a; Ofgem 2019d).

However, the starkest differences in energy price are when mains connection is not present and traditional non-mains energy sources such as oil and LPG are utilised. This is a historic problematic of Welsh peripheries, which persists, due to low population levels, making mains extension economically unviable for energy distribution networks. Traditional non-mains sources hold other vulnerabilities, this is due to the need for household manual monitoring of supply and ordering, and physical vehicular delivery, made more tenuous in adverse weather conditions. Precarious energy access has encouraged some homes to adopt energy practices, such as the installation of wood-burning stoves which use a locally sourced and cheap energy source, or the installation of

solid fuel stoves which are very energy inefficient. Combined with this, high numbers of traditional solid stone buildings, which are hard to heat, hard to keep warm and hard to insulate means that many households are required to consume more energy to attain thermal comfort.

Compounding high living costs is the prevalence of low incomes. This is due to relatively fewer employment opportunities and/or insecure casual or seasonal work are indicative of rural areas and may be more pronounced where tourism and agriculture represent large proportions of the employment sector. For more secure, higher paid work people travel to core areas. For some, there is a choice between working locally for lower income or obtaining higher incomes elsewhere but incurring higher expenditure on transport - reducing their overall residual income once transport costs are removed. For communities in the periphery, low income is just one factor affecting energy affordability, high living cost due to transport, energy (and in tourism areas such as the BBNP - housing costs) are also in affect. Subsequently, even those in relatively well-paid jobs experience precarious energy affordability.

The above elements of peripheral deprivation also hold implications for low-carbon transition. High living costs place additional restrictions on household budgets, restrictions that in turn may limit low-carbon transition due it its advancement in any form (production or energy saving) requiring finance. Transition is also subject to building structures, whereby solid stone walls, the dominant style of building in peripheral Wales, makes energy efficiency harder and more expensive to achieve. Likewise, physical space and in the case of solar, non-North facing rooves are needed for energy production, this again can impact on the viability of energy production. While these implications for low-carbon transition are similar for communities in and outside of the BBNP, for those inside they can be rigidified by planning systems that restrict or increase the cost of low-carbon interventions. Additionally, as autonomy over transition is highly influenced by housing tenure – i.e. owner-occupiers are most able to transition - the particular housing market within the BBNP may restrict this more acutely than elsewhere to those most wealthy.

Mains energy access plays an important role in the viability of low-carbon transition in the form of energy production. At smaller scales, poor energy access to the mains heating networks can make transition more attractive as low-carbon energy production, in addition to some subsidies (such as RHI) can in the longer-term be more cost-effective than remaining on traditional non-mains energy (such as oil). Poor access to electricity

grids is less common, however does mean that subsidies such as FIT are not accessible. At a larger scale, non-electricity grid access presents economic challenges, as without it, any electricity produced cannot be sold or distributed. In these instances, mains electricity access is still needed. As areas of available grid capacity are scarce in the periphery, in most instances the grid requires extending or upgrading to enable the distribution of new electricity production. Costs associated with this are prohibitive and restrict new developments to the largest energy developments capable of absorbing such costs.

Within the BBNP, planning requirements do not permit large scale energy developments. This can protect Park communities from bearing the cost of low-carbon transition at a large scale. However, planning restrictions due to conservation rules, can also make small-scale developments more difficult by increasing the costs or limiting the type and scale of technology. For example, for a household wanting to install an ASHP, a high level of building energy efficiency must be attained first. If living in a stone-built home they are restricted to the most expensive wall-cladding insulation, and if it was viewed that external cladding would not suit the aesthetic of the Park, only internal cladding would be allowed (internal cladding is also dependent on the listed status of the house). Internal cladding is the most disruptive form of insulation as it requires the redecoration of all rooms affected. However, transition experiences within the BBNP were not uniform, some interviewees experienced the same issues and benefits as those outside of the Park, while others experienced more difficulties as a result of living in the Park. Thus, while the overall picture is mixed, communities within the BBNP, while protected from energy injustices faced by communities outside of the park when large scale commercial developments take place, can experience injustice through being limited in the type and scale of transition they can pursue.

Chapter 8. Discussion & Conclusions: Energy Periphery, place-based energy injustices and transitions

8.1 Introduction

This research sought to understand the tripartite interplay between energy vulnerability, peripherality and energy transition. Each can hold separate concerns for energy deprivation, spatial disadvantage and energy regime change. Often considered in silo, there is a gap in understanding how energy vulnerability, peripherality and low-carbon energy transition interplay in different ways, and how this interplay impacts the mode, distribution and affect of each. Without exploration of these interplays energy vulnerability and transition literature are incomplete. Further, there is a gap in the exploration of energy transitions from not just a spatial perspective, but a peripheral perspective, consequently how transition is progressing around and within peripheries and to what affect is little known. Finally, as energy transition may hold some opportunities to alleviate energy vulnerabilities, there is opportunity to achieve policy goals - reducing fuel poverty and achieving carbon reduction targets simultaneously. Without enhanced understanding of the interplay between peripheralization, energy vulnerability and low-carbon transition, policy measures will remain only partially successful.

To address these research gaps, a case-study was carried out in mid-south Wales exploring variegated reasons for, and experiences of, energy vulnerability, peripherality and low-carbon energy transition. An energy justice and spatial justice framework was adopted and mixed research methods were used, including interviews, focus groups, observation, document analysis and quantitative statistical analysis. Primary data collection was carried out with a range of different groups including households and community groups, public, private and third sector organisations through to energy experts and the Welsh Government. This provided insight into multiscale, multidimensional and interconnected experiences of energy vulnerability, peripherality and energy transition.

To bound the case study, much consideration was given as to how periphery is theoretically understood and how this materialises. This research understands peripheries as socially constructed places of relative low value, experiencing socio-cultural, economic and political disadvantage. These disadvantages perpetuate circular processes

of social, economic and political marginalization, realised spatially. They also create and continuously reinforce a dependence on the core. As a relative place, periphery development is symbiotic with core development and peripheries are often on the edge or fringe of core spaces. As a socio-spatial construct, peripheries are subject to scale, thus peripheries can be different places within a neighbourhood, sub-region, region, country or the globe. Thus, core places can hold within them lower scale peripheries and peripheries can hold within them lower-scale cores. For the purpose of this research, this theoretic was simplified using Copus's (2001) peripheralization model to select places of relative peripherality. Thus, the research is based within Wales which relative to other UK nations can be considered a national periphery. Narrowing the scope further the same considerations for periphery were applied within Wales. Thus, the case study is located in and around the Brecon Beacons National Park (BBNP), Mid-South Wales. As observed by Fischer-Tahir & Nauman (2013), often (but not exclusively) peripherality coincides with rurality, this is the case here where the study area is predominantly rural, but also includes exurban and post-industrial areas.

This research illuminates how in Wales energy has and continues to play a fundamental role in spatialization processes at all scales, interplaying with and reinforcing economic processes that distinguish places as core or periphery. The multiple disadvantages that have developed within Welsh peripheries represent both spatial injustices and energy injustices. The circular and self-perpetuating process of peripheralization creates interplay between spatial injustice and energy injustice, and their subsequent reification. As elements of peripherality can vary over in space and time, so too does the manifestations of spatial injustice and energy injustice and their impacts. Energy vulnerability, as a form of energy injustice, likewise holds spatial contingency, thus energy vulnerability experiences in Wales are influenced by elements of peripheral disadvantage. Processes of spatialization and energy vulnerability together influence transition mode, trajectory and outcome. Furthermore, low-carbon transition itself holds influence over drivers of energy vulnerability and elements of peripheral disadvantage. These findings hold important knowledge contributions towards the advancement of energy vulnerability and transition literature, addressing research gaps in each.

This chapter presents the final discussion of research findings which inform these research conclusions. The first three sections are dedicated to answering the research questions; Section 8.2 explores *How is peripherality experienced within and around the*

Brecon Beacons National Park, Wales? Section 8.3 explores the connection between peripherality and energy vulnerability, demonstrating how elements of peripheral energy vulnerability in Wales are place-based answering the second research question; *How does energy vulnerability manifest within and around the Brecon Beacons National Park, Wales?* Then, by building on the prior sections, Section 8.4 answers the final research question *How is low-carbon energy transition experienced within and around the Brecon Beacons National Park, Wales?* It demonstrates how place-based energy vulnerabilities, present in part due to spatialization processes, impact how and where low-carbon transition in Wales takes place. It also explores how low-carbon transition has influenced elements of energy vulnerability and peripherality. Following this, Section 8.5 highlights and summarises contributions to theoretical discussions. In Section 8.6 policy and other recommendations are made as to how low-carbon transitions can be taken forward in ways to maximise benefits to peripheries. Finally, in Section 8.7 research limitations and suggestions for further research are discussed.

8.2 Experiences of peripherality: Interplaying spatial and energy injustices

Peripherality was experienced in a number of different ways by research interviewees, as political marginalisation, as decline in public services, as weak economy and in poor transport infrastructures⁴². These experiences of peripherality are individual interviewee perceptions, and are subject to individual histories, contexts and biases and are influenced by the research process itself. However, when triangulated with other sources of cultural, economic and political data, such as media representations, official statistics, parliamentary proceedings and other research, it is apparent that these experiences are reflective of peripherality in Wales.

Politically, peripheralization of Wales and within Wales' regions results in the marginalization and non-recognition of periphery needs by decision-makers at relative scale (i.e. nationally or regionally). Interviewees at different scales gave various examples of political peripheralization via a range of experiences at different scales. Nationally, this was evident in weaker policy powers held in Wales comparative to other devolved

⁴² For initial discussion see Chapters 6 and 7

UK countries, in particular over transport and energy policy. Limitations in energy policy powers⁴³ was raised by interviewees in *Chapter 6* as limiting the ability of Wales to achieve its low-carbon ambitions. Similarly, restrictions over policy responsibility also means limited financial autonomy in these areas, so in the case of major infrastructural developments, Wales is still considered together with England for public spending decisions⁴⁴. However, other research has demonstrated that in the case of Scotland and Northern Ireland where greatest policy powers have been granted towards supporting the renewable energy market, this has not been fully utilised, instead both countries have chosen to be a part of UK-wide market levers, such as the Renewable Obligation⁴⁵ and Feed-in-Tariff⁴⁶ (Cowell et al. 2017). This is in part attributed to the ability to draw on subsidisation for such policy levers via electricity bills paid by all electricity consumers in the UK, whereas in implementing their own policies such widespread economic support could not be drawn upon (Cowell et al. 2015; Cowell et al. 2017). While this puts into question whether a higher level of energy policy devolution would actually enable Wales to achieve its low-carbon ambitions, the arrangement can still lead to the marginalization of Wales' needs to satisfy those of the centre.

This unbalanced arrangement was experienced at lower scales, between core and peripheral regions of Wales where public spending was an area that many interviewees felt embodied their marginalisation politically. Thus, experiences of political marginalization in *Section 6.3* were associated with declining public services. This decline links to localised spending cuts and reduced budgets over-all for rural Local Authorities in Wales (Stats Wales 2018e; Stats Wales 2018f). Local Authority, other public sector and third sector interviews recognised that in decision making at local levels, rural communities were often overlooked. This was perceived to be driven by small rural budgets, constrained staff time, large geographic areas with sparse populations and the use of area-based measurements to inform locations of spend. Together these elements contribute to the selection of more populated urban areas comparative to rural. This, strategic spending by Local Authorities and other public and third sector organisations is reflective of market logics (allocating spend to where the highest return will be

⁴³ Initial discussion in Section 4.4

⁴⁴ See also Sections 3.3 and 7.3

⁴⁵ See Appendix 2

⁴⁶ See also Chapter 3

generated), further centralising public services and compounding other peripheralization effects (Marsden 2018).

Communities within the BBNP experienced political peripheralization similarly to those outside of it. One difference however is that the BBNP is differentially designated as a national park, consequently its governance by the Brecon Beacons National Park Authority (BBNPA) must follow two core purposes and a duty. This is dissimilar from other local governance authorities such as Local Authorities. In some instances, the core purposes can be misaligned with community needs, for example, permitting limited visual changes on property or landscapes during developments. This can be problematic during the installation of low-carbon interventions such as wall insulation, where planning advice needs to be sought (different to areas outside of a national park or conservation area). As most buildings are solid stone construction, without wall cavities, insulation is limited to wall cladding. Thus, in the Park, limiting the visual impact of insulation can necessitate the use of internal wall cladding, overall, this increases the cost of this process within the Park compared out areas outside of it. Some processes, such as the need to obtain environmental surveys during planning processes, were perceived by some interviewees as unfair and only in place due to being located within the BBNP. However, these requirements were found to be similar to those of other Local Authorities. The BBNPA has taken steps to raise awareness of this via issuing planning advice notes for low-carbon technologies and holding weekly planning advice surgeries of what is or is not permitted within the Park. As transition interventions can reduce energy vulnerabilities, any mechanisms preventing this occurring are sustaining energy vulnerabilities, even if some are perceptions of barriers as opposed to actual barriers. Thus, while there were additional perceptions of political peripheralization within the BBNP experienced through planning procedures, some perceptions were worsened by the misconception of extra planning requirements within the Park.

Another way peripheralization was experienced or made visible to interviewees was through the perceived lack of secure and high-quality work within their local areas⁴⁷. This was also linked by some to declining public services. Within the BBNP in particular, interviewees connected declining services essential to living in the periphery with a focus by businesses and the BBNPA on tourist needs as opposed to community needs. Lack of higher-value work meant that for some interviewees, commuting out of the periphery was

⁴⁷ See Section 7.2

essential, others spoke of their friends or family members making the same choice, or moving out of the periphery altogether⁴⁸. These experiences are supported by official statistics and other research (c.f. Currie & Senbergs 2007; Public Policy Institute for Wales 2016; Mattioli et al. 2017; Chatterton et al. 2018). In addition, dominant employment sectors within the sparsest of settings, such as tourism and agriculture, typically hold irregular and low-paid opportunities (Statistics for Wales 2015b). Indeed, as the National Assembly for Wales (2018b) demonstrates within the areas of this research in-work poverty rates are some of the highest in Wales. However, this picture is not exclusive as within the periphery there are some opportunities for employment in higher managerial and professional jobs (Office for National Statistics 2012). Additionally, there are growing numbers of retirees moving into the periphery, altering this economy further. Considering employment and income data together suggests that within rural peripheries there is an income or wealth gap between those in lower paid, unreliable, part time roles and those in higher paid professional jobs.

As *Section 7.3* highlighted, the need to travel outside of the periphery further constrained household budgets as poor transport networks meant that personal vehicles were deemed by over 90% of interviewees as essential. These experiences are reflective of other research in Wales that has demonstrated the more remote a setting, the more likely personal vehicle ownership is (Chatterton et al. 2018). The same research highlights the additional costs associated with vehicle ownership. The expense of private vehicle ownership reduces the overall household budget, consequently impacting abilities to afford and consume energy. As Mattioli et al. (2017) note, households are more likely to restrict their domestic energy consumption to maintain personal transport, than vice versa. This research also found that in official statistics regarding household living costs, location of household combined with vehicle ownership costs are not included, as such, vehicle ownership remains a hidden budget constraint making official assumptions regarding the cost of living in rural areas underestimated.

Poor energy infrastructure is a particular problematic of Welsh peripheries⁴⁹. The spatial concentration of mains energy infrastructure in more populated and urbanised areas is reflective of its development during the Industrial Revolution and privatised, market driven system (Hammond 2000; Fouquet 2010; Foxon 2013). As such, mains energy

⁴⁸ See Section 7.3

⁴⁹ See Section 7.4

networks in Wales favour settlements with larger customer bases over smaller, sparsely populated places distal from the existing networks. It is no coincidence that the peripheral, village of Ystradfellte (within this case study area) was the last village connected to the national electricity grid in England and Wales; connection only taking place in 2005 (Morris 2005) some 77 years after the first grid tower was erected (National Grid 2019). This spatial arrangement impacted energy access, affordability and consumption for many interviewees. In the first instance, if unconnected to a distribution network then energy consumption (from that source) cannot occur. Second, poor quality distribution networks are more likely to fail, for example in periods of severe winter weather. Both factors hold influence perceptions of security of supply and the inevitability of adopting alternative energy sources, regardless of inconvenience or additional costs that may be incurred.

Whilst building stock is not necessarily an outcome of peripherality as understood by core-periphery models, Wales, and in particular, rural Local Authority areas of Wales have the highest levels of energy inefficient building stock in the UK (Staffell et al. 2018; Roberts & Henwood 2019). These types of buildings are more difficult and costly to heat. It is their dominance in peripheral places in addition to their energy inefficiency and lack of adaptability (increasing the cost of living for those who reside within them), that links household building structure in Wales with peripherality. As per *Section 7.5*, the majority of households interviewed lived within such buildings and thus are more likely to experience higher energy consumption and overall higher energy costs than those who live in alternatively built homes. This can compound economic disadvantages of peripheral living if combined with possible low-income and/or high transport costs.

Overall, experiences of periphery were made visible through combinations of social, political and economic disadvantage and marginalisation at multiple scales. The same experiences are also indicative of spatial injustice and energy injustice. Spatial justice highlights wider forms of social injustice, which due to the materiality of human existence and the dialect between society and space, have spatial consequences. It accounts for locational discrimination, political organization of space, geographical development, and the ability to use and benefit from socially valued resources. Thus, experiences of political marginalization and lower levels of funding for public services, poorer local economies and employment opportunities as well as poor infrastructural resources are all indicative of spatial injustice. Energy injustice, manifest as unfair and equitable allocation of costs

and benefits within the energy system, which is visible here as poor energy infrastructures, lack of access to such structures and higher energy prices.

However, spatial and energy injustices are interconnected and complementary to each other. For example, the spatial configuration of the energy network in Wales is both a spatial injustice and an energy injustice. Physical poor access to the network is based on location, resulting in lack of access to the energy resource and subsequently the services fuelled by that resource. These interplays are visible in other way - experiences of political peripheralization included lack of ability to utilise local natural resources and as having local social and economic needs ignored. This aligns with both aspects of spatial injustice and the recognition tenet of energy justice, whereby “cultural and political domination, insults, degradation and devaluation” result in ‘non-recognition’, and ‘misrecognition and disrespect’ (Jenkins et al. 2016, p. 177). The next section unpacks the connection between peripheral disadvantage and energy injustice further, exploring experiences of spatially contingent energy vulnerabilities within the periphery.

8.3 Energy Peripheries: Energy vulnerable places

Energy plays a key role in spatialization processes contributing to the creation of places through processes of natural resource extraction, energy production, distribution and consumption⁵⁰. This includes how such processes and their cost and benefits are distributed in space but also how such processes and their costs and benefits influence the same spaces. In this way “energy is bound up with the reproduction of uneven patterns of development and access to flows of capital” (Castan Broto & Baker 2018, p.3). Energy interplays with other elements of spatialization to fuelling economic growth in some areas and affect decline in others. The intertwined relationship between spatialization processes and energy implies that experiences of spatial injustice and energy injustice will be similarly intertwined (as unpacked in *Section 8.2*). Subsequently spatially implicated is energy vulnerability. Energy vulnerability⁵¹ has been conceptualised as consisting of six drivers: *Access, Affordability, Flexibility, Energy Efficiency, Needs and Practices*

⁵⁰ See Chapter 4

⁵¹ See Chapter 1

(Simcock & Petrova 2017). In this research, all energy vulnerability drivers were variably influenced by elements of peripheralization⁵².

Access to energy was affected by the spatial distribution of the mains energy networks in the research area which is more sparse and older than other areas of the UK. This is informed by historic processes associated with the Industrial Revolution and persists due to privatised energy suppliers and network operators working to market logics and marginalisation of periphery energy needs due to central regulation. As a result, some communities experience a lack of access to mains energy sources or more frequent electricity ‘cut-off’.

This in turn affects *Affordability* of energy due to the need for alternative energy sources to be sourced. These typical traditional alternatives included Oil, LPG and often coincided with the use of solid-fuel burners such as wood-burning stoves or Aga and Rayburn stoves⁵³. Such energy sources (with the exception of coal and wood) are higher cost than mains energy. Additionally, Agas and Rayburns are energy inefficient and so use more energy to run exacerbating household energy costs. However, energy affordability is also more generally experienced in Wales due to overall higher costs of mains energy comparative to other UK regions.

Flexibility was affected by the lack of access to mains networks which meant some interviewees felt ‘trapped’ into accessing alternative energy sources⁵⁴. Living in solid stone homes also created some experiences of inflexibility due to difficulties in installing insulation⁵⁵. Finally, lack of Flexibility was also experienced as a result of the effects of Affordability where changing energy source or a domestic energy system was financially prohibitive to some.

Energy efficiency is affected by the electricity network, which due to its age and distance in the periphery from central power stations leads to more energy losses during transmission, increasing energy costs (Ofgem 2015). It was also affected by the use of alternative energy technologies such as Agas and Rayburns which are less energy efficient than more common gas central heating and radiators or cooking with gas or electric ovens. Additionally, it was affected by living in solid stone buildings are one of

⁵² See also Table 4.2

⁵³ See Section 7.3

⁵⁴ See Section 7.4

⁵⁵ See Section 7.5

the least energy efficient forms of building and which also make difficult and more costly the installation of energy efficiency measures such as wall insulation.

Needs affected by personal circumstances such as age, health and lifestyle. Of these, age may hold some spatial contingency due to the higher percentage of older people living within the periphery and the trend of increasing numbers of older people predicted. In addition, as a personal vehicle was viewed by most interviewees as an essential component of peripheral life, this is due to poor public transport networks combined with the need to travel longer distances to access essential services, employment and education. This was a common energy ‘Need’, experienced by most interviewees⁵⁰. Not only did personal vehicle ownership increase overall energy consumption, but also impacts on household budgets which indirectly affecting ‘Affordability’ of energy. However, ability to meet energy needs was variably impacted by all other energy vulnerability drivers.

Practices were affected by a number of factors. First, as an energy ‘Need’, dependence on personal vehicles to participate in many aspects of daily life in the periphery is also an energy ‘Practice’ that increases energy vulnerability. Second, several interviewees used wood-burning stoves as a means of securing their energy supply due to past instances of being cut off from other sources. This along with some interviewees use of range-stoves created practices of predominantly using the room in the home with the stove or wood-burner over winter months to keep warm as opposed to heating the whole home. Alternatively, one interviewee financially trapped in expensive and less ‘Energy Efficient’ oil central heating and cooking system, had no choice but to keep the system on during summer months to cook food. Subsequently they experienced over-heating, and opened windows to cool the house. This energy practice was caused by other spatially contingent energy vulnerabilities (‘Access’, ‘Affordability’, ‘Flexibility’ and ‘Energy Efficiency’).

It should be noted that the energy vulnerabilities outlined are specific to peripheries and are created as part of peripheralization processes. However, there are also energy vulnerabilities that are more generic, such as health-related conditions and/or related to tenure and occupier autonomy⁵⁶. These were evident in the research and while not necessarily spatially contingent (although there may be further research establishing links

⁵⁶ See Chapter 7

between spatial interplay of economics, health and energy vulnerabilities), the occurrence of these more generic vulnerabilities in a peripheral context accumulates with other peripherally created vulnerabilities, so that their effect is compounded and creates energy vulnerabilities particular to peripheral places.

Energy vulnerabilities experienced by interviewees inside and outside of the BBNP were generally the same as either those within or without of the Park. The only differences were those experienced as a result of differences in peripherality as discussed in *Section 8.2*. A higher level of concern in BBNPA planning processes for visual impact (comparative to non-national park planning authorities) means that it can be more difficult to gain approval for some development, that includes development that could off-set energy vulnerabilities (i.e. external wall insulation). Or the same processes can increase the cost of such developments. Additionally, the additional emphasis within the Park on tourism development (comparative to areas outside of the Park) could be reinforcing situations of low-paid, insecure income thus heightening risk of energy unaffordability.

Connection between peripheralization and energy vulnerability are multiple and as Figure 8.1 demonstrates, interplay in messy ways. Energy vulnerabilities can produce other connected vulnerabilities, which mean households can experience more than one energy vulnerability simultaneously. For example, lack of access to energy networks necessitates the sourcing of alternative forms of energy. These alternatives are usually higher cost, and in some cases are used in conjunction with less energy efficient equipment (Agas or Rayburns). This in turn impacts upon how well household energy needs are met and also whether alternative energy practices are adopted. Thus, lack of 'Access' to energy, due to peripheral disadvantage holds further consequences for all other energy vulnerability drivers; 'Affordability', 'Efficiency', 'Flexibility', 'Needs' and 'Practices'. Subsequently, each new vulnerability driver that is affected, creates further connections with vulnerability drivers.

Energy vulnerability, as with peripheralization, can be circular in effect. For example, energy 'Affordability' can be problematic due to lower incomes and/or high cost of peripheral living, lack of access to energy means more expensive energy sources are used increasing living costs, this is compounded by living in an energy inefficient home, increasing energy consumption to meet thermal comfort needs. A stretched household budget means changing energy system or energy source or increasing the energy efficiency of the home is not possible. So, the cycle continues. This example also

demonstrates that elements of peripheral disadvantage interplay with energy vulnerability to reinforcing the presence of each other.

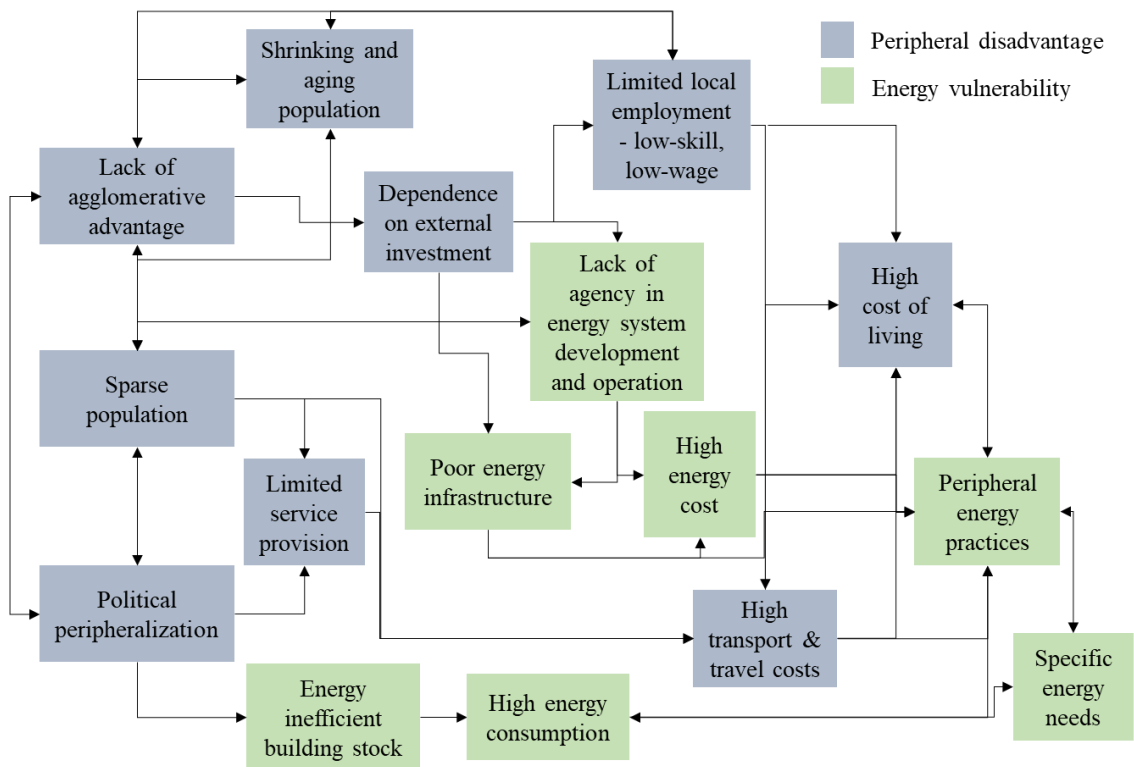


Figure 8.1. Interplay of peripheralization elements and energy vulnerability.
Source: Author

Therefore, elements of peripheral disadvantage and drivers of energy vulnerability are interlinked in numerous ways, the presence of each, either singularly or in combination, holds impacts for other elements and drivers, including the reinforcement of their presence. Such interplay of spatial injustice and energy injustice results in the formation of place-specific energy vulnerabilities, observed from a peripheral perspective, energy vulnerability is interlinked with elements of peripheral disadvantage (see Figures 4.5 and 8.1).

However, to fully grasp the interplay between peripheral disadvantage, energy injustice and their consequence, consideration has to be extended further than at the point of end use, or energy vulnerability experienced at a household scale. Spatial justice attempts to elucidate and make visible how dynamics of power and social fairness manifest spatially leading to uneven access to certain spaces and resources or ability to make good use of them. Energy justice, considered more broadly than energy vulnerability, offers a framework to explore equity and fairness at any or all stages of an energy system. Both are derived from social and environmental justice, and together they illuminate how

socio-cultural, economic and political forces work to create different places, the relative position of which influences the distribution of costs and benefits within the whole energy system. Considering the whole energy system allows a more comprehensive inclusion of the perspectives of the interviewees. Many of the households interviewed, when talking about the places they live and energy, spoke not only of their end-use energy needs, but frequently referred to ‘upstream’ energy processes, of production and distribution. This included past resource extraction activities in the form of deep anthracite mining, to newer forms close by such as opencast mining and wind farms. Indeed, many households sourced some of their own energy resource, either via collecting wood for wood burning stoves or solar radiation for solar PV. Thus, to fully understand the impacts of such interplay the whole energy system must be considered from a peripheral perspective.

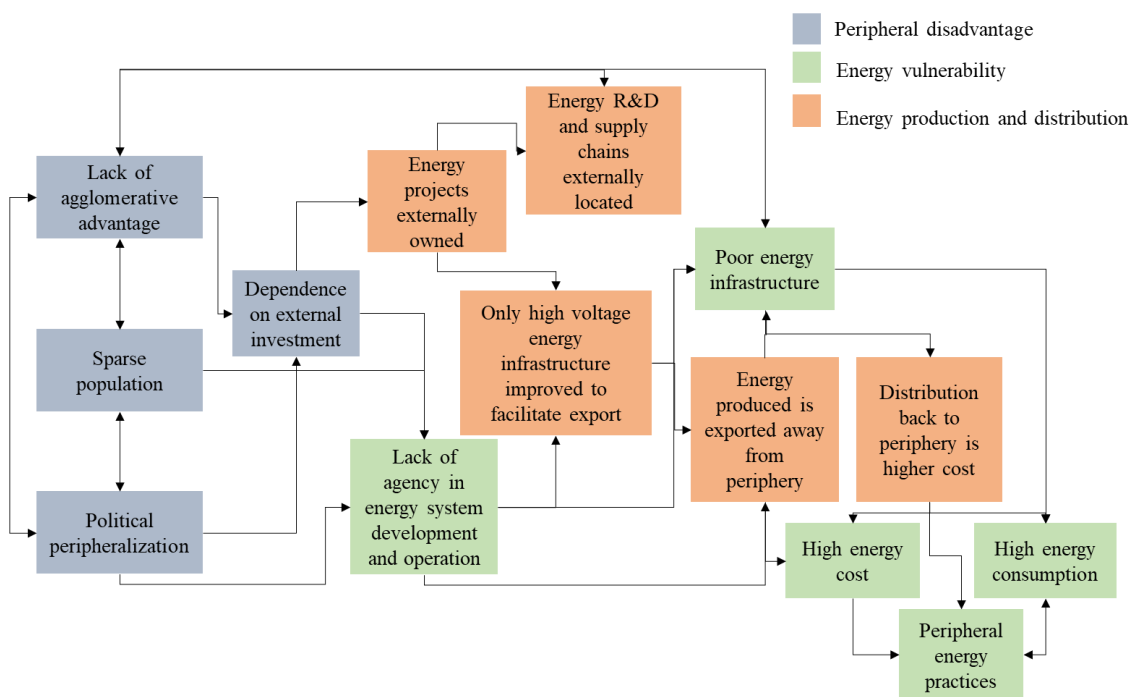


Figure 8.2. Interplay of peripheralization elements and energy vulnerability with ‘upstream’ energy processes in the periphery.
Source: Author

Within this research case study, interplay between energy and spatial injustice was experienced throughout the energy system, feeding into the circular processes of peripheralization and place-specific energy vulnerabilities. This is conceptualised as ‘energy periphery’ provides a means of focusing attention on the unique energy injustices experienced throughout an energy system by peripheral places. In the first instance, it highlights the vulnerability faced by places with availability of natural resources for

energy production, but with low populations and limited social, economic and political capacity. Such places - exemplified by Wales and its sub-national peripheries in this research - while providing the resources for primary energy production, experience difficulty in accessing the same energy produced. In addition, weak social, economic and political capacity creates problematics for the recognition of peripheries in energy decisions and exclusion from energy processes and procedures. These problematics influence how, where, at what scale and by whom energy production takes place, how and to whom it is distributed and at what cost, in addition to any of the other benefits that may arise. In weaker economic positions and largely dependent on external investment, energy peripheries can often view new energy developments that offer some economic benefits with favour, especially those which promise employment. This can be the case even if employment opportunities are overstated and benefits are only short term. Very often, longer term benefits and profits extracted from such project's slip out of the periphery (Yenneti et al. 2016; Bryn et al. 2017; Weller 2018), leaving them very much as they were – dependent still on external investment and energy vulnerable. Within energy peripheries the circular and self-reinforcing process of peripheralization and its disadvantageous outcomes, imbued with energy injustices are illuminated. Such injustices propagate vulnerabilities for communities within energy peripheries throughout the whole energy system, producing “a whole distinctive and systematic class of energy inequities” (O’Sullivan et al. 2020, p. 4).

However, as others have highlighted, peripheries and peripheral experiences are not homogeneous (Hayter et al. 2003) and this was the case here, where within the periphery different land designations or hierarchies were assigned differentiating the constellation of energy periphery factors. The Brecon Beacons National Park, considered internationally significant, while experiencing much of the same peripheral-specific energy vulnerabilities as areas outside of the Park, experienced a difference in problematics of energy production. Here, the legal protections towards the natural environment meant that exploitation from external large-scale energy production was negated. However, the same protections in conjunction with its other purpose towards encouraging access to the land and other peripheral disadvantages meant that energy production at smaller scales was perceived to be more difficult. Thus, there remains peripheral-specific energy vulnerability throughout the energy system within the BBNP, due to its relative spatial position even though how these some aspects of their formation are varied compared to the periphery outside of the Park.

In a similar line of thought, while rural Wales has provided the empirical foundation to conceptualise energy periphery and focus attention on usually overlooked spaces, energy periphery can be applied to other places to exemplify similar disadvantageous contexts. This is achievable due to the relativity of ‘periphery’ as a geographic concept, meaning it can be considered at multiple scales and within multiple contexts. For example, recent studies have demonstrated at a global scale, already economically peripheral countries struggle to utilise their energy resources themselves, in ways that benefit their own populations, or in ways that alter their economic peripherality (c.f. Baker et al 2014). At sub-national scales, other studies have demonstrated that peripheries experience similar patterns of resource availability which combined with limited social, economic and political power limits their ability to make best use of them but also fosters a vulnerability on sometimes exploitive investment and energy development (c.f. Haag et al. 2012; Yenneti et al. 2016; Sareen & Haarstad 2018; Weller et al. 2018).

This research has unpacked spatial and energy injustice through the energy system by focusing predominantly on rural peripheries within Wales, in a country that is also predominantly rural, to conceptualise energy periphery, this is in line with literature that points to the frequent coalescence of rurality with periphery (Fischer-Tahir & Nauman 2013). However, as energy periphery can be applicable at multiple scales in different places it doesn’t necessarily follow that all energy peripheries will be sub-national or rural, likewise, it doesn’t follow that all peripheries, whatever the scale, experience energy-related disadvantage. That being said, energy periphery raises attention to the frequent co-constitution of spatial injustice and energy injustice - how peripheral disadvantage can open the door to energy injustice, and that for peripheral places with resources for energy production, this injustice endures all along the energy system.

Overall, many energy vulnerabilities experienced within the periphery have a spatial contingency which is derived from the process of peripheralization and subsequent peripheral marginalisation and disadvantage. Peripheralization and energy vulnerability are mutually-reinforcing creating a vicious circle, or “problem spiral” difficult to break (Fischer-Tahir & Nauman 2013, p. 18). Energy injustices in the periphery are not confined to energy vulnerability at the point of consumption, or end use. The uneven distribution of social, political and economic power between differential spaces holds influence over the risk of energy injustice along all parts of the energy system, from resource extraction, energy production, distribution and consumption. In Wales,

peripheries, as spaces of marginalisation and disadvantage experience energy injustice throughout the energy system and can be conceptualised as energy peripheries. This conceptualisation while encapsulating the multiple energy injustices experienced within the periphery can also aid illumination of how such spatio-energy injustices interplay with processes of low carbon transition. This is explored further in the next section.

8.4 Energy Periphery in transition

Low-carbon transition is progressing in energy peripheries. New energy processes of production, distribution and consumption are altering the physicality of the energy system through decentralisation and distributed energy production. For example, low-carbon energy production can now occur at the site of resource extraction - different to traditional carbon-heavy energy sources such as coal where resources are exported to centralised power stations for conversion to energy. Consequently, peripheries with high levels of natural assets are becoming combined sites of resource extraction and energy production⁵⁷. This change is occurring in Wales where while resource extraction has traditionally taken place in the periphery, energy production took place in central urban areas (with the exception of Pembrokeshire⁵⁸). Now, rural areas produce more electricity than previously, and from different resources (low-carbon sources such as wind, solar and biomass) (Welsh Government 2018a). In 2016, rural areas such as Powys and Ceredigion produced more low-carbon electricity (MW per capita) than other urban or valley areas (Welsh Government 2018a).

The number of different energy productions and the variance in scale of energy producers is also increasing, creating transition opportunities for individuals and communities as well as private and public sectors. Energy democratisation as an outcome of transition, in some respects, is challenging existing capitalist structures that gravitate towards agglomeration, centralisation and maximum profit (Foxon 2013; Szulecki 2018; Benedek et al. 2019). Those who do take forward transition can directly counteract peripheral energy vulnerabilities, securing 'Access' to energy supply, making it more 'Affordable', increasing 'Flexibility' and 'Energy Efficiency', altering energy 'Practices' and

⁵⁷ See Chapters 3 and 4

⁵⁸ Pembrokeshire holds the port of Milford Haven and Pembroke Dock both of which are of strategic importance for oil and gas trading in the UK. Both areas have refined oil for many years. Milford Haven refinery closed in 2015 but Pembrokeshire Dock is still operational.

ultimately meeting their energy 'Needs'. The benefits of this are similar between interview groups; households; third sector community/community groups; Small Medium Enterprises (SMEs); and large-scale commercial developers, differing mainly in mode of transition, financial and other capacities which influences scale. Thus, as transition can simultaneously reduce carbon emissions and climate change while providing social and economic benefits to the places it is located, it is possible to see how it is perceived as a moral or "civic good" (Jenkins et al. 2016, p. 177). Low-carbon transition holds some opportunities to redress current spatial imbalances and benefit peripheral populations.

However, while low-carbon transition can hold positive effects for elements of peripheral disadvantage and energy vulnerability, it is constrained by the same factors. Peripheral disadvantages such as political peripheralization, lack of agglomerative advantage, limited local employment and poor infrastructures, with the energy vulnerabilities they contribute to converge with other spatially contingent energy vulnerabilities such as energy inefficient housing stock, high energy cost and peripheral energy practices that influence and sometimes prevent transition taking place (as per *Figure 8.1*). This section explores experiences of transition in the energy periphery, highlighting how peripherality and energy vulnerability inter-connect with variegated low-carbon transition experiences.

A key driver of energy transition and influence on spatialization processes are political ideologies and policy implementation. Political governance institutions hold the ability to influence their constituent populations in addition to the private and wider public sectors. Therefore, much of the ability to drive and shape a just energy transition lies with political governance institutions. In the UK, the power to shape transition is complicated by the devolution of its component countries. Each country holding a unique composition of physical geographies, industrial and energy sectors, energy networks, and internal or lower scale governance actors with differing energy ambitions and ideologies (Cowell et al. 2017). In addition, policy power to shape transition is unequally devolved, with Wales being granted the least powers of all, which while it is arguable as to whether Wales' transition would be different if more powers were available (Cowell et al. 2017) it has held some influence (Georgakaki et al. 2015; Llewellyn et al. 2017), limiting direct Welsh influence to lower-scale transitions and being representative of Wales' political peripheralization in the UK.

The economic peripheralization of Wales has fostered a dependence on external economic investment for economic development (Jones 2015). This includes large-scale low-carbon energy production developments which are perceived as holding dual purpose, of contributing to the economy of Wales and contributing to Wales' low-carbon targets⁵⁹. This is supported by other research that highlights how ownership of low-carbon energy production at a regional and national scale holds multiple benefits for economic development (Benedek et al. 2018). It can create employment opportunities in addition to economic profits and avenues for profit re-investment that could enable profit retention within the host place. Peripheral disadvantage also means that Wales has a small voice during decision-making regarding technology type and scale. Combined, these elements of peripheralization limit capacity to own and operationalize large-scale resources within Wales or to realise long-term benefits from such developments. Thus, energy production in Wales, is predominantly externally owned offering only limited employment opportunities (Bryan et al. 2017). In order to maximise economic benefits, value-adding economic processes in addition to energy production also need to be 'locally owned', processes including those within R&D sectors and supply chains (Jones 2015; Institute of Welsh Affairs 2018).

This research focused predominantly on small-scale or micro-scale energy production. However, as many interviewees discussed large-scale developments generally when thinking of transition, and also specifically relating to large-scale developments close to where they lived or worked, large-scale energy production is included in discussion. At present in Wales, large-scale energy development is dominated by external commercial ownership. This was noted by many interviewees who while supportive of large-scale low carbon energy development, were unhappy that they could not directly access the energy produced and that profits were gained elsewhere⁶⁰. These perceptions are further fostered by the lack of awareness of most interviewees of community benefit funds or how they are invested. Thus, despite such large-scale commercial developments within the study area providing some community benefit fund, the benefit was not experienced by interviewees. However, this is not a universal experience as other communities in Wales have more widely invested their funds in 'civic goods'. For example, The Carno Community Trust Fund in Powys has awarded grants for the installation of a wood pellet boiler at their community centre, solar panels and charging points for Electric Vehicles

⁵⁹ See also Chapter 4

⁶⁰ See Section 6.3

(EVs) (RWE Npower Renewables *undated*). Funds here have subsequently gone towards addressing community centre economic viability and energy vulnerability, as well as offering some futureproofing for the wider community in terms of EV charging points. Thus, in this instance large-scale developments have helped address energy vulnerabilities at lower scales.

At present there is no official guidance in Wales as to how funds are allocated and who manages them, this leaves them open to interpretation resulting in uneven distribution of benefit amount, how and where the fund is re-invested, and developer assistance. Consequently, some communities fare better and receive more assistance in addressing wider energy vulnerabilities using community benefit funds than others. This can have a spatial distribution, depending on the indigenous community's 'capacity' (Middlemiss & Parish 2010; Bristow et al. 2012) and developer ethos. Thus, some communities are better placed to make longer-term strategic investments that counteract energy vulnerabilities or wider peripheral disadvantages than others.

Wales still holds some power and ability to assert its own ideals (Llewellyn et al. 2017). New policy levers such as the *Wellbeing of Future Generations Act (2015)*, *Planning (Wales) Act (2015)*, *Environment (Wales) Act (2016)*, *Wales Act (2017)*, and *Climate Change Regulations (2018)* as well as political commitments for all new renewable energy production to have "an element of local ownership" (Welsh Government 2017b) have laid foundations of change. Additionally, in December 2018 a new First Minister for Wales was selected, signalling an enhanced socialist political agenda with very clear links made between Wales's economy, environment and social benefits. Further commitments for decarbonisation have also been outlined in *Prosperity for All: A Low Carbon Wales (2019b)* to decarbonise Wales "in a way which maximises wider benefits for Wales, ensuring a fairer, healthier and more equal society" (p.6). Thus, at the time of writing it appears at a national scale in Wales political and policy changes are already unfolding, affecting the way political, public and private institutions and businesses within Wales work which in turn should alter the way low-carbon transition continues to unfold.

Central operation and regulation of the energy network in the UK by the National Grid and Ofgem (respectively) compound spatial and energy injustices in Wales, highlighting clearly the interplay between peripheralization, energy vulnerability and transition. The spatial distribution of the electricity grid and need to balance UK-wide supply and

demand effectively marginalises both energy consumers and prospective energy producers in Wales. As per the *Electricity Act (2001)*, the National Grid has to maintain supply for all energy consumer in the UK this involves balancing electricity produced with electricity consumed. Ofgem regulates this and the whole energy market to protect customers from power-shortages and excessive energy costs. However, this centralised and regulated system holds in-flexibilities which are disadvantageous for Wales. For example, electricity consumed in Wales, even if produced in Wales has to flow through the UK-wide system. The cost of this electricity is determined in the UK electricity wholesale market, and electricity for consumption is distributed via Distribution Network Operators (DNOs) back into the areas of origin, and wider. While this process is in place to increase efficiency and competition in the energy market, and ensuring constant supply, it increases the cost of mains electricity in Wales comparative to other UK regions. This is because factors such as energy consumption, population level and distribution distances heavily influence regional energy costs (Ofgem 2015: 2019d; House of Commons Library 2017a). Wales' relative position in the UK as a political and economic periphery becomes mirrored within the energy system. Thus, there is little influence to alter the existing arrangements which see the cost of electricity production experienced in Wales while benefits such as lower cost electricity or electricity profits enjoyed elsewhere.

Low-carbon transition is not altering this asymmetrical dynamic as it is similarly constrained by the spatial distribution of the electricity grid in Wales. Indeed, peripheries within Wales can be further marginalised comparative to Welsh cores during transition processes. For example, connecting new energy developments to the national electricity grid in non-urban areas of Wales has become especially problematic and expensive. This is due to the poor physical reach of the network in peripheral areas, low capacity on the network for new electricity production (*Figure 7.10*), and pre-existing capacity being bought by large-scale commercial developers. The cost of upgrading or expanding the grid is usually passed on to the developer, the costs of which are only affordable to large-scale developments. Consequently, electricity production in peripheral Wales is increasingly restricted to either large-scale or micro-scale developments, discriminating against those who may fall in between, such as community developments. As per *Chapters 3 and 4*, the spatial distribution of large-scale developments and arising benefits hold questions for energy justice.

More recently Ofgem has sought to increase flexibility into this to allow smaller-scale sellers into the market and concessions are beginning to emerge for non-licensed suppliers (Ofgem 2017a) and creation of micro-grids⁶¹. In such instances, larger, or non-domestic scale electricity may be consumed at the point of production, thus, places who host electricity production may be able to directly consume the electricity. These concessions are restricted at present to Regulatory Sandboxes⁶² as they are in trial stage. However, if such developments were allowed in Wales energy could be sold or shared between households, communities or regions potentially reducing the cost of energy, as losses along the distribution lines would be reduced and/or alternative power price agreements could be agreed. However, currently regulations prevent such innovations to be more widely developed, leaving Welsh electricity consumers with the continued Affordability energy vulnerability as transition progresses. In this way, and identified by interviewees, the current energy system disadvantages energy developments in peripheral areas, particularly those that are small-scale and contributes to the spatial contingency of energy vulnerabilities.

Access to mains electricity and gas networks held sway over the type of low-carbon energy production technology chosen by interviewees, this was in-part due to the financial implications of each. Heat technologies are only eligible for Renewable Heat Incentive (RHI), while electricity technologies are eligible for electricity generation payment (regardless of grid connection) and Feed-in-Tariff (FIT) (with grid connection). In this way, access to mains electricity and gas grids informed decisions as often selling surplus electricity to the National Grid via mains connection is the main way that interviewees gained back their initial investment. In addition, remaining connected to the mains electricity network (as opposed to creating their own micro-grid) ensures continuity of supply should their energy production fail. Conversely, existing connection to the gas mains makes installation of heat technologies economically unbeneficial (see *Sections 3.2 and 7.4*). Thus, take-up of heat technologies was generally limited to those without gas connection. Most interviewees who had installed energy production noted continuous Access to their energy, reduced energy cost and consumption, and increased income all of which increased Affordability. This in turn meant interviewees could more

⁶¹ A micro-grid is a decentralised grid that operates in parallel to or independent of the national grid (Ofgem 2017b).

⁶² A regulatory sandbox allows the trial of new products, services and business models without some of the usual rules applying. This occurs where Ofgem regulation prevents the launch of a product or service that could benefit consumers (Ofgem 2018).

readily meet their energy Needs. In addition, as the energy produced does not get exported or imported for use by the same producer, losses are also minimised thus increasing Energy Efficiency.

However, poor energy infrastructure in the periphery had wider effects, either adding to motivations to transition, i.e. in order to gain a more secure energy supply (as discussed in *Section 8.3*), or by creating “lock-in” to old carbon heavy systems (Healy & Barry 2017, p. 451). Interviewees without mains gas supply typically had oil and LPG, with oil in particular necessitating alternative energy systems. Additionally, some had adopted alternative energy Practices, installing Agas or Rayburns to use with these energy sources. This as per *Section 8.3* feeds into ‘Affordability’, ‘Flexibility’, ‘Energy Efficiency’ and ‘Practice’ energy vulnerability drivers and further highlights how spatially contingent energy vulnerabilities can limit low-carbon transition. The combined high cost of running these systems along with the high cost of altering them can mean those households are ‘locked-in’ to these outdated, inefficient, carbon heavy technologies and are in effect locked-out of transition (Walker 2008; Healy & Barry 2017). This lock-in is likely to be compounded as low-carbon transition progresses as there is a risk that many peripheral households and businesses could be left ‘stranded’ (Healy & John 2017) in the form of carbon heavy vehicles and energy systems. Socially the inability for many people within energy peripheries to participate equally in social life can act singularly and jointly with economic impacts to further solidify negative stereotypes of peripheral places as regressive and inherently different to core places.

The mode of transition experienced by interviewees was generally split between two main forms – increased energy efficiency and/or energy production. Energy efficiency interventions were perceived as simpler, lower cost and ‘common-sense’ as they included basic measures such as draught-excluding and energy-saving lightbulbs. However, they also included more costly and complex interventions such as wall-insulation. As per *Section 7.5*, most interviewees, across groups had installed basic energy efficiency measures. More complex and expensive energy efficiency measures were less common and usually installed by those already carrying out some building renovation or installing energy production in order that the benefit of the latter was maximised.

Out of various energy efficiency measures adopted, the installation of insulation produced the most noticeable results to interviewees, increasing thermal comfort and reducing energy consumption, thus reducing energy bills. It also altered the ways that some

interviewees used what were previously cold spaces, encouraging increased use. For those accessing vehicular-delivered oil and LPG, it meant reducing the frequency they monitored and ordered supplies. Thus, considering energy vulnerability drivers, increased energy efficiency directly counteracts poor Energy Efficiency while also counteracting energy Affordability, Flexibility, Needs and Practices. However, some interviewees had direct negative experience of increased energy efficiency, where incorrect insulation had been installed causing dampness in the building and the need for removal and reinstallation with the correct material⁶³. In addition, interviewees in inefficient solid stone buildings were limited to basic efficiency measures due to the inflexibility of the building structure and the additional cost associated with wall-insulation for that type of building⁶⁴. Thus, building structure not only increased the likelihood of energy vulnerability, but also constrained low-carbon transition.

Energy production included an array of different energy sources and technologies. Smaller-scale production (1 Megawatt (MW) or below) included water and micro-hydro, sun and solar PV, air-heat conversion and air source heat pumps (ASHP), ground heat and ground source heat pumps (GSHP), woodchip and biomass boiler, and wind with small single wind turbines. Large-scale developments included wind and wind farm, sun and solar farm, and organic waste and anaerobic digestion. Direct experiences of interviewees who had installed energy production is concentrated at the smaller scale (1 MW and below). Of the small-scale energy production, the technology installed was highly dependent on the suitability of the building or land area for the technology, the ease of installation and the cost. Thus, solar PV was a popular choice as, compared to other technologies, it can be installed on building rooves negating some space issues, it is a more common technology, thus installers are more readily available, it works with existing energy systems and in combination with other low-carbon energy production and it is relatively lower-cost. Other technologies such as GSHP require more space to house the technology and suitable external topographies, they are uncommon so sourcing installers and maintenance engineers can be problematic (see *Figure 7.16*) and although they can work with old radiator energy systems, they work best with underfloor heating and air-conditioning systems, increasing expense.

⁶³ See Section 6.3

⁶⁴ See Section 7.5

Positive transition experiences were not guaranteed as some interviewees experienced problems with installation and/or finding maintenance engineers if faults arose, costing more in the longer term (see also *Figure 7.5*). Additionally, while anecdotally discussed with public sector interviewees, some social housing tenants who had received ASHP had not been given training on how to use the system. This resulted in some tenants turning off the system completely and purchasing alternative small electric heaters. Others did not gain thermal comfort from the new system, this was attributed to ASHP working constantly to maintain ambient room temperatures, as opposed to radiating heat from a central point in the room. Thus, tenants did not feel the heat and turned up the system too high. As a consequence, they experienced very high energy bills comparative to what they would have previously experienced. In these instances, transition increased energy vulnerability by decreasing energy ‘Affordability’, creating ‘Inefficient’ energy ‘Practices’ and not meeting energy ‘Needs’.

Motivation to install transition interventions comprised concerns for the environment, improved living conditions and energy consumption reduction, and long-term financial investment and security⁶⁵. These motivations were shared across interview groups, varying slightly between individuals. Energy efficiency and energy production interventions can last for many years depending on their maintenance and wear and tear, leading to reduced energy consumption and increased energy affordability for as long as they are in place. In addition, energy production can secure an income for seven years (RHI) or between 20-25 years (FIT). For households, energy production was taken up by owner-occupiers, with plans to remain in their current property long term. Additionally, most were in an older age group, currently retired or with plans to retire in the near future, income produced acted to supplement a fixed pension income (whether private/public or both) in addition to reducing outgoings which may be harder to maintain on retirement incomes and as ageing progressed.

Many of the households involved in this research indicated that they would like to be able to take forward transition, for some who had already carried out some transition interventions, they would like to do more. However, in-line with other research (c.f. Walker 2008) the economic cost of transition to many was a barrier. While the costs may vary according to technology and scale, they are present no matter who is initiating the transition (household, community, SME or public sector). This was true even if living

⁶⁵ See Section 7.2

outside of the BBNP and thus under less stringent planning conditions and therefore able to install lower-cost interventions. This is where the economic disadvantages of peripheralization associated with a lack of agglomerative advantage, limited local employment that is low-skilled/low wage, higher living costs due to poor infrastructures, high energy costs and a reliance on personal transport (see *Figure 8.1*) are misaligned with the economic basis of transition. For many peripheral households the budget available to finance low-carbon interventions is already restricted but also the relative risk associated with such change should something go wrong is increased. Similar financial constraints were experienced across other interview groups. In this way, various peripheral disadvantages and spatial contingent energy vulnerabilities prevent low-carbon transition.

Dependence on personal transport due to poor peripheral public transport networks combined with the need to travel longer distances to access essential services, employment and education are both cause and effect of peripheralization. This can raise the cost of living in the periphery. As per *Section 8.2*, these spatial elements are also energy vulnerability drivers, forming energy Needs and Practices specific to the periphery. Consequential to this is the impact it has on energy Affordability. Thus, as with many other aspects of peripherality, dependence on personal transport impact on household budgets makes the cost of low-carbon transition prohibitive to some. Low carbon transition could also cause further vehicle-related energy vulnerabilities, poor energy infrastructures could make electric vehicle networks limited in the periphery. Additionally, the cost of maintaining existing carbon-heavy fuel vehicles can mean that transitioning to electric vehicles is not possible anyway. Thus, this particular spatially contingent energy vulnerability can hold multiple problematics for low-carbon transition and represent lock-in to old carbon heavy technologies.

Practices were affected by a number of factors. First, as an energy Need, dependence on personal vehicles to participate in many aspects of daily life in the periphery is also an energy Practice that increases energy vulnerability. Second, several interviewees used wood-burning stoves as a means of securing their energy supply due to past instances of being cut off from other sources. This along with some interviewees' use of range-stoves created practices of predominantly using the room in the home with the stove or wood-burner over winter months to keep warm as opposed to heating the whole home. While there are existing interventions that can assist households with such costs, for example,

Nest and Arbed, each held limited impact in the case-study area. With the exception of the BBNPA, area-based measurement tools such as the WIMD have been used by Local Authorities and the Third Sector to inform the application of such schemes⁶⁶. Interviewees explained that the use of such measures enabled fast and strategic decisions to be made that ensured the highest volume of interventions were implemented for the lowest cost. As such tools weight more heavily deprivation in urban areas, it is those areas that are most frequently selected for assistance. Thus, in the instance of Arbed, a Welsh Government programme to assist households in fuel poverty, non-urban areas are overlooked, despite having need for the programme. In addition, programmes such as Nest which offer assistance to households based on individual need is only available to those claiming a benefit. This works against rural households in many ways, first as historically rural populations are less likely to claim benefits (Bramley & Watkins 2013; National Assembly for Wales 2008) there will be less households eligible for the programme. Second, benefit claims such as Universal Credit which can supplement low incomes, do not take into account the additional costs associated with rural living – transport and energy – thus, rural households are often identified as better off but may actually be living in work poverty⁶⁷.

For households of rented accommodation, transition barriers are not only associated with transition costs but also non-ownership of their accommodation whereby they usually lack the authority to make alterations to the building structure or energy services. This not only prevents transition unfolding but also increases energy vulnerability. This is in line with other research (c.f. Walker 2008; Bouzarovski 2013; Ambrose 2015) elucidating that lack of ownership over the building they live in means that private tenants lack the power to alter their energy source or alter the building to increase energy efficiency without landlord approval. For some in tenuous lease agreements, requesting such changes is out of the question due to fears of eviction; even if not tenants can feel unable to raise issues⁶⁸. Additionally, it is not in either the Landlord's best interest to invest in low-carbon measures as it will cost them money and benefit the tenant. Likewise, for the tenant, investing in a property they do not own would not benefit them unless the lease was especially long-term. While new UK-wide Landlord Regulations came into force in April 2018, they only stipulate that private rented properties should gain an Energy Performance Certificate of E rating (Department for Business Energy and Industrial

⁶⁶ See Section 6.3

⁶⁷ See Section 7.2

⁶⁸ See Section 7.5

Strategy [BEIS] 2018a)⁶⁹, this is arguably still very poor. In Wales, the *Housing Act (Wales) (2014)* makes no stipulation of housing standards for private landlords. Social tenants are protected from some energy vulnerabilities brought on by poor housing conditions due to the *Welsh Quality Housing Standard (2002)*. However, they are unable to actively participate in transition unless instigated by the landlord.

Initiating low-carbon transition requires a level of knowledge of transition technologies, suitability to the place, transition finances and overall development processes including around planning permissions. A lack of knowledge links to the Practices energy vulnerability driver, whereby a lack of knowledge or existing socio-cultural norms can limit effective use of energy systems or prevent change to alternative systems. Different capacity deficits between groups have been shown to counteract each other if low-carbon transition was taken forward in partnership (c.f. Institute of Welsh Affairs 2019; Seyfang et al. 2013). Partnership working between local authorities and third sector groups, or even multiple combinations including businesses and commercial developers can fill knowledge, time and economic gaps that each other may hold. Other research has demonstrated this can be of benefit to all partners (c.f. Institute of Welsh Affairs 2019; Seyfang et al. 2013). Partnership working between local actors can also mean low carbon transition ownership is retained by the same actors and the benefits are at their disposal. Within the case study area, the BBNPA presents an example of how local governance can influence the trajectory of low-carbon transition through partnership working⁷⁰.

The BBNPA has capitalised on its unique position of having an environmentally based core purpose, understanding of the Park's natural resources and relationships with resident communities and other public bodies. This has resulted in the formation of nuanced, place-specific transitions taken on by community groups and the BBNPA individually and also in partnership. For example, co-working between the BBNPA and community group The Green Valleys enabled the growth of the group into a Community Interest Company (CIC) which has since gone on to assist numerous other communities and SMEs to install micro-hydro energy production (see also *Figure 7.4*). This could be further expanded on as the environmental focus of the BBNPA core purpose together with strong multi-scale local networks means it could further facilitate a nuanced, place-specific transition and foster partnership between itself and/or between other

⁶⁹ See also Chapter 1

⁷⁰ See Chapter 6

organisations, groups and BBNP communities. This can be complementary to its core purposes of protecting the natural environment and generating economic outputs by being an actor within various transition activities. By building on its existing transition base, the BBNP could be “international exemplars for sustainability” by “providing exemplars of best practice for wider Wales” (Marsden et al. 2015, p. 27 and p. 41).

While these examples demonstrate excellent routes of partnership working at smaller scales, they are at present uncommon and even within the Local Authorities themselves are usually stand-alone projects. Additionally, in some ways the same institutions that facilitate partnership working, can work against low-carbon transition progress. In the case of the BBNP, the core purpose ‘to conserve and enhance the natural beauty, wildlife and cultural heritage of the national parks’ can prevent some low-carbon transition. This can be by creating further administrative processes, or higher financial expenditure for low-carbon interventions that are publicly visible, for example, in the installation of external wall insulation which is a permitted development outside of conservation areas but which requires approval within them⁷¹. For this reason, some communities in the BBNP can experience energy vulnerabilities that are compound by the core purposes of the BBNPA. Thus, local governance, with key knowledge of place, vulnerabilities and also transition processes are in a key position to progress transition. However, place-specific factors, such as conservation designations and the constraints of working within large geographic areas curtail these abilities and, in some cases, work against peripheral populations.

For community groups, low-carbon transition provided the means for some public services and community assets to increase their economic viability by reducing operation costs for public buildings and services. This can protect against the ongoing public spending reductions for services and local amenities. Additionally, as per *Figure 6.7* income generated from low-carbon energy production offers an opportunity to direct spend on areas that meets specific local needs, whether that is further low-carbon measures, social inclusion or transport poverty. In the case of community groups and third sector, transition was planned and implemented by volunteers; as such the time they can devote to such undertakings is limited. Community group interviewees spoke of volunteer fatigue and of “burnout” (Haggerty & McBride 2016, p. 217), due to the heavy investment of time needed to devote to low-carbon projects for success. In particular working through

⁷¹ See Chapter 7

the various development processes such as securing the location for development and carrying out feasibility studies and gaining planning permission were cited as the most difficult and time-consuming processes. To succeed, community capacity must be strong (Middlemiss & Parish 2010; Adams & Bell 2015), even then, there was no guarantee of success.

For the Small Medium Enterprises (SME) and Farms interviewed, again, low-carbon transition held similar benefits. However, as the scale of these transitions tended to be greater, so too were some of the benefits realised. Transition as in case of one farm (*Figure 7.4*) provided an income that was equivalent to that of the farming activity and subsidies. This offered long-term financial security providing piece of mind in addition to the ability to reinvest in other low-carbon interventions. For the SME in *Figure 7.3*, the financial security and income provided by transition has allowed further reinvestment in low-carbon interventions and the ability to extend opening hours and employ other staff. These were financial risks that in the past may have been too great to attempt. In this way, low-carbon transition offers a means of reducing energy vulnerabilities for communities and SMEs and also counteracting some elements of peripheralization. However, undertaking low-carbon transition for SME's can represent a risk as staff taking forward low-carbon transition may already have another full-time role, in perhaps an unrelated field. As one SME interview demonstrated (see *Figure 7.5*), embarking on low-carbon transition without this can be costly. As highlighted by all interviewees in *Chapter 6* this is in part due to the planning and energy regime at all scales being difficult to navigate for small-scale developers, where due to their limited knowledge and economic capacity transition risks are emphasised.

As per *Chapter 6*, industrial sectors in the periphery are characterised by their economic vulnerability. This includes the agricultural sector which as highlighted by an interviewee (*Section 7.2*) can be intensive to energy consumers. Producing their own energy instead of purchasing it can realise substantial economic savings. The benefits of increased income via energy production may be more salient for farmers as the UK leaves the European Union (EU) (or Brexit). For example, the agricultural sector in the UK is largely subsidised and governed by EU frameworks such as the Common Agricultural Policy (CAP), EU structural funds and EU regulations around the environment and agriculture (Wales Centre for Public Policy 2018). As the agreement for Brexit as a whole is still being ratified, questions remain over what funding will be granted for the sector and how

it will be governed and regulated (Wales Centre for Public Policy 2018). The removal of other EU funding sources such as Structural Funds, of which Wales receives £680 million per year, aimed at addressing poverty and reducing regional disparities will hold impacts for areas considered economically deprived, and Wales as a whole. EU Structural Funds are to be replaced with a UK Shared Prosperity fund, however, as decisions taken by the centre can marginalise the periphery, there are concerns regarding what share for the funds Wales will receive and what caveats may be placed on spend (National Assembly for Wales 2018b). This is worsened by a perceived lack of communication between Wales and Westminster leaving “important decisions relating to post-Brexit funding for Wales [...] in the hands of the UK Government” (National Assembly for Wales 2018b, p. 9). Thus, transition in such instances could offer economic protection from uncertain economic changes.

The spatial contingencies of low-carbon transition are highlighted in Table 8.1. This table expands on *Table 4.2* which outlined the spatial contingency of energy vulnerability drivers. Now, columns are added to outline the opportunities transition can present in the periphery to alter energy vulnerabilities and also the ways that peripherality can obstruct these causing injustices.

Overall, transition has been taken forward in various ways within the energy periphery. When transition is affected, it can positively impact upon energy vulnerabilities, increasing energy ‘Access’, ‘Affordability’, ‘Flexibility’, ‘Energy Efficiency’, and positively impacting energy ‘Needs’ and ‘Practices’. It also holds some opportunity to improve elements of peripheral disadvantage. Economically transition can reduce outgoings and secure new income revenues by reducing economic outgoings, this has a wider benefit of reducing the cost of peripheral living, retaining the viability of public spaces and providing a financial leeway for SME’s.

Table 8.1. Peripheral low-carbon transition energy vulnerability opportunities and injustices

Energy Vulnerability Driving force	Description	Spatial -Peripheral Contingency	Peripheral low-carbon transition opportunity	Peripheral low-carbon injustice
Access	Lack of ability to access energy appropriate for household needs.	Poor regional/sub-regional energy infrastructure & old domestic energy systems.	Local/domestic production negates current access issues.	Powerlessness, capacity, cost and building structures limit inclusion. Finding reliable installers/maintenance can be problematic.
Affordability	High ratio between costs of fuels and household income.	Remoteness from core increases fuel costs. Peripheral socioeconomics relatively impacts energy affordability.	Production can reduce bills and generate a secure income.	Transition measures can be costly, limiting who can participate.
Flexibility	Inability to change energy service provision.	Energy infrastructure and place-specific building style create 'lock-in'.	A combination of energy sources increases flexibility of supply especially for those with limited supply choice in 1 st instance.	Building structure and land availability can be inflexible and incompatible with transition requirements. Renewable energy production can reduce flexibility of supply.
Energy efficiency	Disproportionate high loss of energy.	Domestic energy systems and building style can be place-specific.	Reduced energy consumption.	Transition measures can be costly, limiting who can participate. Some energy efficiency measure have been installed incorrectly causing issues for interviewees.
Needs	Greater energy requirements due to personal circumstances.	Aging populations, reliance on personal transport.	Transition measures can increase comfort and increase affordability. Electric vehicles could be more economical to run if coupled with energy production.	Building structure and land availability can be inflexible and incompatible with transition requirements. Peripheral energy networks do not have capacity for electric vehicle network.
Practices	Lack of knowledge, socio-cultural norms.	Place-specific coping practices and/or energy systems. Dependence on personal transport.	Transition can increase interaction between people and energy, increasing knowledge and altering norms.	Lack of knowledge/education around transition measures has led to increases in energy bills and/or increased frequency in damp issues.

Source: Author

However, asymmetrical distribution of political, economic and social power between the periphery and the centre inform a lack of recognition and marginalisation of peripheral energy needs and aspirations, the spatial distribution of energy and other infrastructures and peripheral socioeconomics. All of these form elements of peripheral disadvantage which also inform spatially contingent energy vulnerabilities including particular energy needs and practices. Low-carbon transition mode, scale and distribution is consequently shaped by these factors, in some cases made more attractive, but more often made unattainable.

8.5 Implications for justice

Drawing on the empirical evidence and analysis of this research along with knowledge gained from the wider literature this section summaries the overall theoretical contribution of this thesis. This research has explored the nexus of peripherality, energy vulnerability and low carbon transition. In order to fully grasp the interplay between peripheral disadvantage, energy injustice and transition, an energy justice and spatial justice lens was adopted. Energy justice and energy vulnerability offers a framework to explore equity and fairness at any or all stages of an energy system. Spatial justice attempts to elucidate and make visible how dynamics of power and social fairness manifest spatially leading to uneven access to certain spaces and resources or ability to make good use of them. Sharing foundations in social and environmental justice, combined they illuminate how socio-cultural, economic and political forces work to create different places, the relative position of which influences the distribution of costs and benefits within the whole energy system.

A combination of theoretical and pragmatic considerations informed the bounding of the case study. Pragmatically, funding arrangements and personal researcher constraints limited at least part of the data collection to be based in Wales, and the Brecon Beacons National Park. Theoretically, consideration was given to concepts of fuel poverty (Boardman 1991; 2015; Hills et al. 2013; Middlemiss & Gillard 2015; Snell et al. 2015), energy vulnerability (Day & Walker 2013; Hall et al. 2013; Bouzarovski 2013; Simcock & Petrova 2017) and energy justice (Hall et al. 2013; Heffron et al. 2015; Sovacool & Dworkin 2015; Jenkins et al. 2016) within which, it is understood that energy deprivation is unevenly experienced through society and holding multiple materially harmful outcomes for those deprived of energy.

Second, processes of spatialization and place creation were considered, drawing on core and periphery theories which understand that the development of spatial hierarchies economical favour core places to the detriment of peripheral places (Myrdal 1957; Krugman 1991; Fujita et al. 1999; Copus 2001; Hudson 2015). Such spatial structures hold more than economic consequence, influencing political and socio-cultural representation and rhetoric (Bourdieu 1984; Lefebvre 1991; Schneider & Ingram 1993; Fischer-Tahir & Nauman 2013) and ultimately influencing the ability of peoples within peripheral places to inform decisions about their own economies and resources (Hayter et al. 2003; Argent 2013; Fischer-Tahir & Nauman 2013; Calvert 2016; Milbourne &

Mason 2017; Bridge et al. 2018). Thus, creating unevenly distributed power through space, or spatialized injustice (c.f. Dikeç 2001; Soja 2010) that accumulates in the periphery.

These two main theoretical considerations were important to consider together as energy is interlinked within spatialization processes and therefore, there may be connection between energy and peripheralization, peripheralization and energy vulnerability and finally peripherality, energy vulnerability and low carbon transition. Considering theory and pragmatisms, the case study was bound in and around the Brecon Beacons National Park (BBNP), Mid-South Wales, which while predominantly rural, in line with Fischer-Tahir & Nauman (2013) assertion that often peripherality coincides with rurality, the case also included some exurban and post-industrial areas. In this way a multitude of differently spatially positioned perspectives were exemplified, illuminating the multiple interplay between processes of peripheralization, energy vulnerability and energy transition in Wales.

Interviewees experiences of peripherality were varied and numerous, manifesting as political marginalisation, as decline in public services, as weak economy and in poor transport infrastructures. Such experiences held wide impacts, affecting the effectiveness of public service delivery, employment opportunities and incomes (household and business), and residual income. Through triangulation with other sources of cultural, economic and political data, such as media representations, official statistics, parliamentary proceedings and other research, it is apparent that these individual experiences are reflective of wider peripherality in Wales. What also became apparent was that existing energy infrastructure reflected spatial hierarchies, where older networks with a sparser reach were evident in the case study area comparative to core places in Wales. This spatial energy configuration was materially visible to interviewees, especially those who had no choice but to source alternative energy. Similar to the other aspects of peripherality that were discussed, energy-related peripherality was also informed by both historic and current economic and spatial development processes. Through the exploration of peripheral experience, understanding was gained as to some of the ways that spatial injustices and energy injustices interplay within a peripheral context and can create energy vulnerabilities that are specific to the periphery.

Within the periphery, various experiences of energy vulnerability were highlighted. Some were discussed by interviewees that could be considered as 'non-place specific' for

example, vulnerabilities due to housing tenure, however, many of the energy vulnerabilities experienced were place-specific or spatially contingent. As outlined in Section 8.2, spatial contingency was found within all six energy vulnerability drivers; *Access, Affordability, Energy Efficiency, Flexibility, Practices* and *Needs*. Indeed, the connection between peripherality and energy vulnerability were found to be multiple with numerous possible constellations of interconnections (see also Figure 8.1). The interconnection means that more than one form of energy vulnerability can be experienced at one time, for lack of ‘Access’ to energy, due to peripheral disadvantage can impact the ‘Affordability’ of alternative energy sourced, how ‘Efficient’ alternative energy system configurations are, whether alternative ‘Practices’ are adopted to facilitate such alternatives and how energy ‘Needs’ are met. The research also found that similar to peripherality, energy vulnerability can be circular in effect whereby one energy vulnerability, very simply, ‘Affordability’ can create ‘Inflexibility’ to alter the current energy context, thus leaving a household ‘locked in’ to unaffordable energy and feedbacking to ‘Affordability’.

Seeking to more comprehensively realise the interplay between peripheral disadvantage, energy injustice and their consequence, consideration was extended further than at the point of end use, or energy vulnerability experienced at a household scale. Exploring interplay at all stages of the energy system – at points of energy production, distribution as well as consumption – illuminated how energy vulnerabilities at a household scale are informed by other interplays between energy processes and spatialization further ‘upstream’ in the energy system. This consideration does not veer away from the empirical findings; indeed, it fits within the expressed experiences and perspectives of many of the interviewees who themselves linked together processes of energy production and their own consumption. This interplay is discussed in *Section 8.2* and exemplified in Figure 8.2.

In this case, a periphery with availability of natural resources for energy production, but with low populations and limited social, economic and political capacity experience difficulty in accessing the same energy produced. The same weak social, economic and political capacity creates problematics for the recognition and inclusion of peripheries in energy decisions and other processes. Without recognition of peripheral energy (and wider) needs and wants, little influence from the periphery is placed on how, where, at what scale and by whom energy production takes place. Likewise, little influence is

placed on how and to whom it is the energy itself is distributed and at what cost, in addition to any of the other benefits that may arise. Any input into decision making by peripheries is skewed by their weak and dependent economic position, making any development that offers some economic benefits, especially those which promise employment, very attractive - even if employment opportunities are limited and/or low paid and other benefits are only short term. This is in line with core-periphery theories (c.f. Argent 2013; Hayter et al. 2003) and other research that has demonstrated such processes are extractive and foster further dependence on external economic investment and energy vulnerable (c.f. Yenneti et al. 2016; Bryn et al. 2017).

From this, 'energy periphery' is conceptualised - providing a means of focusing attention on the unique energy injustices experienced throughout an energy system by peripheral places – raising attention to the frequent co-constitution of spatial injustice and energy injustice. Energy periphery also encapsulates how some peripheral communities experience place-specific energy vulnerabilities and disadvantages through the entire energy system due to relative spatially asymmetrical distribution of power between peripheries and centres. These processes, inherently interconnected and circular maintain the self-reinforcing process of peripheralization and its disadvantageous outcomes, imbued with energy injustices. Energy periphery derives spatial foundation from 'periphery' as understood in key core-periphery theory (Myrdal 1957; Krugman 1991; Copus 2001; Forslid & Ottaviano 2003; Ascani et al. 2012; Hudson 2015), is a relative concept and applicable at many scales within many contexts. As such, energy periphery is not confined to this research case study and can be applied to other places to exemplify similar disadvantageous energo-spatio contexts. There are a number of advantages to applying the energy periphery concept to different contexts at global, national and sub-national scales. First, the energy poverty and transition literature retains a focus on core and urban contexts, little focus to date has been placed upon peripheral and rural experiences of energy deprivation and energy transition. Second, as energy transition is increasingly positioned as a civic and environmental good, economic development and a means to reducing energy costs and thus aiding the eradication of fuel poverty (Foxon et al. 2010; Hawkey et al. 2013; Pye et al. 2015, p. 673; Jenkins et al. 2016; Benedek et al. 2019), research is needed to explore how and where this is and is not the case.

Energy periphery does not intend to apply a broad brush and un-nuanced understanding of peripherality-energy vulnerability-transition nexus. In line with other research

findings, the various low carbon transitions that became evident during the course of this research within the periphery do appear to be creating a more ‘just’ energy system in many ways (Foxon 2013; Szulecki 2018; Benedek et al. 2019). First, it is being taken up by many individuals and organisations - from individual households, to commercial businesses and the public sector – and at varying scales (e.g. micro, meso and macro). In terms of energy production, such varied take up is decentralising energy production and de-monopolising if not democratising the energy system. Energy production and energy conservation interventions singularly or combined did counteract some elements of peripheral disadvantage and peripheral-specific energy vulnerabilities. For example, by reducing energy consumption and proving savings on energy bills, by providing an alternative and secure energy supply (Figure 7.15) and with the most striking results visible at micro/meso scale – providing economic subsidisation for small businesses and public services (Figures 7.3 and 7.4). This has small but knock-on effects for the local economies, leaving households with more surplus income to spend, providing more local employment opportunities, or maintaining local services that offer social and community benefits, retention of such services reduces the need to travel elsewhere. In addition, as some of the interviewees expressed, it offered piece of mind for those on limited incomes or ill health, relieving some burden of bill paying and offering increased comfort within their homes.

However, the take-up of low carbon transition opportunities was not universal, as outlined in the previous section, some interviewees spoke of ambition to produce their own energy or install carbon saving interventions but faced difficulties in doing so. These difficulties were traced back to the combination of spatial injustices and energy injustices inherent within peripheral disadvantage. For example, elements of peripherality such as sparse and declining populations contribute to poor local energy infrastructure, these in combination with energy inefficient and inflexible homes, an energy vulnerability driver, means many of the households interviewed sourced alternative (non-mains) energy that were often more carbon heavy and are higher cost. In addition to meet their energy needs, the same households would need to consume more energy than their counterparts in non-peripheral places. Such contexts limited the physical adaptability of the existing energy system configuration (old, poor energy infrastructure – inflexible building and household energy system design) as well as financial ability to participate in transition. This example only highlights one limited combination of how peripherality elements and peripheral energy vulnerability drivers can align and limit transition uptake. As Figures 8.1 and 8.2

demonstrate such combinations can be variable and multiple. Thus, adopting a spatial and energy justice lens has provided a means for unpacking the dynamics involved in creating situations of energy deprivation and other energy vulnerabilities by expanding contributing factors to more than issues of household budgets, building structure and energy consumption. Instead contributing factors were expanded to include the socio-technical, socio-economic and socio-political at multiple scales.

The lens has also allowed consideration of energy production and distribution in addition to consumption. Illuminated by this is that energy vulnerability may manifest most readily at a household scale and the socio-geographic and socio-economic structure of different places means that these vulnerabilities can be exacerbated depending on location. In addition, energy vulnerability is more than an energy injustice at the point of supposed consumption. Instead it is impacted on by predecessor energy processes of production and distribution (c.f. Figure 8.2). Each process holds spatial implications in how and where they materially positioned which is informed by economic and socio-political structures and decisions. This research identified that in the periphery, energy injustices are present in all three energy processes - production, distribution and consumption - capacity to own energy production and distribution and manage consumption levels and costs here is limited. This affects multiple actors in addition to households, for example affecting community groups, businesses and the public sector. These injustices are likely to increase in relevance as decentralisation becomes more common during low-carbon energy transition and existing peripheral disadvantages remain, reinforcing some of the existing uneven distribution of costs and benefits within the energy system.

While low carbon transition may be disrupting some aspects of the existing energy system, it is still unfolding within it, and is similarly both advanced and constrained by liberal energy market logics. For this reason, as with the pre-existing energy system, low carbon transition retains preference for energy production via large-scale development, and energy distribution to those who can afford it. Energy distribution still predominantly take place across existing distribution networks, at lower cost to places closer to central points and higher cost to those in remote areas. Thus, with some exceptions, low carbon transition does not remediate poor energy access in places where costs cannot be recouped quickly. Only at micro scales of energy production and distribution is transition altering distribution and cost - where energy producers can consume their own energy. In order to benefit from this, in most cases transition requires economic buy-in – thus even at this

scale with enhanced distribution and democratisation transition remains subject to capitalist logics.

As transition has progressed so far costs and benefits have not been evenly distributed, including how and where transition is taking place, who is taking it forward and how and who pays the costs and who gains the benefits. This holds immediate implications for energy justice including energy vulnerability. Transition also holds spatial implications, most visible at a larger scale where locations for energy production are sought that have space, populations and access to natural resource, thus favouring rural peripheries. Additionally, energy vulnerability and space also hold implications for transition, where those already energy vulnerable are least able to take on transition and, due to the spatial contingency of energy vulnerabilities, this will impact more profoundly on some places over others. Thus, energy vulnerability, spatialization and transition processes are highly interlinked. Energy transition in energy peripheries appears to benefit a small range of households, alleviating their end-use energy vulnerability via domestic energy production or increased energy efficiency, but most households remain locked-in to outdated, inefficient, carbon heavy technologies in the form of carbon heavy vehicles and domestic energy systems. Overall, peripherality inhibits abilities to take advantage of the opportunities low-carbon transition presents, risking compounding existing vulnerabilities.

Overall, this research has established that the spatial injustice of peripherality holds direct and indirect impacts on energy vulnerability and energy transition. For peripheries, characterised by various disadvantages and declines, energy vulnerabilities are pronounced and place-specific. Place-specific energy vulnerabilities interplay with wider energy vulnerabilities throughout the energy system compounding their impacts, creating energy peripheries. Therefore, while energy transition is possible and is also able to counteract aspects of place-specific disadvantage and energy vulnerabilities, spatial differentiation and the relative weaker social, economic and political power held within peripheries compared to the core, influences where this can take place. Further solidifying differential spatial transition abilities is the economic basis of transition which amalgamates with the economic foundations of spatialization. Peripheries are subsequently in weak positions to take advantage of transition opportunities and risk deeper peripherality as transition progresses without them unless steps are taken now to address spatially contingent energy injustices inherent within the transition process.

This research has established that processes of spatialization hold direct and indirect impacts on energy vulnerability, and combined, spatialization and spatially contingent energy vulnerabilities influence low-carbon energy transition. Spatial structures, such as core-periphery, and the advantages and disadvantages asymmetrically embedded within them, including energy vulnerabilities, are difficult to challenge as they are reinforced through a variety of social, political and economic constructions. Each of which, while interconnected, are individually multi-scalar and complex.

8.6 Recommendations to harness energy transition and reduce peripheral vulnerabilities

This research has established that processes of spatialization hold direct and indirect impacts on energy vulnerability and energy transition. Such spatial structures and the disadvantages embedded within them are difficult to challenge as they are reinforced through a variety of social, political and economic constructions, each of which, while interconnected, are individually multi-scalar and complex. Additionally, while energy transition, even in its most democratic and fair form, is unlikely to re-position peripheries as cores (or vice versa) it does hold opportunities to redress some of the current spatial imbalance and benefit peripheral populations. For energy transition to have such influence, its current trajectory and distribution of its costs and benefits must be addressed now, as currently it is reinforcing an already uneven and discriminatory energy system.

Uneven distributions of political power between countries and within regions and sub-regions of policy powers, funding and autonomy interplays with socio-cultural and economic processes to the disadvantage of peripheries at many scales. In addition, the drive towards certain modes of low-carbon transition, including those which may or may not counteract energy vulnerabilities is heavily influenced by policy. As such, policy recommendations are made towards addressing imbalance of power and recognition:

- Ofgem should recognise and address the disadvantages faced by energy customers in Wales regarding energy costs.
- Existing policy levers in Wales must recognise and accommodate the varying endowments and needs of different places, and be utilized in ways where policy objectives can be applied in different places but in complementary ways.

- Policy commitment for all energy developments ‘to have an element of local ownership’ needs to be nuanced and strengthened, this links with a strengthening of guidelines for the allocation and management of community benefit funds to ensure no community is disadvantaged due to relative peripherality.
- Welsh low-carbon energy supply chains and R&D must be encouraged to develop and grow. This includes the development of energy production and energy efficiency technologies. In addition, a greater emphasis is needed on research and implementation of new heat technologies to counteract limitations of electricity grid.

A key problematic of low-carbon transition and energy vulnerability at household scale was how current assistance programmes can be exclusionary due to how they measure the need for assistance. Compounding this is the non-recognition of the extra costs associated with living in rural areas. Finally, in order that households are able to transition, place-based limitations on transition must be addressed:

- Housing Regulations should be strengthened to offer better protection in terms of building energy efficiencies for privately rented homes.
- Programmes towards assisting households’ transition should focus more widely on energy needs in combination with building structures. In addition, programmes should not be limited to benefit claimants, instead actual living costs (including energy costs and transport costs) should be considered.

Finally, local governance and policy institutions hold a fundamental role in addressing energy vulnerabilities, localised peripheral disadvantages and taking forward low-carbon transition. Having excellent knowledge bases of place-based assets and needs, recommendations are made as to how these can be capitalised upon:

- The BBNP to become a ‘niche’ space for transition: enabling communities to transition more easily; facilitate partnership working; and further actively participating in low-carbon transition as an organisation.
- Planning procedures should view more favourably energy developments, particularly small-scale, which stipulate local reinvestment of profits or which stipulate additional social value.

8.7 Research limitations & further research

This research adopted a qualitative research design and aimed to gain depth of understanding currently unfulfilled within the literature. While every effort was made to reduce weaknesses in the research process, doubtless there remain areas for improvement. The case study area, based in Wales and in and around the Brecon Beacons National Park (BBNP) provided an excellent foundation for the exploration of the effects of multi-scalar and different interplaying processes of peripheralization, energy vulnerability and energy transition. In addition, the effects of alternate governance arrangements and priorities on the preservation of such spaces, and possible energy vulnerabilities and transition routes were also illuminated. However, in bounding the research in such a way, other spaces have not been explored. For example, while peripherality within the case area is understood, it may have been beneficial to also explore similar or different peripheries within Wales or even within other countries, such as Scotland. The development of the energy periphery concept thus at present is applicable to Wales, and although likely applicable to other peripheries, further research may be required to explore if this is the case. In addition, this research due to its design captures perceptions of peripherality and energy vulnerability in Wales strongly. To balance this other data had to be sourced, for example, policy documents, official statistics and other research to triangulate the perceptions and experiences presented.

Measuring the key concepts of peripherality and energy vulnerability proved challenging as both are relative and subjective. To try and bound peripherality required taking a wider view of the case study area, where it is positioned physically, and relatively socially and spatio-economically in Wales and then the UK. Energy vulnerability while easier to bound thanks to the ‘energy vulnerability drivers’ proposed by Simcock and Petrova (2017), still remained relatively open to interpretation. In addition, ‘vulnerability’ was not a term that could be readily used during interviews with households as despite some living in precarious energy contexts, personally they would not identify as vulnerable. Thus, alternative ways of asking questions that did not imply their specific vulnerability had to be designed.

Illuminating energy vulnerability may have benefitted from alternative methods to those used in this research. As energy is largely intangible, except in the services it provides, or the heat it produces, talking about it (or lack of) can be hard to articulate. Other research has attempted to overcome this by using Narrative or Biographic methods with photo

elicitation (c.f. Henwood et al. 2015). Adopting an alternative approach such as these may have eased discussions of energy and energy vulnerability for the interviewees and perhaps illuminated alternative insights that this research has not. Similarly, low-carbon transitions proved to be an abstract concept for some interviewees, other research has used Deliberative Focus groups to inform and untangle participant perspectives. Finally, as low-carbon transitions are changes to the energy regime in time as well as space, this research would have benefited from a longitudinal approach (c.f. Roberts & Henwood 2019) researching the same groups or communities of people, or phenomena at different times, thus gaining an insight into changes through time. Capturing possible changes in perceptions and experiences over time in this case-study area would be of great benefit to transition research.

Interviewee selection due to the recruitment strategy adopted held some self-selection bias. This is evident with regards to domestic and community interviews as opposed to the other groups. For example, the majority of owned households and community groups interviewed were those that had taken some form of transition forward and who volunteered their time after seeing the research advertised. Other tenure types or third sector groups without transition had to be purposely recruited and are fewer in sample numbers. This provided its own benefits, enhancing understanding of how and who within peripheries are able to participate in transition, and in terms of household demographics – more closely represented that of the overall study area. However, further interviews with those ‘non-transitioning’ or more ‘passively-transitioning’ would strengthen findings around energy vulnerabilities and transition barriers. Additionally, the Brecon Beacons National Park Authority (BBNPA) played an informative role during initial research design and interviewee recruitment, especially at the early stages. This influence is likely to have biased the research towards focusing most readily on areas within the BBNP and with interviewees closely connected to the BBNPA. However, this was limited in some way during later data collection stages by carrying out interviews with people outside of the BBNP and unconnected (at least in a direct sense) to the BBNPA.

During the research many new energy related research projects were completed in Wales and new policies and energy targets were released. This included, the *Environment (Wales) Act* (2016), *Wales Act* (2017), *Planning Policy (version 10) Wales* (2019), *Climate Change Regulations (Wales)* (2019) in addition to commitments announced in 2017 towards 70% of electricity generated in Wales to be from renewables and 1GW of

energy to be locally owned by 2030 and by 2020 all renewable energy production to have an element of local ownership. Indeed, as this research concludes, the *Wales Act (2017)* will come into force and energy policy will be further devolved placing it more in-line with other UK countries. In connection to this, in business rates in Wales increased in 2016, holding severe ramifications for previously exempt micro-hydro where some saw a tax increase of on average 300%⁷². Additionally, in 2018 Westminster announced its decision not to support the Swansea Bay Tidal Lagoon (SBTL). While the announcement came after data collection had completed, it was predicted by many long before. These two political and policy actions no doubt influenced some of the perceptions of UK and Welsh political governance held by interviewees. Thus, further research would be beneficial to follow the outcomes of such policies and research agendas on peripheral energy vulnerabilities and transition.

In addition, a major context shift is occurring in Europe and the UK more generally in the form of Brexit (the UK's exit from the EU). This is predicted to have severe ramifications for the agricultural sector (see *Section 8.4*) and also economically deprived areas of Wales, both of which have been in receipt of substantial EU subsidies (since 2000 economically deprived areas of Wales have received £53bn) (Dickens 2017). Withdrawal of such EU subsidies is to be replaced by a UK Shared Prosperity Fund, however, concerns remain as to the share Wales will receive given its peripheral position in the UK (National Assembly for Wales 2018b). As such, further research is required to monitor and explore this political process and periphery impacts.

There are several new low-carbon developments currently in trial stages in Wales as Regulatory Sandboxes (Ofgem 2017b). Further research into their success and the wider transition 'demonstrator projects' underway in the UK would be beneficial to establish which may be best routes for peripheral areas in Wales. Finally, the reduction in FIT has already led to new transition business models being adopted by many actors. In particular, partnerships between different actors. Further research is needed to establish the extent of such alternative partnerships, their success and also their applicability to peripheral areas.

⁷² As per Chapter 5

References

Adams, C.A. and Bell, S. 2015. Local energy generation projects: assessing equity and risks. *Local Environment* 20(12), pp. 1473-1488.

Adams, D. 1996. *Stage Welsh. Nation, nationalism and theatre: The search for cultural identity*. Llandysul, Dyfed: Gomer Press.

Aitken, M. 2010. Wind power and community benefits: Challenges and opportunities. *Energy Policy* 38, pp. 6066-6075.

Agterbosch, S., Meertens, R.M., and Vermeulen, W.J.V. 2007. The relative importance of social and institutional conditions in the planning of wind power projects. *Renewable and Sustainable Energy Reviews*, pp. 393-405.

Agyeman, J. and Evans, B. 2004. 'Just sustainability': the emerging discourse of environmental justice in Britain? *The Geographical Journal* 170, pp. 155-164.

Allen, J. 2003. *Lost geographies of power*. Oxford: Blackwell Publishing.

Allen, J., Massey, D., Cochrane, D., Charlesworth, J., Court, G., Henry, N., and Sarre, P. 1998. *Rethinking the Region*. London: Routledge.

Allen M., Downing, E., Edwards, T., Seaton, N., and Semple, M. 2014. *CAP Reform 2014-20: EU agreement and implementation in the UK and Ireland* [Online]. Available at: <http://researchbriefings.parliament.uk/ResearchBriefing/Summary/RP14-56> [Accessed 5 March 2019].

Allen, R.C. 2012. Backward into the future: The shift to coal and implications for the next energy transition. *Energy Policy* 50, pp. 17-23.

Ambrose, A. 2015. Improving energy efficiency in private rented housing: what makes landlords act? *Indoor and Built Environment* 24(7), pp. 913-924.

Anderson, W., White, V. and Finney, A. 2012. Coping with low incomes and cold homes. *Energy Policy* 49, pp. 40-52.

ap Gwilym, E. 2015. Spending on HS2 and its impact on Welsh funding. *Institute of Welsh Affairs* [Online]. Available at: <https://www.iwa.wales/click/2015/12/spending-on-hs2-and-its-impact-on-welsh-funding/> [Accessed 5 March 2019].

Argent, N. 2013. Reinterpreting Core and Periphery in Australia's Mineral and Energy Resources Boom: an Innisian perspective on the Pilbara. *Australian Geographer* 44(3), pp. 323-340.

Ascani, A., Crescenzi, R., and Iammarino, S. 2012. *New Economic Geography and Economic Integration: A Review*. WP1/02 Search Working Paper [Online]. Available at: <http://www.ub.edu/searchproject/wp-content/uploads/2012/02/WP-1.2.pdf> [Accessed 12 September 2019].

Atkinson, J., Littlewood, J., Greens, A. and Karani, G. 2015. Did ARBED I save energy Wales' deprived dwellings. *Procedia* 83, pp. 444-453.

Bailey, N., Bramley, G. and Hastings, A. 2015. Symposium Introduction: Local responses to 'austerity'. *Local Government Studies* 41(4), pp. 571-581.

Baker, S. and Mehmood, A. 2015. Social innovation and the governance of sustainable places. *Local Environment* 20(3), pp. 321-334.

Balta-Ozkan, N., Watson, T., and Mocca, E. 2015. Spatially uneven development and low carbon transitions: Insights from urban and regional planning. *Energy Policy* 85, pp. 500-510.

Barnes, M., Butt, S. and Tomaszewski, W. 2008. *The Dynamics of Bad Housing: The Impact of Bad Housing on the Living Standards of Children*. London: National Centre for Social Research.

BBC. 2017. *Welsh councils facing cash cuts for next two years* [Online]. Available at: <https://www.bbc.co.uk/news/uk-wales-politics-41557214> [Accessed 5 March 2019].

BBC. 2018a. *Excess winter deaths almost double in Wales*. [Online]. Available at: <https://www.bbc.co.uk/news/uk-wales-46397891> [Accessed: 29 January 2019].

BBC. 2018b. *Storm Callum: Flood clean-up continues in Wales* [Online]. Available at: <https://www.bbc.co.uk/news/uk-wales-45858700> [Accessed 5 March 2019].

- BBC. 2018c. *Welsh councils facing real-terms cuts to funding* [Online]. Available at: <https://www.bbc.co.uk/news/uk-wales-politics-45789564> [Accessed 5 March 2019].
- Beatty, C., and Fothergill, C. 1996. Labour Market Adjustment in Areas of Chronic Industrial Decline: The Case of the UK Coalfields. *Regional Studies* 30(7), pp. 627-640.
- Bell, R. 1996. Local sensitivities and the representation of peripherality. *Journal of Transport Geography* 4(2), pp. 27-36.
- Benedek, J., Sebestyén, T., and Bartók, B. 2018. Evaluation of renewable energy sources in peripheral areas and renewable energy-based rural development. *Renewable and Sustainable Energy Reviews* 90, pp. 516-535.
- Bennett, J. 2005. The agency of assemblages and the North American blackout. *Public Culture* 17(3), pp. 445-465.
- Bere, J., Jones, C., and Munday, M. 2017. Energy and development in the periphery: A regional perspective on small hydropower projects. *Environment and Planning C* 35(2), pp. 355-375.
- Bergmann, A., Hanley, N., and Wright, R. 2006. Valuing the attributes of renewable energy investments. *Energy Policy*, 34, pp. 1004-1014.
- Bickerstaff, K., Walker, G. and Bulkeley, H. 2013. *Energy Justice in a Changing Climate*. London: Zed Books Ltd.
- Blaikie, N. 2009. *Designing Social Research*. Cambridge: Polity Press.
- Bloom, D.E., Canning, D., and Fink, G. 2011. Implications of Population Aging for Economic Growth. Program on the Global Demography of Aging. *Working Paper No. 64*. Harvard Initiative for Global Health: The Program on the Global Demography of Aging.
- Boardman, B. 1991. *Fuel Poverty*. London: Belhaven Press.
- Boardman, B. 2010. *Fixing Fuel Poverty: Challenges and solutions*. London: Earthscan.
- Bourdieu, P. 1984. *Distinction. A social critique of the judgement of taste*. London: Routledge Kegan & Paul.

Botterill, D., Owen, R.E., Emanuel, L., Foster, N., Gale, T., Neelson, C. and Selby, M. Perceptions of the periphery: The experience of Wales. In: Brown, F. & Hall, D. eds. *Tourism in peripheral areas, case studies*. Clevedon: Channel View Publications, pp. 7-32.

Bouzarovski, S. 2013. Energy poverty in the European Union: landscapes of vulnerability. *Energy Environment* 3, pp. 276-289.

Bouzarovski, S., Petrova, S., Kitching, M. and Baldwick, J. 2013. Precarious domesticities: energy vulnerability among urban young adults. In: Bickerstaff, K., Walker, G. & Bulkeley, H. eds. *Energy Justice in a Changing Climate*. London: Zed Books Ltd, pp. 30-45.

Bouzarovski, S., Petrova, S. and Tirado Herrero, S. 2014. From fuel poverty to energy vulnerability: The importance of services, needs and practices. *Working Paper Series, SWPS 2014-25*. Sussex: University of Sussex.

Bouzarovski, S., and Simcock, N. 2017. Spatializing energy justice. *Energy Policy* 107, pp. 640-648.

Bouzarovski, S., and Triado Herrero, S. 2017. The energy divide: Integrating energy transitions, regional inequalities and poverty trends in the European Union. *European Urban and Regional Studies* 24(1), pp. 69–86.

Bradshaw, M. 2014. *Global Energy Dilemmas*. Cambridge: Polity Press.

Bradshaw, J., Middleton, S., Davis, A., Oldfield, N., Smith, N., Cusworth, L. and Williams, J. 2008. *A minimum income standard for Britain: What people think*. Research Report. York: Joseph Rowntree Foundation.

Bramley, G. and Watkins, D. 2013. *Local Incomes and Poverty in Scotland: Developing Local and Small Area Estimates and Exploring Patterns of Income Distribution, Poverty and Deprivation*, Report of Research for the Improvement Service on behalf of four Local Authorities (Edinburgh, Falkirk, Fife and Highland) and the Scottish Government [Online]. Available at: <http://www.improvementservice.org.uk/assets/local-incomes-poverty-scotland.pdf> [Accessed 20 September 2019].

Brecon Beacons National Park Authority (BBNPA). 2009. *The Brecon Beacons National Park: a good place for Glastir Sustainable Land Management Scheme* [Online]. Available at: https://www.beacons-npa.gov.uk/wp-content/uploads/oldsite/environment/farming-in-the-brecon-beacons/The%20Brecon%20Beacons%20National%20Park_a%20good%20place%20for%20Glastir_final_cover1x.pdf [Accessed 5 March 2019].

Brecon Beacons National Park Authority (BBNPA). 2012. *Basic Facts About the National Park* [Online]. Available at: <http://www.beacons-npa.gov.uk/wp-content/uploads/basic-facts-about-the-brecon-beacons-national-park.pdf>. [Accessed 16 August 2018].

Brecon Beacons National Park Authority (BBNPA). 2013a. *Local Development Plan 2007-2022*. Brecon: Brecon Beacons National Park Authority.

Brecon Beacons National Park Authority (BBNPA). 2013b. *Residents Survey, October 2013, Final Report*. Birmingham: M.E.L. Research.

Brecon Beacons National Park (BBNP). 2015. *Planning Annual Performance Report (April) 2014-2015* [Online]. Available at: <https://governance.beacons-npa.gov.uk/mgConvert2PDF.aspx?ID=14381> [Accessed 9 March 2017].

Brecon Beacons National Park Authority (BBNPA). 2019. *What will happen to the National Park?* [Online]. Available at: <https://www.beacons-npa.gov.uk/environment/climate-change/what-will-happen-to-the-national-park/> [Accessed 5 March 2019].

Bridge, G. 2010. *Heading 'downstream': towards a cultural political economy of energy consumption*. Paper presented at Energy Subjects: cultural economies of energy consumption. Seminar 3 in the ESRC-funded 'Geographies of Energy Transition' series, Manchester.

Bridge, G., Bouzarovski, S., Bradshaw, M., and Eyre, N. 2013. Geographies of energy transition: Space, place and the low-carbon economy. *Energy Policy*, 53, pp. 331-340.

Bridge, G. 2018. The map is not the territory: A sympathetic critique of energy research's spatial turn. *Energy Research & Social Science* 36, pp. 11-20.

- Bridge, G., Ozkaynak, B., and Turhan, E. 2018. Energy infrastructure and the fate of the nation: Introduction to special issue. *Energy research and social science* 41, pp. 1-11.
- Bristow, G. Cowell, R. and Munday, M. 2012. Windfalls for whom? The evolving notion of 'community' in community benefit provisions from wind farms. *Geoforum* 43, pp. 1108-1120.
- Bryan, J., Evans, C., and Munday, M.C. 2017. Regional electricity generation and employment in UK regions. *Regional Studies* 51(3), pp. 414-425.
- Bryman, A. 2016. *Social Research Methods, fifth edition*. Oxford: Oxford University Press.
- Bulkeley, H. Castán Broto, V., Hodson, M. and Marvin, S. 2011. *Cities and Low Carbon Transitions*. Oxon: Routledge.
- Bulkeley, H. Castán Broto, V. and Maassen, A. 2014. Low carbon transitions and the reconfiguration of urban infrastructure. *Urban Studies* 51(7), pp. 1471-1486.
- Bulkeley, H. and Walker, G. 2005. Environmental Justice: A new agenda for the UK. *Local Environment* 10(4), pp. 329-323.
- Buzar, S. 2007. When homes become prisons: the relational spaces of postsocialist energy poverty. *Environment and Planning* 39, pp. 1908-1925.
- Calvert, K. 2016. From 'energy geography' to 'energy geographies': Perspectives on a fertile academic borderland. *Progress in Human Geography* 40(1), pp. 105-125.
- Campaign for Better Transport. 2018. *Buses in Crisis: A report on bus funding across England and Wales 2010–2018* [Online]. Available at: https://bettertransport.org.uk/sites/default/files/research-files/Buses-in-Crisis-2018_0.pdf [Accessed 5 March 2019].
- Capeheart, L. and Milovanovic, D. 2007. *Social Justice: Theories, Issues and Movements*. London: Rutgers University Press.
- Carbon Brief. 2018. *Six charts show mixed progress for UK renewables*. Available at: <https://www.carbonbrief.org/six-charts-show-mixed-progress-for-uk-renewables>.

Carrington, D. 2015. UK cancels pioneering £1bn carbon capture and storage competition. *The Guardian* 25 November 2015 [Online]. Available at: <https://www.theguardian.com/environment/2015/nov/25/uk-cancels-pioneering-1bn-carbon-capture-and-storage-competition> [Accessed 5 March 2019].

Cass, N. and Walker, G. 2009. Emotion and rationality: The characterisation and evaluation of opposition to renewable energy projects. *Emotion, Space and Society* 2, pp. 62-69.

Castan Broto, V., and Baker, L. 2018. Spatial adventures in energy studies: An introduction to the special issue. *Energy research and social science* 36, pp. 1-19.

Catney, P., Dobson, A., Hall, S.M., Hards, S., Robinson, Z., Ormerod, M., and Ross, S. 2013. Community knowledge networks: an action- orientated approach to energy research. *Local Environment* 18(4), pp. 506-520.

Cavity Insulation Victims Alliance. 2019. *Worthwords Blobs on the Cavity Wall Insulation Crisis* [Online]. Available at: <http://www.civalli.com/news> [Accessed 5 March 2019].

Centre for Sustainable Energy. 2015. *Mapping domestic energy efficiency in Great Britain* [Online]. Available at: <https://www.cse.org.uk/downloads/reports-and-publications/policy/insulation-and-heating/planning/building-performance/mapping-EPC-data-full-feasibility-report.pdf> [Accessed 5 March 2019].

Chow, J. Kopp, R.J., & Portney, P.R. 2003. Energy Resources and Global Development. *Science* 302, pp. 1528-1531.

Citizens Advice. 2016. *Fair Play for Prepay* [Online]. Available at: https://www.citizensadvice.org.uk/about-us/campaigns/current_campaigns/recent-campaigns/fair-play-for-prepay-campaign/fair-play-for-prepay/ [Accessed: 3 May 2016].

Citizens Advice. 2017. *Living without mains gas* [Online]. Available at: <https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/Livingwithoutmainsgas.pdf> [Accessed 28 June 2018].

Chatterton, T., Anable, J., Cairns, S., and Wilson, R.E. 2018. Financial Implications of Car Ownership and Use: a distributional analysis based on observed spatial variance considering income and domestic energy costs. *Transport Policy* 65, pp. 30-39.

Chalvatzis, K.J. and Ionnidis, A. 2017. Energy Supply Security in Southern Europe and Ireland. *Energy Procedia* 105, pp. 2916-2922.

Climate Change Act 2008. (c.27). London: The Stationery Office.

Committee on Climate Change. 2018. *Reducing UK emissions. 2018 Progress Report to Parliament* [Online]. Available at: <https://www.theccc.org.uk/publication/reducing-uk-emissions-2018-progress-report-to-parliament/> [Accessed 28 March 2019].

Consumer Data Research Centre (CDRC). 2018. *Dwelling Age Group Counts (LSOA)* [Online]. Available at: <https://data.cdrc.ac.uk/dataset/house-ages-and-prices/resource/4f1956b2-3128-4297-ba97-059e1fbc1fcc> [Accessed 5 March 2019].

Copus, A.K. 2001. From Core-periphery to polycentric development: Concepts of spatial and aspatial peripherality. *European Planning Studies* 9(4), pp. 539-552.

Competition and Markets Authority. 2016. *Energy market investigation Summary of final report* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/531157/Energy-final-report-summary.pdf [Accessed 28 June 2018].

Consumer Research Data Centre. 2016. *Population Density and Urban/Rural Classification* [Online]. Available at: <https://data.cdrc.ac.uk/dataset/population-density-and-urban-rural-classification> [Accessed 5 March 2019].

Cooper, C., Chiaradia, A., Webster, C. 2016. *Spatial Design Network Analysis software, version 3.4*, Cardiff University. Available at: <http://www.cardiff.ac.uk/sdna/>.

Cornock, D. 2018. Tributes, anti-Welsh bigotry and that lagoon again. *BBC* 20 March 2018 [Online]. Available at: <https://www.bbc.co.uk/news/uk-wales-politics-43473797> [Accessed 31 January 2019].

Cosslett, R. L. 2018. Anti-Welsh bigotry is rife. It's just as well we're a tough people. *The Guardian* 15 March 2018 [Online]. Available at:

<https://www.theguardian.com/commentisfree/2018/mar/15/anti-welsh-bigotry-eddie-jones-england-brexit> Accessed [31 January 2019].

Cowell, R. 2010. Wind power, landscape and strategic, spatial planning - The construction of 'acceptable locations' in Wales. *Land Use Policy* 27, pp. 222-232.

Cowell, R., Bristow, G., and Munday, M. 2011. Acceptance, acceptability and environmental justice: the role of community benefits in wind energy development. *Journal of Environmental Planning and Management* 54(4), pp. 539-557.

Cowell, R., Bristow, G., and Munday, M. 2012. Wind energy and justice for disadvantaged communities. *Viewpoint*. York: Joseph Roundtree Foundation.

Cowell, R., Ellis, G., Sherry-Brennan, F., Strachan, P. A., and Toke, D. 2015. Rescaling the Governance of Renewable Energy: Lessons from the UK Devolution Experience. *Journal of Environmental Policy and Planning* [Online]. Available at: DOI: 10.1080/1523908X.2015.1008437.

Creswell, J.W. 2013. *Qualitative Inquiry and Research Design*. London: SAGE Publications Ltd.

Creswell, T. 2015. *Place an Introduction*. 2nd Edition. West Sussex: John Wiley & Sons Ltd.

Cullen, B.T. and Pretes, M. 2000. The meaning of marginality: Interpretations and perceptions in social science. *The Social Science Journal* 37(2), pp. 215-229.

Currie, G., and Sensberg, Z. 2007. Exploring forced car ownership in metropolitan Melbourne. *Australia transport research forum*, 2007, pp. 1-24.

Day, R. and Walker, G. 2013. Household energy vulnerability as 'assemblage'. In: Bickerstaff, K., Walker, G. & Bulkeley, H. eds. *Energy Justice in a Changing Climate*. London: Zed Books Ltd, pp. 14-29.

Demski, C., Poortinga, W. and Pidgeon, N. 2014. Exploring public perceptions of energy security risks in the UK. *Energy Policy* 66, pp. 369-378.

Denzin, N.K. and Ryan, K.E. 2007. Qualitative methodology (including focus groups). In: Outhwaite, W. & Turner, S.P. (eds). *The SAGE handbook of Social Science Methodology*. London: SAGE Publications Ltd, pp. 578-594.

Department for Business, Energy & Industrial Strategy. 2015. *The non-gas map* [Online]. Available at: <https://www.nongasmap.org.uk/>. [Accessed 10 March 2017].

Department for Business, Energy & Industrial Strategy. 2016. *Energy Statistics, Quarter 3 2016* [Online]. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/579543/Press_Notice_December_2016.pdf [Accessed 10 March 2017].

Department for Business, Energy and Industrial Strategy. 2017a. *The Domestic Private Rented Property Minimum Standard* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749021/Domestic_Private_Rented_Landlord_Guidance_-_June_18.pdf [Accessed 5 March 2019].

Department for Business Energy and Industrial Strategy. 2018a. *Annual Fuel Poverty Statistics Report, 2018 (2016 data)* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/719106/Fuel_Poverty_Statistics_Report_2018.pdf [Accessed 28 January 2019].

Department for Business, Energy and Industrial Strategy. 2018b. *Oral statement to Parliament, Statement by Business and Energy Secretary Greg Clark on the proposed Swansea Bay tidal lagoon* [Online]. Available at: <https://www.gov.uk/government/speeches/proposed-swanseabay-tidal-lagoon> [Accessed 5 March 2019].

Department for Business, Energy and Industrial Strategy. 2018c. *The Renewable Heat Incentive: A reformed and refocused scheme* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/680624/ukia_20180029_en.pdf [Accessed 5 March 2019].

Department for Business, Energy and Industrial Strategy. 2018d. *Contracts for Difference scheme for renewable electricity generation* [Online]. Available at:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/714067/contracts-for-difference-renewable-energy-consultation-response-part-a.pdf [Accessed 5 March 2019].

Department for Business, Energy and Industrial Strategy. 2018e. *Energy Trends: September 2018, special feature article - Renewable electricity in Scotland, Wales, Northern Ireland and the regions of England in 2017* [Online]. Available at: <https://www.gov.uk/government/statistics/energy-trends-september-2018-special-feature-article-renewable-electricity-in-scotland-wales-northern-ireland-and-the-regions-of-england-in-2017> [Accessed 5 March 2019].

Department of Business, Energy and Industrial Strategy. 2018f. *Power stations in the United Kingdom* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/.../dukes5_11.xls [Accessed 5 March 2019].

Department for Business Energy and Industrial Strategy. 2018g. *Energy Trends March 2018* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/712458/Energy_Trends_March_2018.pdf [Accessed 3 April 2019].

Department for Business, Energy and Industrial Strategy. 2019a. *Policy paper: Contracts for Difference* [Online]. Available at: <https://www.gov.uk/government/publications/contracts-for-difference/contract-for-difference> [Accessed 5 March 2019].

Department for Business, Energy and Industrial Strategy. 2019b. *UK carbon capture, usage and storage* [Online]. Available at: <https://www.gov.uk/guidance/uk-carbon-capture-and-storage-government-funding-and-support> [Accessed 5 March 2019].

Department for Business, Energy and Industrial Strategy. 2019c. *Statement on suspension of work on the Wylfa Newydd nuclear project* [Online]. Available at: <https://www.gov.uk/government/speeches/statement-on-suspension-of-work-on-thewylfa-newyddnuclear-project> [Accessed 5 March 2019].

Department for Business, Energy and Industrial Strategy. 2019d. *Total final energy consumption at regional and local authority level* [Online]. Available at:

<https://www.gov.uk/government/statistical-data-sets/total-final-energy-consumption-at-regional-and-local-authority-level> [Accessed 5 March 2019].

Department for Environment, Food & Rural Affairs & Department for Business, Enterprise and Regulatory Reform. 2008. *The UK Fuel Poverty Strategy 6th Annual Progress Report* [Online]. Available at: <http://www.bris.ac.uk/poverty/downloads/keyofficialdocuments/Fuel%20poverty%20strategy%202008.pdf> [Accessed 5 March 2019].

Department for Environment, Food & Rural Affairs and Department for Transport. 2017. *Air quality plan for nitrogen dioxide (NO₂) in UK (2017)* [Online]. Available at: <https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017> [Accessed 5 March 2019].

Department of Energy and Climate Change. 2010. *The Green Deal A summary of the Government's proposals*. London: Department of Energy and Climate Change.

Department of Energy and Climate Change. 2011. *UK Renewable Energy Roadmap* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48128/2167-uk-renewable-energy-roadmap.pdf [Accessed 5 March 2019].

Department of Energy and Climate Change. 2012a. *The Energy Efficiency Strategy: The Energy Efficiency Opportunity in the UK*, London: The Stationary Office.

Department of Energy and Climate Change [DECC]. 2012b. *Statistical Release: Experimental statistics. Estimates of Home Insulation Levels in Great Britain: January 2012* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/49408/4537-statistical-release-estimates-of-home-insulation-.pdf [Accessed 5 March 2019].

Department of Energy and Climate Change. 2013a. *Policy Brief, Energy Act: Fuel Poverty* [Online]. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/266851/Fuel_Poverty_Policy_Brief_RA.pdf [Accessed: 18 April 2016].

Department of Energy and Climate Change. 2013b. *Areas and types of properties off the gas grid. Special feature – NEED analysis*. London: Department of Energy and Climate Change.

Department of Energy and Climate Change. 2013c. *UK Renewable Road Map Update 2013*, London: The Stationary Office.

Department of Energy and Climate Change. 2014. *Community Energy Strategy* [Online]. Available at: <https://www.gov.uk/government/publications/community-energy-strategy> [Accessed 5 March 2019].

Department of Energy and Climate Change. 2015a. *Annual Fuel Poverty Statistics Report, 2015*. London: Department of Energy and Climate Change.

Department of Energy and Climate Change. 2015b. *Digest of UK Energy Statistics (DUKES) 2015*, London: Department of Energy and Climate Change.

Department of Energy and Climate Change. 2015c. *2014 Greenhouse Gas Emissions* [Online]. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/496946/2014_Final_Emissions_Statistical_Summary_Infographic.pdf [Accessed: 13 July 2016].

Department of Energy and Climate Change. 2015d. *Performance and Impact of the Feed in Tariff Scheme: Review of Evidence* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/456181/FIT_Evidence_Review.pdf [Accessed: 13 July 2016].

Department of Energy and Climate Change. 2016. *Special feature – Renewable energy in 2015* [Online]. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/532963/Renewable_energy_in_2015.pdf [Accessed 13 July 2016].

Devine-Wright, P. and Wiersma, B. 2013. Opening up the “local” to analysis: exploring the spatiality of UK urban decentralized energy initiatives. *Local Environment* 18(10), pp. 1099-1116.

Dickins, S. 2016. Unemployment rate gap widens between Wales and UK. *BBC* 14 September 2016 [Online]. Available at: <http://www.bbc.co.uk/news/uk-wales-37360503> [Accessed 5 March 2019].

Dickins, S. 2017. What happens next with Wales' EU funding? *BBC* 2 June 2017 [Online]. Available at: <https://www.bbc.co.uk/news/uk-wales-40105919> [5 March 2019].

Dikeç, M. 2001. Justice and the spatial imagination. *Environmental Planning A* 33, pp. 1785-1805.

Disney, J. 2016. After brutal spending cuts, rural bus services have reached the end of the line. *The Conversation*. Available at: <https://theconversation.com/after-brutal-spending-cuts-rural-bus-services-have-reached-the-end-of-the-line-63432>.

Dittmer, J. 2013. Geopolitical assemblages and complexity. *Progress in Human Geography*, pp. 1-7.

Dubois, U. 2012. From targeting to implementation: The role of identification of fuel poor households. *Energy Policy* 49, pp. 107-115.

Druckman, A. and Jackson, T. 2008. Household energy consumption in the UK: a highly geographically and socio-economically disaggregated model. *Energy Policy* 36(8), pp. 3167-3182.

Easton, M. 2013. The unbearable sadness of the Welsh valleys. *BBC* 25 June 2013 [Online]. Available at: <https://www.bbc.co.uk/news/magazine-23028078> [Accessed 2 February 2019].

Eco Centre Wales. 2012. *Evaluation of Arbed: Phase One* [Online]. Available at: <https://gov.wales/docs/desh/publications/121011energyarbedevaluationen.pdf> [Accessed 5 March 2019].

Eco Travel Network. Undated. *Eco Travel Network* [Online]. Available at: <https://www.ecotravelnetwork.co.uk/> [Accessed 4 March 2019].

Edwards, P. 2018. AM's office flooded as river Usk bursts its banks in Brecon. *The Brecon and Radnor Express* 13 October 2018 [Online]. Available at: <http://www.brecon-radnor.co.uk/article.cfm?id=110008&headline=AM%27s+office+flooded+as+river+Usk>

k+bursts+its+banks+in+Brecon+and+Crickhowell§ionIs=news&searchyear=2018 [Accessed 5 March 2019].

Ellsworth-Krebs, K., Reid, L. and Hunter, C.J. 2015. Home-ing in on domestic energy research: “House”, “home”, and the importance of ontology. *Energy Research and Social Science* 6, pp. 100-108.

el-Ojeili, C. 2014. Reflections on Wallerstein: The modern world-system, four decades on. *Critical Sociology* 41(4-5), pp. 679-700.

Energy Saving Trust. 2014. *Feed-in Tariffs* [Online]. Available at: <http://www.energysavingtrust.org.uk/domestic/feed-tariffs-0> [Accessed: 18 April 2016].

Energy Saving Trust. 2018a. *Cavity wall* [Online]. Available at: <https://www.energysavingtrust.org.uk/home-insulation/cavity-wall> [Accessed 5 March 2019].

Energy Saving Trust. 2018b. *Solid Wall* [Online]. Available at: <https://www.energysavingtrust.org.uk/home-insulation/solid-wall> [Accessed 5 March 2019].

Energy Saving Trust. 2018c. *Electric heating systems* [Online]. Available at: <http://www.energysavingtrust.org.uk/home-energy-efficiency/heating-and-hot-water/electric-heating-systems> [Accessed 28 June 2018].

Environmental Audit Committee. 2018. *Green finance: mobilising investment in clean energy and sustainable development* [Online]. Available at: <https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/1450/1450.pdf> [Accessed 5 March 2019].

Eriksson, M. 2010. *(Re)producing a periphery, popular representations of the Swedish North*. PhD Thesis. Umeå University, Sweden.

Essletzbichler, J. 2012. Renewable Energy Technology and Path Creation: A Multi-scalar Approach to Energy Transition in the UK. *European Planning Studies* 20(5), pp. 791-816.

European Commission. Undated a. *2020 climate & energy package* [Online]. Available at: https://ec.europa.eu/clima/policies/strategies/2020_en [Accessed 5 March 2019].

European Commission. Undated b. *2030 climate & energy framework* [Online]. Available at: https://ec.europa.eu/clima/policies/strategies/2030_en [Accessed 5 March 2019].

Eurostat. 2017. *News Release: 2015, GDP per capita in 276 EU regions - Four regions over double the EU average...and still nineteen regions below half of the average* [Online]. Available at: <http://ec.europa.eu/eurostat/documents/2995521/7962764/1-30032017-AP-EN.pdf/4e9c09e5-c743-41a5-afc8-eb4aa89913f6> [Accessed 28 June 2018].

Everett, R. and Rampage, J. Energy needs. In: Boyle et al. eds. *Energy Systems and Sustainability. 2nd edition*. Oxford: Oxford University Press, pp. 57-89.

Faller, F., 2015. A practice approach to study the spatial dimensions of the energy transition. *Environmental Innovation and Societal Transitions*, 19, pp. 85-95.

Fankhauser, S., and Jotzo, F. 2018. Economic growth and development with low-carbon energy. *WIREs Climate Change* 9, pp. 1-16.

Fecht, D., Jones, A., Hill, T., Lindfield, T., Thomson, R., Hansell, A.L., and Shukla, R. 2018. Inequalities in rural communities: adapting national deprivation indices for rural settings. *Journal of Public Health* 40(2), pp. 419-425.

Fischer-Tahir, A. and Nauman, M. 2013. Introduction: Peripheralization as the Social Production of Spatial Dependencies and Injustice. In: Fischer-Tahir, A. & Nauman, M. eds. *Peripheralization: The Making of Spatial Dependencies and Social Injustice*. Wiesbaden: Springer VS, pp. 9-26.

Fontana, A., and Frey, J.H. 2005. The interview – from neutral stance to political involvement. In Hammersley, M. (Ed). *Social Research – Philosophy, Politics and Practice*. London: Open University Press. pp. 695-727.

Forslid, R. & Ottaviano, G.I.P. 2003. An analytically solvable core-periphery model. *Journal of Economic Geography* 3(3), pp. 229-240.

Fouquet, R. 2010. The Slow Search for Solutions: Lessons from Historical Energy Transitions by Sector and Service. *BC3 Working Paper Series 2010-05* [Online]. Available at: <https://addi.ehu.es/bitstream/handle/10810/14207/BC3WP201005.pdf?sequence=1> [Accessed 16 September 2019].

Foxon, T.J., 2013. Transition pathways for a UK low carbon electricity future. *Energy Policy* 52, pp. 10-24.

Foxon, T.J., Hammond, G. P. & Pearson, P. J. G. 2010. Developing transition pathways for a low carbon electricity system in the UK. *Technological Forecasting and Social Change* 77(8). pp 1203-1213.

Frank, A.G. 1969. *Capitalism and Underdevelopment in Latin America: Historical Studies of Chile and Brazil*. London: Monthly Review Press, Modern Reader Paperbacks.

Fujita, M., Krugman, P., & Venables, A. 1999. *The spatial economy; cities, regions and international trade*. Cambridge, MA: MIT Press.

Fuller, S. and McCauley, D. 2016. Framing energy justice: perspectives from activism and advocacy. *Energy Research & Social Science* 11, pp. 1-8.

Gallent, N., Mace, M. and Tewdwr-Jones, M. 2003. Dispelling a myth? Second homes in rural Wales. *Area* 35(3), pp. 271-284.

Geels, F. W. 2005. Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. *Technological Forecasting and Social Change* 75, pp. 681-696.

Geels, F. W. and Schot, J. W. 2007. Typology of sociotechnical transition pathways. *Research Policy* 36(3), pp. 399-417.

Geels, F.W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J., Neukirch, M., and Wassermann, S. 2016. The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990-2014). *Research Policy* 45(4), pp. 896-913.

Georgakaki, A., De Laurentis, C. and Eames, M. 2015. The importance of regional scenarios for low carbon transitions: the case of Wales. *International Journal of Critical Infrastructures* 11(2), pp. 97-114.

Gillard, R., Snell, C., and Bevan, M. 2016. Advancing an energy justice perspective on fuel poverty: Household vulnerability and domestic retrofit policy in the UK. *Energy research & social science* 29, pp. 53-61.

Gnansounou, E. 2008. Assessing the energy vulnerability: Case of industrialised countries. *Energy Policy* 36(10), pp. 3734-3744.

Golubchikov, O., and O'Sullivan, K. 2020. Energy Periphery: Spatial (in)justices and the precarious geographies of low carbon transition, *Energy and Buildings* 211, pp. 1-11.

Google Maps. 2018. *UK Renewables Map* [Online]. Available at: <https://www.google.com/maps/d/viewer?mid=17FaYeZBclizFSJst9CMBfpzFYUGXNpMG&ll=52.41944457978755%2C-4.1991867794922655&z=8> [Accessed 5 March 2019].

Gov.UK. 2019. *PM Theresa May: we will end UK contribution to climate change by 2050* [Online]. Available at: <https://www.gov.uk/government/news/pm-theresa-may-we-will-end-uk-contribution-to-climate-change-by-2050> [Accessed July 2019].

Gregory, D., Johnston, R., Pratt, G., Watts, M. J. and Whatmore, S. 2009. *The Dictionary of Human Geography*, Oxford: Blackwell Publishing Ltd.

Gray, M. and Barford, A. 2018. The depth of the cuts: the uneven geography of local government austerity. *Cambridge Journal of Regions, Economy and Society* 11(3), pp. 541-563.

Griffiths, H.M. 2014. Water under the bridge? Nature, memory and hydropolitics. *Cultural Geographies* 21(3), pp. 449-474.

Grimes, S. 2003. The digital economy challenge facing peripheral rural areas. *Progress in Human Geography* 27, pp. 174-193.

Grin, J., Rotmans, J., and Schot, J. 2010. *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change*. London: Routledge.

Gross, C. 2007. Community perspectives of wind energy in Australia: the application of a justice and community fairness framework to increase social acceptance. *Energy Policy* 35, pp. 2727-2736.

Gross, C. 2008. A Measure of Fairness: An Investigative Framework to Explore Perceptions of Fairness and Justice in a Real-Life Social Conflict. *Human Ecology Review* 15(2), pp. 130-140.

Guba, E.G. and Lincoln, Y.S. 1994. Competing paradigms in qualitative research. In: Denzin, N.K. and Lincoln, Y.S. (eds). *Handbook of Qualitative Research*. London: SAGE Publications Ltd, pp. 105-117.

Guertler, P. 2012. Can the Green Deal be fair too? Exploring new possibilities for alleviating fuel poverty. *Energy Policy* 49, pp. 91-97.

Gwent Energy CIC. Undated. *Designed for you. Bespoke systems to fit your needs, your budget and your space* [Online]. Available at: <https://gwentenergycic.org/> [Accessed 5 March 2019].

Haggett, C. and Aitken, M. 2015. Grassroots Energy Innovations: the Role of Community Ownership and Investment. *Current Sustainable Renewable Energy Report* 2, pp. 98-104.

Hall, S. M., Hards, S. and Bulkeley, H. 2013. New approaches to energy: equity, justice and vulnerability. Introduction to the special issue. *Local Environment* 18(4), pp. 413-421.

Hammond, G.P. 2000. Energy, environment and sustainable development: A UK perspective. *Transitions in Chemical Engineering* 78(B), pp. 304-323.

Hammond, G. and Pearson, P. J., G. 2013. Challenges of the Transition to a Low Carbon, More Electric Future: From Here to 2050. *Energy Policy* 52, pp. 1-9.

Hanley, N., and Nevin, C. 1999. Appraising renewable energy developments in remote communities: the case of the North Assynt Estate, Scotland. *Energy Policy* 27, pp. 527-547.

Hannon, M.J., Foxon, T.J. and Gale, W.F., 2013. The co-evolutionary relationship between energy service companies and the UK energy system: Implications for a low-carbon transition. *Energy Policy* 61, pp. 1031-1045.

Hansen, T. and Coenen, L., 2015. The geography of sustainability transitions: Review, synthesis and reflections on an emergent research field. *Environmental Innovation and Societal Transitions* 17, pp. 92-109.

Harmon, D. 2004. Intangible values of protected areas: What are they? Why do they matter? *The George Wright Forum* 21(2), pp. 9-22.

Harrington, B. E, Heyman, B., Merleau-Ponty, N., Stockton, H., Ritchie, N. and Heyman, A. 2005. Keeping warm and staying well: findings from the qualitative arm of the Warm Homes Project. *Health and Social Care in the Community* 13(3), pp. 259-267.

Haggerty, J. and McBride, K. 2016. Does local monitoring empower fracking host communities? A casestudy from the gasfields of Wyoming *Journal of Rural Studies* 43, pp. 235-247.

Harvey, D. 1973. *Social Justice and the City*. University of Georgia Press, Athens.

Harvey, D. 1996. *Justice, nature and the geographies of difference*. Oxford: Blackwell Publishers Ltd.

Harvey, D. 2000. *Spaces of Hope*. Edinburgh: Edinburgh University Press.

Hawkey, D., Webb, J., and Winskel, M. 2013. Organisation and governance of urban energy systems: district heating and cooling in the UK. *Journal of Cleaner Production*, 50, pp. 22-31.

Hayter, R., Barnes, T.J., & Bradshaw, M.J. 2003. Relocating resource peripheries to the core of economic geography's theorising: Rational and agenda. *Area* 35(1), pp. 15-23.

Healy, N., and Barry, J. 2017. Politicizing energy justice and energy system transitions, fossil fuel divestment and a 'just transition'. *Energy Policy* 108, pp. 451-459.

- Healy, N., Stephens, J.C., and Malin, S.A. 2019. Embodies energy injustices: Unveiling and politicizing the transboundary harms of fossil fuel extractivism and fossil fuel supply chain. *Energy Research & Social Science* 48, pp. 219-234.
- Heatherington, K. 1998. *Expressions of Identity Space. Performance Politics*. London: SAGE Publications Ltd.
- Heffron, R. J., McCauley, D. 2014. Achieving sustainable supply chains through energy justice. *Applied Energy* 123, pp. 435-437.
- Heffron, R. J., McCauley, D., and Sovacool, B. K. 2015. Resolving society's energy trilemma through the Energy Justice Metric. *Energy Policy* 87, pp. 168-176.
- Heley, J., Gardner, G., and Watkin, S. 2011. Cultures of local economy in a Celtic fringe region. *European Urban and Regional Studies* 19(4), pp. 366–382.
- Hendry, C. 2016. *The Role of Tidal Lagoons, Final Report* [Online]. Available at: <https://hendryreview.files.wordpress.com/2016/08/hendry-review-final-report-english-version.pdf> [Accessed 5 March 2019].
- Hernández, D. 2015. Sacrifice Along the Energy Continuum: A Call for Energy Justice. *Environmental Justice* 8(4), pp. 151-156.
- Henwood, K., Pidgeon, N., Groves, C., Shirani, Butler, C., and Parkhill, K. 2015. *Energy Biographies Research Report* [Online]. Available at: <http://energybiographies.org/our-work/our-findings/reports/> [Accessed 19 September 2019].
- Hills, J. 2012. *Getting the measure of fuel poverty Final Report of the Fuel Poverty Review*, CASE report 72. London: Department of Energy and Climate Change.
- Hinkel, J. 2011. Indicators of vulnerability and adaptive capacity: Towards a clarification of the science–policy interface. *Global Environmental Change* 21, pp. 198-208.
- HM Government. 2009. *The UK Low Carbon Transition Plan. National strategy for climate and energy* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/228752/9780108508394.pdf [Accessed 5 March 2019].

HM Treasury. 2015a. *Chancellor George Osborne's Spending Review and Autumn Statement 2015 speech* [Online]. Available at: <https://www.gov.uk/government/speeches/chancellor-george-osbornes-spending-review-and-autumn-statement-2015-speech> [Accessed 5 March 2019].

HM Treasury. 2015b. *£2 billion support for Hinkley Point* [Online]. Available at: <https://www.gov.uk/government/news/2-billion-support-for-hinkley-point-c> [Accessed 5 March 2019].

Hobson, K., Hamilton, J. and Mayne, R. 2014. Monitoring and evaluation in UK low-carbon community groups: benefits, barriers and the politics of the local. *Local Environment*, pp. 1-14.

Hoffman, S. M. and High-Pippert, A. 2005. Community Energy: A Social Architecture for an Alternative Energy future. *Bulletin of Science Technology Society* 25(5), pp. 387-401.

Hooks, B. 1990. *Yearning: Race, Gender, and Cultural Politics*. Chicago: Southend Press.

House of Commons Energy and Climate Change Committee. 2016a. *2020 renewable heat and transport targets. Second Report of Session 2016–17* [Online]. Available at: <https://publications.parliament.uk/pa/cm201617/cmselect/cmenergy/173/173.pdf> [Accessed 5 March 2019].

House of Commons Energy and Climate Change Committee. 2016b. *Home energy efficiency and demand reduction, Fourth Report of Session 2015–16* [Online]. Available at: <https://publications.parliament.uk/pa/cm201516/cmselect/cmenergy/552/552.pdf> [Accessed 5 March 2019].

House of Commons Hansard. 2017. *Cavity Wall Insulation: Wales*. 19 April 2017, Volume 624 [Online]. Available at: <https://hansard.parliament.uk/commons/2017-04-19/debates/3EDC8DFE-7EC7-4344-8381-1CB86BA4A8E3/CavityWallInsulationWales> [Accessed 5 March 2019].

House of Commons Library. 2000. *The Warm Homes and Energy Conservation Bill (Revised edition)* [Online]. Available at:

researchbriefings.files.parliament.uk/documents/RP00-26/RP00-26.pdf [Accessed 5 March 2019].

House of Commons Library. 2010. *Cold Weather Payments* [Online]. Available at: <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN00696> [Accessed 5 March 2019].

House of Commons Library. 2016a. *Energy Prices* [Online]. Available at: researchbriefings.files.parliament.uk/documents/CDP-2016-0058/snsg-04153.pdf [Accessed 5 March 2019].

House of Commons Library. 2016b. *Climate Change Levy: renewable energy & the carbon reduction commitment* [Online]. Available at: <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7283#fullreport> [Accessed 5 March 2019].

House of Commons Library. 2017a. *Energy in Wales*, Debate Pack, 13 September 2017 [Online]. Available at: <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CDP-2017-0163> [Accessed 28 June 2018].

House of Commons Library. 2017b. *ECO, the Energy Company Obligation* [Online]. Available at: <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN06814> [Accessed 5 March 2019].

Hudson, R. 2015. Uneven development, socio-spatial polarization and Political Responses. In: Lang, T., Henn, S., Sgibnev, W., & Ehrlich, K. *Understanding geographies of polarization and peripheralization: Perspectives from Central and Eastern Europe and beyond*. Basingstoke: Palgrave Macmillan, pp. 25-39.

Huws, C., F. 2018. *Why racism against Welsh people is still racism* [Online]. Available at: <https://theconversation.com/why-racism-against-welsh-people-is-still-racism-96303> Accessed [31 January 2019].

Institute for Public Policy Research. 2018. Beyond ECO the future of fuel poverty support [Online]. Available at:

<https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/Beyond%20ECO.pdf>
Accessed [4 April 2019].

Institute of Welsh Affairs. 2018. *The economic costs and benefits of renewable energy transition in Wales*. Cardiff: IWA.

Institute of Welsh Affairs. 2019. *Factors influencing local and community engagement in renewable energy in Wales*. Cardiff: IWA. [Online]. Available at: <https://www.iwa.wales/wp-content/uploads/2019/03/Re-energising-Wales-local-and-community-engagement-FINAL-1.pdf> Accessed [23 March 2019].

Intergovernmental Panel on Climate Change (IPCC). 2014. *Climate Change 2014, Mitigation of Climate Change*. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge: Cambridge University Press.

International Union for Conservation of Nature. 2008. *Defining Protected Areas*. Gland, Switzerland: IUCN.

Jenkins, D., Middlemiss, L. and Pharoah, R. 2011. *A study of fuel poverty and low-carbon synergies in social housing*. Edinburgh: Heriot-Watt University.

Jenkins, K., McCauley, D, Heffron, R., Stephan, H., and Rehner, R. 2016. Energy justice: A conceptual review. *Energy Research & Social Science* 11, pp. 174-182.

Jenkins, K., Sovacool, B.K., McCauley, D. 2018. Humanizing socio-technical transitions through energy justice an ethical framework for global transformative change. *Energy Policy* 117, pp. 66-74.

Jones, C. 2015. On Capital, Space and the World System: A Response to Ron Martin. *Territory, Politics, Governance* [Online]. Available at: DOI: 10.1080/21622671.2015.1064827.

Jørgensen, U. 2012. Mapping and navigating transitions—The multi-level perspective compared with arenas of development. *Research Policy* 41, pp. 996-1010.

- Kitchen, L. 2012. Are Trees Always ‘Good’? Urban Political Ecology and Environmental Justice in the Valleys of South Wales. *International Journal of Urban and Regional Research* 37(6), pp. 1968-1983.
- Knox, K. 2013. *Energy justice and climate change: Reflections from a Joseph Rowntree Foundation research programme*. In: Bickerstaff, K., Walker, G. & Bulkeley, H. eds. *Energy Justice in a Changing Climate*. London: Zed Books Ltd, pp. 79-90.
- Krohn, S. and Damborg, S. 1999. On public attitudes towards wind power. *Renewable Energy* 16(1-4), pp. 960-964.
- Krugman, P. 1991. Increasing returns and economic geography. *Journal of Political Geography* 99(31), pp. 483-499.
- Kuhlicke, C., Scolobig, A., Tapsell, S., Steinfuhrer, A. and De Marchi, B. 2011. Contextualizing social vulnerability: findings from case studies across Europe. *Natural Hazards* 58, pp. 789-810.
- Ladle, R.J. Jepson, P. and Gillson, L. 2011. Social values and conservation biogeography. In, Ladle, R.J. & Whittaker, R.J. eds. *Conservation Biogeography*. Oxon: Blackwell Publishing Ltd, pp. 13-30.
- Lefebvre, H. 1991. *The Production of Space*. Oxford: Blackwell Publishers Limited.
- Levitas, R., Pantazis, C., Fahmy, E., Gordon, D., Lloyd, E. and Patsios, D. 2007. The multidimensional analysis of social exclusion. Department of Sociology and School for Social Policy, Townsend Centre for the International Study of Poverty and Bristol Institute for Public Affairs. Bristol: University of Bristol.
- Li, K., Lloyd, B., Liang, X.J. and Wei, Y.M. 2014. Energy poor or fuel poor: What are the differences? *Energy Policy* 68, pp. 476-481.
- Liddell, C., Morris, C., McKenzie, S.J.P. and Rae, G. 2012. Measuring and monitoring fuel poverty in the UK: National and regional perspectives. *Energy Policy* 49, pp. 27-32.
- Lle.gov. 2019. *Built Up Area by Population Size* [Online]. Available at: http://lle.gov.wales/map#b=bing_aerial&l=347,0.88;1,0.99;&m=-3.27985,52.57337,7 [Accessed 5 March 2019].

Llewellyn, D., Rhose, M., Day, R., and Fyfe, H. 2017. Evolving energy landscapes in the South Wales Valleys: Exploring community perception and participation. *Energy Policy* 108, pp. 818-828.

Longhurst, N. 2015. Towards an 'alternative' geography of innovation: Alternative milieu, socio-cognitive protection and sustainability experimentation. *Environmental Innovation and Societal Transitions* 17, pp. 183-198.

Longhurst, N. & Chilvers, J. 2016. Mapping diverse visions of UK energy transitions: Co-producing socio-technical imaginaries. *3S Working Paper 2016D28*. Norwich: Science, Society and Sustainability Research Group.

Loorbach, D. 2010. Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework. *Governance* 23(1), pp. 161-183.

Lopolito, A., Morone, P. and Sisto, R., 2011. Innovation niches and socio-technical transition: A case study of bio-refinery production. *Futures* 43(1), pp. 27-38.

Lucas, K. 2012. Transport and social exclusion: Where are we now? *Transport Policy* 20, pp. 105-113.

MacKinnon, D., Shaw, J., and Docherty, I. 2010. Devolution as Process: Institutional Structures, State Personnel and Transport Policy in the United Kingdom. *Space and Polity* 14(3), pp. 271-287.

Marsden, T. 2018. *The question of rural development: post-Brexit* [Online]. Available at: <https://blogs.cardiff.ac.uk/brexit/2018/03/21/the-question-of-rural-development-post-brexit/> [Accessed 11 April 2019].

Marsden, T, Lloyd-Jones, J., and Williams, R. 2015. *National Landscapes: Realising their Potential. The Review of Designated Landscapes in Wales* [Online]. Available at: <https://gov.wales/docs/desh/publications/151020-review-designated-landscapes-report-en.pdf> [Accessed 5 March 2019].

Marshall, B., Cardon, P., Poddar, A., and Fontenot, R. 2013. Does sample size matter in qualitative research?: A view of qualitative research. *Journal of computer information systems*, pp. 11-22.

- Mason, M. 2010. Sample size and saturation in PhD studies using qualitative interviews. *Qualitative social research* 11(3), Art 4 [Online]. Available at: DOI: <http://dx.doi.org/10.17169/fqs-11.3.1428>.
- Massey, D. 1992. Places and Their Pasts. *History Workshop Journal*, No. 39, pp. 182-192.
- Massey, D. 1994. *Space, Place and Gender*. Cambridge: Polity Press.
- Mattes, J., Huber, A. and Koehrsen, J., 2015. Energy transitions in small-scale regions – What we can learn from a regional innovation systems perspective. *Energy Policy* 78, pp. 255-264.
- Meadowcroft, J. 2009. What about the politics? Sustainable development, transition management, and long term energy transitions. *Policy Sciences* 42(4), pp. 323-340.
- Messenger, S. 2017. Business rates rise 'a threat to hydro projects'. *BBC* 11 May 2017 [Online]. Available at: <https://www.bbc.co.uk/news/uk-wales-39874843> [Accessed 5 March 2019].
- Messenger, S. 2018. Swansea Bay tidal lagoon: How the numbers were crunched. *BBC* 25 June 2018 [Online]. Available at: <https://www.bbc.co.uk/news/uk-wales-44601268> [Accessed 6 February 2019].
- Middlemiss, L. and Gillard, R. 2013. “*How can you live like that?*”: *energy vulnerability and the dynamic experience of fuel poverty in the UK*. Research Report. University of Leeds.
- Middlemiss, L. and Gillard, R. 2015. Fuel poverty from the bottom-up: Characterizing household energy vulnerability through the lived experience of the fuel poor. *Energy Research & Social Science* 6, pp. 146-154.
- Middlemiss, L. and Parrish, B.D. 2010. Building capacity for low-carbon communities: The role of grass roots initiatives. *Energy Policy* 38, pp. 7559-7566.
- Milbourne, P. 2004. *Rural Poverty, marginalization and exclusion in Britain and the United States*. Oxon: Routledge.

Milbourne, P., and Mason, K. 2017. Environmental injustice and post-colonial environmentalism: Opencast coal mining, landscape and place. *Environment and Planning A* 49(1), pp. 29-46.

Miller, D. 1999. *Principles of Social Justice*, London: Harvard University Press.

Miller, D.C. and Glaser, B.D. 2016. The 'Inside' and 'Outside': Finding Realities in Interviews. In: Silverman, D. (eds). *Qualitative Research, fourth edition*. London: SAGE Publications Ltd., pp. 51-66.

Moore, R. 2012. Definitions of fuel poverty: Implications for policy. *Energy Policy* 49, pp. 19-26.

Monyei, C.G., Sovacool, B.K., Brown, M.A., Jenkins, K.E.H., Viriri, S., and Li, Y. 2018. Justice, poverty, and electricity decarbonization. *The Electricity Journal* 32, pp. 47-51.

Morgan, K. 2006. Devolution and Development: Territorial Justice and the North-South Divide. *Publius* 36(1), pp. 189-206.

Morris, S. 2005. Big switch-on as the Valley time forgot leaves the Dark Ages. *The Guardian* 2 December 2005 [Online]. Available at: <https://www.theguardian.com/uk/2005/dec/02/stevenmorris.uknews2> [Accessed 5 March 2019].

Muinzer, T.L., and Ellis, G. 2017. Subnational governance for the low carbon energy transition: Mapping the UK's 'Energy Constitution'. *Environment and Planning C: Politics and Space* 35(7), pp.1176–1197.

Müller, M. 2015. Assemblages and actor-networks: Rethinking socio-material power, politics and space. *Geography Compass* 9(1), pp. 27-41.

Munday, M., Bristow, G. and Cowell, R. 2011. Wind farms in rural areas: How far do community benefits from wind farms represent a local economic development opportunity? *Journal of Rural Studies* 27, pp. 1-12.

Murdoch, J. 2005. *Post-structuralist Geography: A Guide to Relational Space*. London: SAGE Publications Limited.

- Murdoch, J. 2006. *Post-structuralist geography*. London: SAGE Publications Ltd.
- Murphy, J., and Smith, A. 2013. Understanding transition-periphery dynamics: renewable energy in the Highlands and Islands of Scotland. *Environment and Planning A*, 45(3), pp. 691-709.
- Myers Jaffe, A., and Manning, R.A. 2001. Russia, energy and the West. *Survival* 43(2), pp. 133-152.
- Myrdal, G. 1957. *Economic Theory and Underdeveloped Regions*. London: University Paperbacks, Methuen.
- Nathan Litchfield and Partners. 2012. *Employment Land Review, Brecon Beacons National Park Authority*. London: Nathan Litchfield and Partners Ltd.
- National Assembly for Wales. 2008. *Poverty and Deprivation in Rural Wales*. Rural Development Sub-committee [Online]. Available at: <http://www.assembly.wales/NAfW%20Documents/Poverty%20and%20Deprivation%20in%20Rural%20Wales.pdf%20-%2022072008/Poverty%20and%20Deprivation%20in%20Rural%20Wales-English.pdf> [Accessed 20 September 2019].
- National Assembly for Wales. 2017. *City Deals and the Regional Economies of Wales* [Online]. Available at: <http://www.assembly.wales/laid%20documents/cr-ld11264/cr-ld11264-e.pdf> [Accessed 28 August 2019].
- National Assembly for Wales. 2018a. *Gross Value Added in Wales – the headlines and beyond* [Online]. Available at: <https://seneddresearch.blog/2018/01/04/gross-value-added-in-wales-the-headlines-and-beyond/> [Accessed 12 July 2018].
- National Assembly for Wales. 2018b. *Preparations for replacing EU funding for Wales* [Online]. Available at: <http://www.assembly.wales/laid%20documents/cr-ld11748/cr-ld11748-e.pdf> [Accessed 5 March 2019].
- National Audit Office. 2017. *Carbon Capture and Storage: the second competition for government support* [Online]. Available at: <https://www.nao.org.uk/report/carbon-capture-and-storage-the-second-competition-for-government-support/> [Accessed 5 March 2019].

Nation.Cymru. 2018. *Extracting our water without remuneration is surely nothing short of exploitation* [Online]. Available at: <https://nation.cymru/opinion/extracting-our-water-without-remuneration-is-surely-nothing-short-of-exploitation/>. [Accessed 4 February 2019].

National Energy Action. 2018. *NEA slams record number of excess winter deaths last winter as predictable, preventable and shameful* [Online]. Available at: <https://www.nea.org.uk/media/news/nea-slams-record-number-of-excess-winter-deaths-last-winter-as-predictable-preventable-and-shameful/>. [Accessed 29 January 2019].

National Grid. 2018. *Network route maps* [Online]. Available at: <https://www.nationalgridet.com/network-and-assets/network-route-maps> [Accessed 5 March 2019].

National Grid. 2019. *History of electricity transmission in Britain* [Online]. Available at: <https://www.nationalgrid.com/group/about-us/our-history/history-electricity-transmission-britain> [Accessed 5 March 2019].

National Trust. Undated. *Energy, Grow your Own* [Online]. Available at: <https://nt.global.ssl.fastly.net/documents/energy-report-2010.pdf> [Accessed 5 March 2019].

Navanayagam, D. 2016. Too poor to stay warm? *BBC* 25 May 2016 [Online]. Available at: <http://www.bbc.co.uk/iplayer/episode/b0756g0x/panorama-too-poor-to-stay-warm>. [Accessed: 3 May 2016].

Nye, M. 2010. Sociopsychological perspectives on the active roles of domestic actors in transition to a lower carbon electricity economy. *Environment and Planning* 42, pp. 697-714.

Okkonen, L., and Lehtonen, O. 2016. Socio-economic impacts of community wind power projects in Northern Scotland. *Renewable energy* 85, pp. 826-833.

Office for National Statistics. 2011. *2011 Census* [Online]. Available at: <https://www.ons.gov.uk/census/2011census> [Accessed 5 March 2019].

Office for National Statistics. 2015. *Regional Gross Value Added (Income Approach): December 2015*. Newport: Office for National Statistics.

Office for National Statistics. 2016a. *Income estimates for small areas, England and Wales: financial year ending 2014*. Newport: Office for National Statistics.

Office for National Statistics. 2016b. *UK non-financial business economy: 2014 regional results (Annual Business Survey)*. Newport: Office for National Statistics.

Office for National Statistics. 2017a. *Small area population estimates in England and Wales: mid-2016* [Online]. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualsmallareapopulationestimates/mid2016#national-park-population-estimates-experimental-statistics> [Accessed 16 August 2018].

Office for National Statistics. 2017b. *Inflation and Price Indices* [Online]. Available at: <https://www.ons.gov.uk/economy/inflationandpriceindices> [Accessed 10 March 2017].

Office for National Statistics. 2018a. *Low carbon and renewable energy economy final estimates* [Online]. Available at: <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2016> [Accessed 5 March 2019].

Office for National Statistics. 2018b. *UK labour market: November 2018* [Online]. Available at: <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/november2018#average-weekly-earnings> [Accessed 5 March 2019].

Office for National Statistics. 2019. *Family spending in the UK: April 2017 to March 2018* [Online]. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/bulletins/familyspendingintheuk/financialyearending2018/previous/v1#spending-levels-on-transport-in-fye-2018-remained-similar-to-fye-2017> [Accessed 5 March 2019].

Office of Fair Trading. 2011. *Off-Grid Energy: An OFT market study*. London: The Stationary Office.

Ofgem. 2016a. *Eligible heating systems in the Domestic RHI* [Online]. Available at: <https://www.ofgem.gov.uk/environmental-programmes/domestic-renewable-heat-incentive-domestic-rhi/about-domestic-rhi/eligible-heating-systems-domestic-rhi> [Accessed: 18 April 2016].

Ofgem. 2016b. *Energy Company Obligation (ECO)* [Online]. Available at: <https://www.ofgem.gov.uk/environmental-programmes/energy-company-obligation-eco> [Accessed: 18 April 2016].

Ofgem. 2017a. *Information Note. Regulatory options for supplying electricity to consumers* [Online]. Available at: https://www.ofgem.gov.uk/.../final_innovation_link_-_selling_energy_to_consumers_.... [Accessed 5 March 2019].

Ofgem. 2017b. *Ofgem's Future Insights Series. Local Energy in a Transforming Energy System* [Online]. Available at: https://www.ofgem.gov.uk/system/files/docs/2017/01/ofgem_future_insights_series_3_local_energy_final_300117.pdf [Accessed 5 March 2019].

Ofgem. 2018. *What is a regulatory sandbox?* [Online]. Available at: <https://www.ofgem.gov.uk/publications-and-updates/what-regulatory-sandbox> [Accessed 24 September 2019].

Ofgem. 2019a. *Feed-in Tariff Installation Report 31 December 2018* [Online]. Available at: <https://www.ofgem.gov.uk/publications-and-updates/feed-tariff-installation-report-31-december-2018> [Accessed 5 March 2019].

Ofgem. 2019b. *Public reports and data: Domestic RHI* [Online]. Available at: <https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi/contacts-guidance-and-resources/public-reports-and-data-domestic-rhi> [Accessed 5 March 2019].

Ofgem. 2019c. *Environmental Programmes* [Online]. Available at: <https://www.ofgem.gov.uk/environmental-programmes> [Accessed 5 March 2019].

Ofgem. 2019d. *State of the Energy Market 2019 Report*. [Online]. Available at: https://www.ofgem.gov.uk/system/files/docs/2019/11/20191030_state_of_energy_market_revised.pdf [Accessed 6 April 2020].

- O'Gorman, K.D. and MacIntosh, R. 2015. Mapping Research Methods. In: O'Gorman, K. & MacIntosh, R. (eds). *Research Methods for Business and Management. Global Management Series*. Oxford: Goodfellow Publishers Ltd, pp. 50-74.
- Osmond, J. 2012. When white water becomes white gold. *Institute of Welsh Affairs* 12 April 2012 [Online]. Available at: <https://www.iwa.wales/click/2012/04/when-white-water-could-become-white-gold/> [Accessed 4 February 2019].
- O'Sullivan, K.C., Howden-Chapman, P.L. and Fougere, G., 2011. Making the connection: The relationship between fuel poverty, electricity disconnection, and prepayment metering. *Energy Policy* 39(2), pp. 733-741.
- O'Sullivan, K., Golubchikov, O. and Mehmood, A. 2020. Uneven Energy Transitions: Understanding continued energy peripheralization in rural communities. *Energy Policy* 138, pp. 1-8.
- Ottaviano, G. and Thisse, J.F., 2004. Agglomeration and economic geography. *Handbook of regional and urban economics* 4, pp. 2563-2608.
- Outhwaite, W. and Turner, S.P. 2007. *The SAGE handbook of social science methodology*. London: SAGE Publications Ltd.
- Pain, K. 2008. Examining 'core-periphery' relationships in a global city-region: The case of London and South East England. *Regional Studies* 42, pp. 2-43.
- Parry, J. 2003. The changing meaning of work: restructuring in the former coalmining communities of the South Wales Valleys. *Work, employment and society* 17(2), pp. 227-246.
- Parsons, C. 2019. *Thesis Draft*. [email].
- Pearson, C. and Winter, G. 2013. *Renewable Energy in Wales: In Figures (National Assembly for Wales Research Paper 13/059)* [Online]. Available at: <http://www.assembly.wales/Research%20Documents/Renewable%20Energy%20in%20Wales%20in%20figures%20-%20Research%20paper-12082013-248986/13-059-English.pdf> [Accessed: 22 September 2015].

Pfenniger, S., and Keirstead, J. 2015. Renewables, nuclear, or fossil fuels? Scenarios for Great Britain's power system considering costs, emissions and energy security. *Applied Energy* 152, pp. 83-93.

Pirie, G.H. 1983. On spatial justice. *Environment and Planning A* 15, pp. 465-473.

Pitzele, G.R. 2004. *The Encyclopedia of Human Geography*. Westport (USA): Greenwood Press.

Polsky, C. Neff, R. and Yarnal, B. 2007. Building comparable global change vulnerability assessments: The vulnerability scoping diagram. *Global Environmental Change*, pp. 472-485.

Poudineh, R. and Jamasb, T. 2012. Smart Grids and Energy Trilemma of Affordability, Reliability and Sustainability: The Inevitable Paradigm Shift in Power Sector. *Working Paper No. 2111643*. US Association for Energy Economics: USAEE.

Powys Public Service Board. 2016. *Wellbeing Assessment, Environment Key Findings* [Online]. Available at: http://pstatic.powys.gov.uk/fileadmin/Docs/Statistics/Future_Generations/5_Powys_Wellbeing_Assessment__Draft_V12_Environment_Key_Findings__.pdf [Accessed 10 March 2017].

Preston, I., White, V., Thumim, j., Bridgeman, T., and Brand, C. 2013. *Distribution of carbon emissions in the UK: Implications for domestic energy policy* [Online]. Available at: <https://www.jrf.org.uk/report/distribution-carbon-emissions-uk-implications-domestic-energy-policy> [Accessed 11 April 2019].

Preston, I., White, V., Blacklaws, K. and Hirsh, D. 2014. *Fuel and Poverty: A rapid evidence assessment for the Joseph Rowntree Foundation*. York: Joseph Rowntree Foundation.

Price, A., 2018. *Wales: The first and final colony*. Ceredigion: First Impressions.

Pritchard. A. and Morgan, N.J. 2000. Culture, identity and tourism representation: Marketing Cymru or Wales? *Tourism Management* 22, pp. 167-179.

Public Policy Institute for Wales. 2016. *Rural Poverty in Wales: Existing Research and Evidence Gaps* [Online]. Available at: <http://ppi.wales.gov.uk/files/2016/06/An-introduction-to-Rural-Poverty.pdf> [Accessed 5 March 2019].

Public Policy Institute for Wales. 2017. *How Wales is Understood in the UK is a Problem* [Online]. Available at: <http://ppi.wales.gov.uk/how-wales-is-understood-in-the-uk-is-a-problem/>. Accessed [2 February 2019].

Punch, K. F. 2014. *Introduction to Social Research, Quantitative and Qualitative Approaches*. London: SAGE Publications Ltd.

Pye, S., Sabio, N. and Strachan, N., 2015. An integrated systematic analysis of uncertainties in UK energy transition pathways. *Energy Policy* 87, pp. 673-684.

Rankin, J. and Butler, P. 2013. Winter deaths rose by almost a third in 2012-13. *The Guardian* 23 November 2013 [Online]. Available at: <https://www.theguardian.com/uk-news/2013/nov/26/winter-deaths-rose-third> [Accessed 29 January 2019].

Raven, R., Schot, J., and Berkhout, F. 2012. Space and scale in socio-technical transitions. *Environmental Innovation and Societal Transitions* 4, pp. 63-78.

Rawls, J. 1971. *A Theory of Justice*. Cambridge: Harvard University Press.

Reeves, A., Basu, S., McKee, M., Marmot, M. and Stuckler, D. 2013. Austere or not? UK coalition government budgets and health inequalities. *Journal of the Royal Society of Medicine* 106(11), pp. 432-436.

Ricardo Energy & Environment. 2017. *Welsh Government Warm Homes Arbed EU, Final Report* [Online]. Available at: <https://gov.wales/docs/desh/publications/171106-welsh-government-warm-homes-arbed-eu-project-final-report-en.pdf> [Accessed 5 March 2019].

Ricci, M., Bellaby, P. and Flynn, R. 2010. Engaging the public on paths to sustainable energy: who has to trust whom? *Energy Policy* 38(6), pp. 2633-2640.

Richie, J. and Lewis, J. 2003. *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London: SAGE Publications Ltd.

- Rip, A. and Kemp, R. 1998. Technological change. In: Rayner, S. & Malone, E. L. eds. *Human Choice and Climate Change. Volume 2*. Columbus: Battelle Press, pp. 327-399.
- Robbins. C. and Rowe, J. 2002. Unresolved responsibilities: exploring local democratisation and sustainable development through a community-based waste reduction initiative. *Local Government Studies* 28(1), pp. 37-58.
- Roberts, D., Vera-Toscano, E. and Phimister, E. 2015. Fuel poverty in the UK: Is there a difference between rural and urban areas? *Energy Policy* 87, pp. 216-223.
- Roberts, E., and Henwood, K. 2019. “It’s an old house and that’s how it works”: Living sufficiently well in inefficient homes. *Housing, theory and society*, pp. 1-20.
- Rogers-Hayden, T., Hatton, F. and Lorenzoni, I. 2011. ‘Energy security’ and ‘climate change’: Constructing UK energy discursive realities. *Global Environmental Change* 21(1), pp. 134-142.
- Rohde, C., Rosenow, J., Eyre, N. and Giraudet, L. 2015. Energy Saving Obligations: Cutting the Gordian Knot of leverage? *Energy Efficiency* 8(1), pp. 129-140.
- Rose, G. 1997. Situating knowledges: positionality, reflexivity and other tactics. *Progress in Human Geography* 21(3), pp. 305-320.
- Ross, M.L. 1999. The political economy of the resource curse. *World Politics* 51(2), pp. 297-322.
- Rotmas, J. and Loorbach, D. 2008. Transition management: reflexive governance of societal complexity through searching, learning and experimenting. In: van den Bergh, J & Bruinsma, F. eds. *Managing the Transition to Renewable Energy*. Cheltenham: Edward Elgar Publishing House. pp. 15-46.
- Rutherford, J. and Coutard, O. 2014. Urban Energy Transitions: Places, Processes and Politics of Socio-technical Change. *Urban Studies* 51(7), 1353-1377.
- RWE Npower Renewables. Undated. *Supporting Communities in Mid Wales* [Online]. Available at: <https://www.innogy.com/web/cms/mediablob/en/3167912/data/3167908/1/rwe->

innogy/rwe-innogy-uk/sites/wind-onshore/united-kingdom/in-operation/local-community/blob.pdf [Accessed 5 March 2019].

Sabbagh, C. and Schmitt, M. 1998. Exploring the Structure of Positive and Negative Justice Judgments. *Social Justice Research* 11(4), pp. 381-396.

Sareen, S., and Haarstad, H. 2018. Bridging socio-technical and justice aspects of sustainable energy transitions. *Applied Energy* 228(C), pp. 624-632.

Saville, J. 1957. *Rural Depopulation in England and Wales 1851-1951*. Oxon: Routledge.

Saville-Roberts, L. 2015. *Capel Celyn Reservoir (50th Anniversary)*. Westminster Hall debate at 4:30 pm on 14th October 2015 [Online]. Available at: <https://www.theyworkforyou.com/whall/?id=2015-10-14c.176.1>. [Accessed 4 February 2019].

Schlosberg, D. 2007. *Defining Environmental Justice, Theories, Movements and Nature*. Oxford: Oxford University Press.

Schlosberg, D. 2013. Theorising environmental justice: the expanding sphere of a discourse. *Environmental Politics* 22(1), pp. 37-55.

Schmid, C. 2008. Henri Lefebvre's theory of the production of space: towards a three-dimensional dialectic. In: Goonewardenas, K., Kipfer, S., Milgrom, R., and Schmid, C. ed(s). *Space, difference, everyday life. Reading Henry Lefebvre*. Oxon: Routledge. pp. 27-45.

Schot, J. W., 1998. The usefulness of evolutionary models for explaining intervention: The case of the Netherlands in the nineteenth century. *History of Technology* 14, pp. 173-200.

Schneider, A. and Ingram, H. 1993. The social construction of target populations. *The American Political Science Review* 87(2), pp. 334-347.

Scottish Government. 2019. *Climate Change action* [Online]. Available at: <https://www.gov.scot/news/climate-change-action-1/> [Accessed 07 July 2019].

Scottish Parliament. 2018. *Fuel Poverty (Target, Definition and Strategy) (Scotland) Bill* [Online]. Available at: <https://www.parliament.scot/parliamentarybusiness/Bills/108916.aspx> [Accessed 28 January 2019].

Scottish Power Energy Networks. 2017. *Distributed Generation SP Manweb* [Online]. Available at: https://www.spenergynetworks.co.uk/pages/dg_spm_heat_maps_terms.aspx [Accessed November 2017].

Secretary of State for Energy and Climate Change. 2015. *Memorandum to the Energy and Climate Change Committee: Post Legislative Scrutiny of the Energy Act 2010* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/413842/47492_Cm_9018_Accessible.pdf [Accessed 5 March 2019].

Senedd Research. 2014. *Off Gas and Fuel Poor* [Online]. Available at: <https://senedresearch.blog/2014/04/30/off-gas-and-fuel-poor/> [Accessed 28 Jan 2019].

Seyfang, G. and Haxeltine, A. 2012. Growing grassroots innovations: exploring the role of community-based initiatives in governing sustainable energy transitions. *Environment and Planning* 30, pp. 381-400.

Seyfang, G., Park, J.J., and Smith, A. 2013. A thousand flowers blooming? An examination of community energy in the UK. *Energy Policy* 61, pp. 977-989.

Shields, R. 2002. *Places on the Margins: alternative geographies of modernity*. Routledge: London.

Shove, E. and Walker, G. 2014. What is energy for? Social practice and energy demand. *Theory, Culture & Social Practice* 31(5), pp. 41-58.

Shurmer-Smith, P. and Hannam, K. 1994. *Worlds of desire, realms of power: A cultural geography*. London: Arnold.

Silverman, D. 2000. *Doing Qualitative Research, third edition*. London: SAGE Publications Ltd.

- Simcock, N. and Petrova, S. 2017. Energy poverty and vulnerability: a geographic perspective. In: Solomon, B.D. and Calvert, K.E. ed(s). *Handbook on the Geographies of Energy*. Cheltenham: Edward Elgar Publishing Limited. pp. 425-437.
- Simon, L.H., and Ruccio, D.F. 1986. A methodological analysis of dependency theory: Explanation in Andre Gunder Frank. *World Development* 14(2), pp. 195-209.
- Skitka, L. J., Winqvist, J. and Hutchinson, S. 2003. Are Outcome Fairness and Outcome Favourability Distinguishable Psychological Constructs? A Meta-Analytic Review. *Social Justice Research* 16(4), pp. 309-341.
- Sky News. 2010. (cited by Tannock, 2015) *A town like Merthyr*. Television broadcast. 7 September 2010.
- Smith, A., Vob, J.P., and Grin, J. 2010a. Innovation studies and sustainability transitions: the allure of the multi-level perspective and its challenges. *Research Policy* 39, pp. 435-448.
- Smith, C.A., and Steel, B.S. 1995. Core-periphery relationships of resource-based communities. *Journal of the Community Development Society* 26(1), pp. 52-70.
- Smith, N. 1994. *Uneven development. Nature, Capital and the production of space*. Oxford: Basil Blackwell.
- Smith, N., Davis, A. and Hirsch, D. 2010b. *A minimum income standard for rural households*. York: Joseph Rowntree Foundation.
- Smith, N., Hirsch, D., Bradshaw, M. and Eyre, N. 2013. Accessibility and capability: the minimum transport needs and costs of rural households. *Journal of Transport Geography* 21, pp. 93-101.
- Snell, C., Bevan, M. and Thomson, H. 2015. Welfare reform, disabled people and fuel poverty. *Journal of Poverty and Social Justice* 23(3), pp. 229-44.
- Soja, E.W. 1980. The socio-spatial dialectic. *Annals of the Association of American Geographers* 20, pp. 207-225.
- Soja, E. W., 2009. The city and spatial justice. *Spatial Justice* 1, pp. 31-39.

- Soja, E. W. 2010. *Seeking Spatial Justice*. Minneapolis: University of Minnesota Press.
- Sovacool, B.K., Sidortsov, R.V. and Jones, B.R. 2014. *Energy, Security, Equality and Justice*. Oxon: Routledge.
- Sovacool, B.K. 2015. Fuel poverty, affordability, and energy justice in England: Policy insights from the Warm Front Program. *Energy* 93, pp. 361-371.
- Sovacool, B.K. and Dworkin, M.H. 2015. Energy justice: Conceptual insights and practical applications. *Applied Energy* 142(15), pp. 435-444.
- Sovacool, B.K., Heffron, R.J., McCauley, D., and Goldthau, A. 2016. Energy decisions reframed as justice and ethical concerns. *Nature Energy* 1, pp. 1-6.
- Spath, P. and Rohracher, H. 2012. Local demonstrations for global transitions - dynamics across governance levels fostering socio-technical regime change towards sustainability. *European Planning Studies* 20, pp. 461-479.
- Staffell, I., Jansen, M., Chase, A., Lewis, C., and Cotton, E. 2018. *Energising Britain: Progress, impacts and outlook for transforming Britain's energy system*. Drax Group: Selby.
- Stake, R.E. 2005. Qualitative case studies. In: Denzin, N.K. & Lincoln, Y.S. (eds). *The Sage handbook of qualitative research, third edition*. London: SAGE Publications Ltd, pp. 433-466.
- Statistics for Wales. 2008. "Rural Wales" – definitions and how to choose between them [Online]. Available at: <https://gov.wales/docs/statistics/2008/080313sb102008en.pdf> Accessed [31 January 2019].
- Statistics for Wales. 2010. *Living in Wales Survey* [Online]. Available at: <https://gov.wales/statistics-and-research/living-in-wales-survey/?lang=en> [Accessed 5 March 2019].
- Statistics for Wales. 2015a. *Welsh Index of Multiple Deprivation 2014: A guide to analysing deprivation in rural areas - Revised* [Online]. Available at: <https://gov.wales/docs/statistics/2015/150812-wimd-2014-guide-analysing-deprivation-rural-areas-revised-en.pdf> [Accessed 5 March 2019].

Statistics for Wales. 2015b. *Industrial sector of workers by size of Built Up Area, 2011* [Online]. Available at: <https://gov.wales/docs/statistics/2015/150520-industrial-sector-workers-size-built-up-area-2011-en.pdf> [Accessed 5 March 2019].

Stats Wales. 2017a. *Population density (persons per square kilometre) by local authority and year* [Online]. Available at: <https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Density/populationdensity-by-localauthority-year> [Accessed 16 August 2018] [Accessed 5 March 2019].

Stats Wales. 2017b. *Commuting patterns by Welsh local authority and measure* [Online]. Available at: <https://statswales.gov.wales/Catalogue/Business-Economy-and-Labour-Market/People-and-Work/Employment/Commuting/commutingpatterns-by-welshlocalauthority-measure> [Accessed 5 March 2019].

Stats Wales. 2018a. *National level population estimates by year, age and UK country* [Online]. Available at: <https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Estimates/nationallevelpopulationestimates-by-year-age-ukcountry> [Accessed 5 March 2019].

Stats Wales. 2018b. *Household Projections for National Parks in Wales, 2014-based* [Online]. Available at: <https://gov.wales/docs/statistics/2017/170726-household-projections-national-parks-2014-based-en.pdf> [Accessed 17 August 2018].

Stats Wales. 2018c. *Average household size (persons) by local authority and year* [Online]. Available at: <https://statswales.gov.wales/Catalogue/Housing/Households/Estimates/averagehouseholdsize-by-localauthority-year> [Accessed 5 March 2019].

Stats Wales. 2018d. *Dwelling stock estimates by local authority and tenure* [Online]. Available at: <https://statswales.gov.wales/Catalogue/Housing/Dwelling-Stock-Estimates/dwellingstockestimates-by-localauthority-tenure> [Accessed 5 March 2019].

Stats Wales. 2018e. *Standard spending assessments and central government support (per head) by authority* [Online]. Available at: <https://statswales.gov.wales/Catalogue/Local-Government/Finance/Settlement/Central-Government-Support/standardspendingassessmentsandcentralgovernmentsupport-perhead-by-authority> [Accessed 5 March 2019].

Stats Wales. 2018f. *Standard spending assessments and central government support by authority* [Online]. Available at: <https://statswales.gov.wales/Catalogue/Local-Government/Finance/Settlement/Central-Government-Support/standardspendingassessmentsandcentralgovernmentsupport-by-authority> [Accessed 5 March 2019].

Stockton, H. and Campbell, R. 2011. Time to reconsider UK energy and fuel poverty policies? *Viewpoint*. York: Joseph Rowntree Foundation.

Tannock, S. 2015. Bad attitude? Migrant workers, meat processing work and the local unemployed in a peripheral region of the UK. *European Urban and Regional Studies* 22(4), pp. 416-430.

The International Institute for Sustainable Development. 2017. *The End of Coal Mining in South Wales: Lessons learned from industrial transformation* [Online]. Available at: <https://www.iisd.org/sites/default/files/publications/end-of-coal-mining-south-wales-lessons-learned.pdf> [Accessed 5 March 2019].

The Scottish Executive. 2002. *Scottish Fuel Poverty Statement*. Edinburgh: Scottish Executive.

The TAS Partnership Limited. 2015. *Transforming Bus Investment in Wales: Interventions Toolkit: A Report to the Welsh Government's Bus Policy Advisory Group*. [Online]. Available at: <https://beta.gov.wales/sites/default/files/publications/2017-08/transforming-bus-investment-in-wales-interventions-toolkit.pdf> [Accessed 5 March 2019].

Thomas, G., Pidgeon, N., and Roberts, N. Ambivalence, naturalness and normality in public perceptions of carbon capture and storage in biomass, fossil energy, and industrial applications in the United Kingdom. *Energy Research & Social Science* 46, pp. 1-9.

Thomson, H. 2016. *The struggle to afford adequate energy: different ways of knowing fuel poverty* [Online]. Available at: <http://fuelpoverty.eu/2016/05/09/waysofknowing/> [Accessed 20 May 2016].

Topham, G. 2017. Great Western mainline: what does a £10bn rail upgrade buy you? *The Guardian* 13 October 2017 [Online]. Available at: <https://www.theguardian.com/uk->

news/2017/oct/13/great-western-mainline-railway-upgrade-electrification-class-800-trains [Accessed 5 March 2019].

Trimble, J. Undated. *Welsh Index of Multiple Deprivation (WIMD) 2014* [Online]. Available at: <https://jamestrimble.github.io/imdmaps/wimd2014/> [Accessed 5 March 2019].

Truffer, B. and Coenen, L. 2012. Environmental innovation and sustainability transformations in regional studies. *Regional Studies* 46, pp. 1-21.

Turnheim, B., Berkhout, F., Geels, F., Hof, A., McMeekin, A., Nykvist, B., and van Vuuren, D. 2015. Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges. *Global Environmental Change* 35, pp. 239-253.

United Nations Development Programme. 2000. *World Energy Assessment: Energy and the challenge of sustainability*. New York: United Nations Development Programme.

UNFCCC. 2019a. *What is the Kyoto Protocol?* [Online]. Available at: <https://unfccc.int/process-and-meetings/the-kyoto-protocol/what-is-the-kyoto-protocol/what-is-the-kyoto-protocol> [Accessed 5 March 2019].

UNFCCC. 2019b. *Nationally Determined Contributions (NDCs)* [Online]. Available at: <https://unfccc.int/process/the-paris-agreement/nationally-determined-contributions/ndc-registry> [Accessed 5 March 2019].

United Nations General Assembly. 2015. *Transforming our world: the 2030 Agenda for Sustainable Development*. Resolution adopted by the General Assembly on 25 September 2015, 70/1. [Online]. Available at: https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E. [Accessed 9 May 2019].

Upton, S. 2014. The Devolution Settlement and Energy Policy in Wales: Reflections on Some Critical Issues. *Contemporary Wales* 27(1), pp. 105-126.

USwitch. Undated. Comparing energy prices by region. [Online]. Available at: <https://www.uswitch.com/gas-electricity/guides/regional-energy-prices/#step1> [Accessed 6 April 2020].

Vanolo, A. 2008. The boarder between core and periphery: Geographical representations of the world system. *The Royal Dutch Geographic Society* 101(1), pp. 26-36.

Wales Centre for Health. 2007. *A profile of rural health in Wales* [Online]. Available at: <http://www.wales.nhs.uk/sitesplus/documents/888/RuralProfile.pdf> [Accessed 5 March 2019].

Wales Rural Observatory. 2013. *Older People and Place in Wales: demography, policy and community* [Online]. Available at: <http://www.walesruralobservatory.org.uk/sites/default/files/Older%20People%20and%20Place%20in%20Wales%20Demography%2C%20policy%20and%20community%202013.pdf> [Accessed 5 March 2019].

Wallerstein, I. 1974. *The Modern World-System: Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century*. New York: Academic Press.

Warren, C.R., Lumsden, C., O'Dowd, S. and Birnie, R.V. 2005. Green on green: Public perceptions of wind power in Scotland and Ireland. *Environmental Planning and Management* 48(6), pp. 853-875.

Walker, G. 2008. Decentralized systems and fuel poverty: Are there any links or risks? *Energy Policy* 36(2), pp. 4514-4517.

Walker, G. 2009. Beyond Distribution and Proximity: Exploring the multiple spatialities of environmental justice. *Antipode* 41(4), pp. 614-636.

Walker, G. and Burningham, K. 2011. Flood risk, vulnerability and environmental justice: Evidence and evaluation of inequality in a UK context. *Critical Social Policy* 31(2), pp. 216-240.

Walker, G. and Day, R. 2012. Fuel poverty as injustice: Integrating distribution, recognition and procedure in the struggle for affordable warmth. *Energy Policy* 49, pp. 69-75.

Walker, G. and Devine-Wright, P. 2008. Community renewable energy: What should it mean? *Energy Policy* 36(2), pp. 497-500.

Walker, G., Devine-Wright, P., Hunter, S., High, H. and Evans, B. 2010. Trust and community: Exploring the meanings, contexts and dynamics of community renewable energy. *Energy Policy* 38(6), pp. 2655-2663.

Walker, G., Hunter, S., Devine-Wright, P., Evans, B., and Fay, H. 2007. Harnessing community energies: Explaining and Evaluating Community Based Localism in Renewable Energy Policy in the UK. *Global Environmental Politics* 7(2), pp. 64-82.

Walker, G., Simcock, N., and Day, R. 2016. Necessary energy uses and a minimum standard of living in the United Kingdom: Energy justice or escalating expectations? *Energy research and social science* 18, pp. 129-138.

Walker, R., Liddell, C., McKenzie, P., Morris, C., and Lagdon, S. 2014. Fuel poverty in Northern Ireland: Humanizing the plight of vulnerable households. *Energy Policy and Social Science* 4, pp. 89-99.

Wang, Y. and Eames, M. 2010. Regional governance, innovation and low carbon transitions: exploring the case of Wales. *Knowledge Collaboration & Learning for Sustainable Innovation ERSCP-EMSU conference*. Delft, The Netherlands, 25-29 October 2010. [Online]. Available at: http://orca.cf.ac.uk/13287/1/Eames_2010.pdf. [Accessed 28 June 2018].

Wats, M. and Bohle, H. G. 1993. Hunger, Famine and the Space of Vulnerability. *GeoJournal* 30(2), pp. 117-125.

Welsh Assembly Government. 2002. *Welsh Housing Quality Standard*. Cardiff: Welsh Assembly Government.

Welsh Assembly Government. 2005. *Technical Advice Note 8, Planning for Renewable Energy*. Cardiff: Welsh Assembly Government.

Welsh Assembly Government. 2008. *One Wales Connecting the Nation: The Wales Transport Strategy* [Online]. Available at: <https://beta.gov.wales/sites/default/files/publications/2017-09/wales-transport-strategy.pdf> [Accessed 5 March 2019].

Welsh Assembly Government. 2010a. *Fuel Poverty Strategy 2010a*. Cardiff: Welsh Assembly Government.

Welsh Assembly Government. 2010b. *A Climate Change Strategy for Wales* [Online]. Available at: <https://gov.wales/docs/desh/publications/101006ccstratfinalen.pdf> [Accessed 28 June 2018].

Welsh Government. 2012. *Energy Wales: A Low Carbon Transition* [Online]. Available at: <https://gov.wales/docs/desh/publications/120314energywalesen.pdf> [Accessed 6 February 2019].

Welsh Government. 2013. *External solid wall insulation. A planning guide for householders* [Online]. Available at: <https://gov.wales/sites/default/files/publications/2018-09/external-solid-wall-insulation.pdf> [Accessed 11 April 2019].

Welsh Government. 2014. *Welsh Index of Multiple Deprivation 2014* [Online]. Available at: <https://statswales.gov.wales/Catalogue/Community-Safety-and-Social-Inclusion/Welsh-Index-of-Multiple-Deprivation/Archive/WIMD-2014> [Accessed 5 March 2019].

Welsh Government. 2015a. *Evaluation of the Nest energy efficiency scheme* [Online]. Available at: <https://gov.wales/docs/caecd/research/2015/150310-evaluation-nest-energy-efficiency-scheme-en.pdf> [Accessed 5 March 2019].

Welsh Government. 2015b. *Analysis of the Access to Services Domain in the Welsh Index of Multiple Deprivation by type of settlement, 2014* [Online]. Available at: <https://gov.wales/docs/statistics/2015/151006-analysis-access-services-domain-wimd-type-settlement-2014-en.pdf> [Accessed 16 August 2018].

Welsh Government. 2016a. *Energy Efficiency in Wales: A strategy for the next 10 years 2016–2026*. Cardiff: Welsh Government.

Welsh Government. 2016b. *Smart Living Internet of Life. First highlight report* [Online]. Available at: <https://gov.wales/docs/det/publications/161019-smart-living-en.pdf> [Accessed 5 March 2019].

Welsh Government. 2017a. *Energy Generation in Wales 2016* [Online]. Available at: <https://gov.wales/docs/desh/publications/171207-energy-generation-in-wales-en.pdf> [Accessed 17 August 2018].

Welsh Government. 2017b. *Lesley Griffiths high on ambition for clean energy*. [Online]. Available at: <https://gov.wales/newsroom/environmentandcountryside/2017/170928-lesley-griffiths-high-on-ambition-for-clean-energy/?lang=en> [Accessed 5 March 2019].

Welsh Government. 2017c. *Energy* [Online]. Available at: <https://gov.wales/topics/environmentcountryside/energy/?lang=en> [Accessed 28 June 2018].

Welsh Government. 2017d. *Securing Wales' Future* [Online]. Available at: https://beta.gov.wales/sites/default/files/2017-01/30683%20Securing%20Wales%C2%B9%20Future_ENGLISH_WEB.pdf [Accessed 5 March 2019].

Welsh Government. 2018a. *Energy Generation in Wales 2017* [Online]. Available at: <https://gov.wales/topics/environmentcountryside/energy/renewable/energy-generation-in-wales/?lang=en> [Accessed 6 February 2019].

Welsh Government. 2018b. *Valued and Resilient: The Welsh Government's Priorities for Areas of Outstanding Natural Beauty and National Parks* [Online]. Available at: <https://gov.wales/docs/desh/publications/180727-designated-landscapes-valued-and-resilient-en.pdf> [Accessed 5 March 2019].

Welsh Government. 2018c. *Written evidence submitted by Welsh Government (CAN0030)* [Online]. Available at: <http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/welsh-affairs-committee/the-cancellation-of-rail-electrification-in-south-wales/written/81576.pdf> [Accessed 5 March 2019].

Welsh Government. 2018d. *100% rates relief for community hydro projects* [Online]. Available at: <https://gov.wales/newsroom/environmentandcountryside/2018/180216-100-percent-rates-relief-for-community-hydro-projects/?lang=en> [Accessed 5 March 2019].

Welsh Government. 2018e. *EU boost for £9.4m project will use Caerau's mine-water to warm local homes* [Online]. Available at: <https://gov.wales/newsroom/environmentandcountryside/2018/180119-eu-boost-9m-project-use-mine-water-to-warm-homes/?lang=en> [Accessed 5 March 2019].

Welsh Government. 2019a. *Welsh Government makes climate emergency declaration* [Online]. Available at: <https://gov.wales/welsh-government-makes-climate-emergency-declaration> [Accessed 7 July 2019].

Welsh Government. 2019b. *Prosperity for All: A Low Carbon Wales* [Online]. Available at: <https://gweddill.gov.wales/docs/desh/publications/190321-prosperity-for-all-a-low-carbon-wales-en.pdf> [Accessed 4 April 2019].

Welsh Water. 2018. *Out in the Cold: Water companies' response to the 'Beast from the East'* [Online]. Available at: <https://www.ofwat.gov.uk/wp-content/uploads/2018/06/Thaw-report-FINAL.pdf> [Accessed 5 March 2019].

Western Power Distribution. 2017. *Network Capacity Map* [Online]. Available at: <http://www.westernpower.co.uk/connections/generation/network-capacity-map.aspx>. [Accessed November 2017].

Which? 2019. *Solid wall insulation costs and savings* [Online]. Available at: <https://www.which.co.uk/reviews/insulation/article/solid-wall-insulation/solid-wall-insulation-costs-and-savings>.

Williams. M. 2000. Interpretivism and Generalisation. *Sociology*, 34, pp. 209-24.

Wolsink, M. 2007. Planning of renewables schemes: Deliberative and fair decision-making on landscape issues instead of reproachful accusations of non-cooperation. *Energy Policy* 35, pp. 2692-2704.

Yang, D.T., and Zhu, X. 2010. Modernization of agriculture and long-term growth. *Discussion Paper No. 5239, the Institute for the Study of Labor (IZA)*. Leibniz Information Centre for Economics: Bonn.

Yenneti, K., Day, R., and Golubchikov, O. 2016. Spatial justice and the land politics of renewables: dispossessing vulnerable communities through solar energy mega-projects. *Geoforum* 76, pp. 90-99.

Yin, R.K. 2014. *Case Study Research, Design and Methods*. London: SAGE Publications Ltd.

Young, I. M., 2009. Structural Injustice and the Politics of Difference. In. Christiano, T. & Christman, J. eds. *Contemporary debates in political philosophy*. Oxford: Blackwell Publishing Ltd, pp. 262-383.

Zampoukos, K. and Ioannides. D. 2011. The tourism labour conundrum: agenda for new research in the geography of hospitality workers. *Hospitality & Society* 1(1), pp. 25-45.

Appendix 1. UK Government Fuel Poverty Policy 1991-2018

Government Scheme	Dates	Detail
Home Energy Efficiency Scheme (HEES)	1991-2000	Generally, offers grants and advice to households to improve home energy efficiency. All devolved schemes aimed at income benefit claimants and pensioners. Devolved as of 1999. In England it was replaced with Warm Front; Scotland with Warm Deal; Wales with HEES; and N. Ireland with Domestic Energy Efficiency Scheme (DEES).
The Home Energy Conservation Act 1995 & Decent Home Programme	1995	Requirement for each housing authority to identify measures to achieve significant improvements in the energy efficiency of dwellings in its areas. Target: 30% improvement from 1996 baseline by 2010.
Cold Weather Payments	1995	The average temperature at a specified weather station must be recorded or forecast as 0°C or below for seven consecutive days between November and March. Original payments were £8.50 per week but increased to £25 per week in 2008. Eligibility is based on receipt of certain income benefits.
Winter Fuel Payments	1997	Tax-free annual payment for those eligible for state pension. Where the oldest person is under 80 the payment is £200, where the oldest person is over 80 the payment is £300.
Warm Homes and Energy Conservation Act	2000	Required devolved governments to create strategies for fuel poverty. Also linked to devolved versions of HEES.
Warm Front Scheme	2000-11	Households could get up to £3,500 to improve heating or insulation in their home for example via loft/cavity/hot water tank insulation, draught-proofing, gas, electric or oil heating upgrades. Home must be owned or privately rented and occupier must qualify for means-tested benefit. (England only).
Fuel Poverty Strategy	2001	Set out UK strategy to alleviate fuel poverty by 2018. Specific plans and targets for each devolved country were then made in separate subsequent strategies.
Decent Homes Standard	2002	One of the four criteria in the Standard was that a property must provide a reasonable degree of thermal comfort.
Housing Act	2004	Introduced a Housing Health and Safety Rating System (HHSRS) where cold homes are a Category 1 Hazard (most severe category).
Energy Efficiency Commitment EE2	2002-05 2005-08	Mandatory targets for gas and electricity suppliers to promote domestic energy efficiency.

Green Deal	2002-14	Loans for improvements to domestic energy efficiency improvements paid back via energy bills. Debt stayed with property not occupier.
Green Deal 2	2014-15	Loans were replaced by grants.
Energy Performance of Buildings (Certificates & Inspections) (England & Wales) Regulations	2007	Places a legal requirement for buildings that are sold or rented to have an Energy Performance Inspection and an Energy Performance Certificate.
Warm Homes Discount	2011	Rebate of £140 for electricity. Eligibility is split between core group and broader group. The broader group rebate is issued on a first come first served basis.
Energy Company Obligation 1 (ECO1)	2013-15	Measures are paid for by all energy customers via a levy on bills.
Energy Company Obligation 2 (ECO2)	2015-17	Energy suppliers with more than 250,000 customers are automatically required to deliver ECO. By 2020 all suppliers with more than 150,000 customers will be obligated. Energy suppliers must contribute to a certain amount of energy-efficient home improvements, based on its share of the energy market. ECO outlined carbon savings to be found via; Carbon Emissions Reduction Obligation (CERO); Carbon Saving Community Obligation (CSCO) / Rural sub-obligation; and Home Heating Cost Reduction Obligation (HHCRO).
Energy Company Obligation 2t (ECO2t)	2017-18	
Energy Company Obligation 3 (ECO3)	2018	
Energy Efficiency (Private rented property) Regulations (England & Wales)	2015	<p>After 2016 landlords cannot unreasonably refuse requests by tenants for energy efficiency. From 2016 landlords must ensure their buildings are at least EPC E.</p> <p>From 2018 if building EPC is below level E it cannot be tenanted.</p> <p>From 2020 if building EPC is below level E it cannot have existing leases renewed.</p>
Pre-payment Meter Price Cap	2017-20	Implemented following recommendation from the Competition and Markets Authority (CMA). The price cap was for customers on pre-payment meters.

Safeguarding Tariff	2018	An extension of the original price cap (above), to protect customers deemed to be vulnerable as they receive the Warm Homes Discount.
Domestic Gas and Electricity (Tariff Cap) Act	2018	Price cap for customers on default tariffs or Standard Variable Tariffs.

Appendix 2. UK Government Climate Change Policy 1994-2019

Government Scheme	Date	Detail
Air passenger duty	1994	Air passenger duty (APD) is charged on all passenger flights from UK airports. The rate of duty varies according to passenger destination and the class of passenger travel.
Landfill Tax	1996	First UK tax with an explicit environmental purpose. The tax is collected from landfill site operators. It is charged at a standard rate per tonne on 'active waste' (such as plastic packaging), and at a lower rate on inactive waste (such as builder's rubble). When the tax was first introduced, the standard rate of tax was £7, and the lower rate was £2. The standard rate of tax has been increased steadily since 1999, and at present is set at £40 per tonne.
Climate Change Levy (CCL), Exemption (CCLE), and Carbon Price Support (CPS)	2001	The CCL is a tax on UK business energy use, charged at the time of supply for energy sourced from electricity, gas, liquid petroleum gas and solid fuel. The CCLE is a tax exemption business energy use where electricity was sourced from certain renewable sources and combined heat and power (CHP). Energy used by the domestic sector and public transport is exempt from the levy. (<i>levy reduced in 2015</i>)
Enhanced Capital Allowance (ECA) scheme	2001-18	Businesses can set 100% of the cost of the low-carbon asset against taxable profits in a single tax year (for the 1 st year). Thus, companies can write off the cost of the new plant or machinery against the business's taxable profits in the financial year the purchase was made.
Aggregates Levy	2002	It was introduced to encourage the recycling of aggregate and is often a consideration in infrastructure and other civil engineering projects as well as the quarrying industry. In particular it applies to sand, gravel and rock that has been either: Dug from the ground; Dredged from the sea; Imported. Businesses must register with HMRC if they exploit aggregate in the UK and must report the quantity of aggregate that has been produced or sold each quarter. Tax relief may be available for aggregates that are exported or used in certain industrial or agricultural processes, or if the material is not actually used as aggregate. Materials such as soil, vegetation and other organic matter are also exempt.
Renewable Obligation and Renewable Obligation Certificates	2002-17	Obligation for energy suppliers to source proportion of electricity supply from renewable sources.
Climate Change Act	2008	Places a legally binding requirement on the Government to set five-yearly carbon budgets, twelve years in advance, from 2008 to 2050. The Government is required to consider the advice of the Committee on Climate Change (CCC, also created under the 2008 Act) when setting these budgets. The aim is to meet the 2008 Act's target of reducing greenhouse gas emissions by 80% by 2050 compared to 1990 levels. Since the 2008 Act became law, the UK has ratified the Paris Agreement with more ambitious aims to limit global temperature increase.

Energy Saving Programme	2008	Energy suppliers and new energy generators have to install energy efficiency measures in deprived areas.
Display Energy Certificates (DECs)	2008	Mandatory energy performance report of public buildings.
UK Low Carbon Transition Plan - National Strategy for climate and energy	2009	Plan for UK low-carbon transition from 2009-2020.
Carbon Budget Order	2009	The first three budgets are for the following five-year periods: 2008-12, 2013-17 and 2018-22.
Renewable Energy Strategy	2009	Outlines how the UK will meet 15% of energy from renewables by 2020.
Community Energy Saving Programme	2009-12	Placed obligation on large UK energy companies to deliver energy saving measures to low income households.
The Energy Act	2010	Contains the legislative provisions required to implement elements of the 'UK Low-carbon Transition Plan - National Strategy for climate and energy (2009)'.
Carbon Reduction Commitment Energy Efficiency Scheme Order	2010-19	Introduced in the Climate Change Act 2008. The CRC was aimed at increasing energy efficiency and reducing carbon emissions from large non-intensive energy users. These emissions are thought to constitute around 10% of greenhouse gases (GHGs) in the UK. The scheme applied to organisations that, over the course of a year, used more than 6,000 megawatt-hours (MWh) of certain electricity and had at least one half-hourly meter settled on the half-hourly electricity market. Both private and public sector companies were subject to the CRC.
Renewables Obligation Order Feed-in Tariffs (ROO-FIT)	2010-19	ROO-FIT is payable for 20 years for electricity generation between 51kw and 5MW. The number of new installations that can receive support under the FIT scheme each month has been capped since 2015. Permitted technologies: solar photovoltaic; wind; micro combined heat and power (CHP); hydro; and Anaerobic digestion (AD).
Feed-In-Tariff (FIT)	2010-19	FIT is payable for 20 years (10 years for CHP) for renewable electricity production of 50kw or below. The number of new installations that can receive support under the FIT scheme each month has been capped since 2015. Permitted technologies: solar photovoltaic; wind; micro combined heat and power (CHP); hydro; and Anaerobic digestion (AD).
UK Renewable Energy Roadmap	2011	Outlines renewable energy targets to 2020.
Carbon Budget Order	2011	4 th carbon budget (2023-2027) set at 1,950 MtCO ₂ e.

Renewable Heat Incentive (non-domestic)	2011	Eligible installations receive quarterly payments over 20 years based on the amount of heat generated. Permitted technologies: solid biomass; biogas below 200kWth; ground and water source heat pumps; geothermal; solar; energy from waste; and CHP system using biomass (<i>different dates of installation apply to each technology</i>).
Carbon Saving Community Obligation	2012-13	Placed obligation on large UK energy companies to provide carbon saving measures to domestic energy users living in areas of low income, adjoining areas and rural areas.
The Carbon Price Floor (CPF)	2013	The CPF taxes fossil fuels used to generate electricity via Carbon Price Support rates set under the Climate Change Levy.
Carbon Reporting	2013	Mandatory carbon reporting for companies on greenhouse gas emissions (GHG) for which they are responsible.
Capacity Market	2013	A steady retainer payment for reliable supply and demand side capacity providers in the UK.
Contracts for Difference (CfD)	2014	CfDs incentivise investment in renewable energy by providing developers of projects with high upfront costs and long lifetimes with direct protection from volatile wholesale prices, and they protect consumers from paying increased support costs when electricity prices are high. Successful developers of renewable projects enter into a private law contract with the Low-carbon Contracts Company (LCCC), a government-owned company. Developers are paid a flat (indexed) rate for the electricity they produce over a 15-year period; the difference between the 'strike price' (a price for electricity reflecting the cost of investing in a particular low-carbon technology) and the 'reference price' (a measure of the average market price for electricity in the GB market).
Energy Savings Opportunity Scheme (ESOS)	2014	Mandatory energy assessment scheme and energy saving identification scheme for large undertakings.
Renewable Heat Incentive (domestic)	2014	Eligible installations receive quarterly payments over 20 years based on the amount of heat generated. Permitted technologies: solid biomass; biogas below 200kWth; ground and water source heat pumps; geothermal; solar; energy from waste; and CHP system using biomass (<i>different dates of installation apply to each technology</i>).
Big Energy Saving Network	2015-16	£1 million for training, support, grants for Third Sector/community groups for outreach to vulnerable customers.
Carbon Budget Order	2016	5 th Carbon Budget. reducing carbon emissions 57% by 2030 on 1990 level (tougher than the carbon emissions target the UK is signed up to as part of the European Union, which requires a 40% cut by 2030 on 1990 levels).
Clean Growth Strategy	2017	Outlined policy plan to meet current and future carbon budgets.

Air quality plan for nitrogen dioxide (NO2) in UK	2017	End the sale of all new conventional petrol and diesel cars and vans by 2040.
Implementing the end of unabated coal by 2025	2018	Close all coal-fired power stations by 2050.

Appendix 3. Interview Protocols

DRAFT Interview Protocol, Project: *Impacts of energy transitions on vulnerable peripheral communities*

Residents

Time of Interview:

Date:

Place:

Interviewee(s):

Position of Interviewee(s):

Breaking the ice

How long have you lived in the area? *If moved into area, why?* What do you like about area? What don't you like about area? Is there anything you would change? Who do you live with? Have you always lived at same address?

In terms of local amenities like food shops or doctors surgeries or post offices etc, are these things available in your area? How do you get to them? Do you need to leave area to access anything?

What do they do for a living? Is the job local or do you travel? Is that the same for other members of the household? How do they travel? Why? Do you have own transport?

If yes, How important is that to you? How often do you have buy petrol? Can you buy it locally? Is your vehicle young/old/reliable? Do you mind having to travel?

If public transport, How important is that you? How often do you use the service? How regular is the service? What are your feelings about using the service?

Can you describe your typical day?

Further – local area

If children – is the school close? Are there many local clubs/activities for children? Are you personally a part of local clubs/organizations? Why? How did they join?

Free time? Actives? Family and friends in the area?

Energy, interventions and other household requirements

What would you say your highest expenses are every month? Why? Which are the essentials or priorities that you have to have? How important is having access to energy to you? Why?

Do you know how much you spend on heating and electric? Which is the most? What type of energy do you use in the house? Have you ever considered changing your energy supply? Why?

How do you pay [pay as you go/monthly/quarterly/by delivery]? How easy is it to manage these payments? Would you prefer to pay another way?

What are the main influences over how much energy you need or use? Do you think you have enough energy to meet your needs? In what way? Do you feel that you have control over how much energy you need?

Would you say you're conscious about how much energy you use? Have you ever felt you need to reduce how much energy you use? Why? Have you taken action to reduce your energy consumption?

If mentioned energy saving measures above – How did you find out to do [change light bulbs, change boiler, install insulation]? Was it easy to do? Have you noticed any difference to your bills? Has it had any other impacts to you or your family? Why did you take this action?

Has there ever been a time when you have struggled to pay for your energy? If so how did you manage? If you prioritized your energy bill was there something else that had to be sacrificed? If you had to choose for some reason between [putting fuel in your car/paying for your bus ticket] or paying your energy bill, which would you prioritize?

Governance and accessing information

Do you have any interest in UK national or Welsh government policies and strategies? Do you think the decisions made within these institutions have any direct impact on your life generally? Or specifically with regards to energy? What do you think about that?

Who do you think are the key players or decision makers when it comes to energy in your area? What roles do they play? How do you think this affects you? How do you think this may affect other local people?

Do you think decisions made by national or local authorities reflect your needs? What do you think is being missed?

Do you know where to get information about making your home more energy efficient or installing renewable energy sources? Have you ever tried to access information? Who do you think can assist you with this in your area? Would you

know how to gain information to different grants or subsidies you may be entitled to?

Have you ever accessed assistance to [install energy production/make home more energy efficient]? If so, how did you hear about it? What scheme was it? Who was it run by? How did it affect you?

Do you feel you can participate in energy efficiency or renewable energy schemes, either for your household or wider community? Why? Do you know if there are any community energy schemes in your area? Do you think they have impacted the area?

If a Community Project in local area

What do you know of xxxx community project?

Have you been involved with the project at all?

How do you think the project has affected you or your family?

How do you think the project has affected the community?

Have you seen any changes in the community, positive or negative, as a result of this project?

Has the project changed your views on energy in any way?

In terms of your energy use, do you think the project has had an impact?

In terms of your energy bills, do you think the project has had an impact?

Given the current political climate and number of cuts being made to welfare and community budgets, do you think this project will have an impact in lessening these affects?

Do you think there's any other project that would help you or the community more?

Interview Protocol, Project: *Impacts of energy transitions on vulnerable peripheral communities*

Institutions

Time of Interview:

Date:

Place:

Interviewee(s):

Position of Interviewee(s):

General energy issues

In your opinion, what are the main issues with regards to energy people within your constituency are facing?

How does this compare/interact with other issues?

Do you think people within the constituency are able to comfortably manage their energy bills?

Are there any specific areas or groups of people who you may expect to be struggling?

Assistance mechanisms/schemes

Are there mechanisms in place to assist people with energy related issues? i.e. bill payment, consumption reduction?

Do you think these mechanisms could be improved?

Do you think renewable energy schemes or retrofitting schemes are easily accessible by all the community?

Do you think they make any impacts to people's day to day lives?

Are there people within the community who you think may be missing out on the benefits from these schemes? Why?

Community project

Have you been involved with xxxx project? In what way?

What impact do you think xxxx community project has had on individual households?

What impact do you think xxxx community project has had on the community as a whole?

Do you think the project would be easily replicated?

Do you think other projects may have greater positive impacts? Are there reasons why these do not go ahead?

Appendix 4. List of events attended for context building, observation and potential interview recruitment.

Date	Event	Organised by
7.10.15	The Green Valleys Annual Meeting	The Green Valleys
16.05.16	Brecon Beacons National Park Authority Senior Management Meeting	BBNPA
20.05.16	BBNPA Committee Annual Meeting	BBNPA
16.11.16	Powys Public Service Board consultancy project seminar	Powys County Council
13.07.17	Energy Policy Seminar	National Assembly for Wales
17.07.17	Low-carbon energy targets - call for evidence	Welsh Government & Western Power Distribution
19.07.17	Cross Party Working Group - Sustainable Energy	RenewUK (Wales)
13.09.17	BBNPA and Universities collaboration workshop	BBNPA
26.09.17	Getting on-shore wind back on track	RenewUK (Wales)
10.10.17	Cross Party Working Group - Fuel Poverty and Energy Efficiency	National Energy Action
18.10.17	SMARTER Energy Innovation	Welsh Government
18.10.17	NEA Fuel Poverty Forum	National Energy Action
14.02.18	Cross Party Working Group - Sustainable Energy	RenewUK (Wales)
26.02.18	Locally Owned Renewable Energy - call for evidence	Welsh Government
10.07.18	SMARTER Wales: A Fairer Energy Future	Welsh Government
26.09.18	Cross Party Working Group - Fuel Poverty and Energy Efficiency	National Energy Action

Appendix 5. Research Poster



ENERGY NEEDS IMPACT OF LOW- CARBON ENERGY

Do you live in the Brecon Beacons National Park?

If so, I would like to talk to you about your energy needs, how you access energy and your opinions on low-carbon energy (renewable energy and energy efficiency).

Your opinions will form the basis of my research degree and will help the Park Authority and others support residents who want to reduce their energy consumption.

I would like to hear from...

People living in the Park

Community groups within the Park

Energy related businesses & organisations

Local councils, institutions & authorities

PLEASE GET IN TOUCH WITH ME

Kate O'Sullivan

Cardiff University & Sustainable Places Institute

Tel: 07961 089937

osullivankm1@cardiff.ac.uk



Sustainable Places
Research Institute
Sefydliad Ymchwil
Mannau Cynaliadwy



Cronfa Datblygu
Cynaliadwy
Sustainable
Development Fund



Cardiff School of Planning and Geography

SUBMISSION OF ETHICAL APPROVAL FORMS

Staff and MPhil/PhD Projects

ALL FORMS FOR ETHICAL APPROVAL MUST BE SUBMITTED TO THE SECRETARY OF THE SCHOOL ETHICS COMMITTEE IN GOOD TIME (PREFERABLY 2 WEEKS) BEFORE THE NEXT SCHEDULED SREC MEETING

*An electronic version must to emailed to **Ruth Leo**, Secretary of Ethics Committee LeoR@cardiff.ac.uk / Tel Ext: 74601/ Room 2.54 Glamorgan Building as a work attachment, bearing relevant staff and/or PGR Student signatures.*

Title of Project: Impacts of energy transitions on vulnerable peripheral communities

Name of researcher(s):

Kate O'Sullivan

Date: 23 MAY 2016

Signature of lead researcher:

Student project

Anticipated Start Date of Fieldwork: JULY 2016

Recruitment Procedures:		Yes	No	N/A
1	Does your project include children under 16 years of age?		x	
2	Have you read the Child Protection Procedures below?			x
3	Does your project include people with learning or communication difficulties?		x	
4	Does your project include people in custody?		x	
5	Is your project likely to include people involved in illegal activities?		x	
6	Does your project involve people belonging to a vulnerable group, other than those listed above?		x	
7	Does your project include people who are, or are likely to become your clients or clients of the department in which you work?		x	
8	Does your project include people for whom English / Welsh is not their first language?		x	

* **Cardiff University's Child Protection Procedures:**

<http://www.cardiff.ac.uk/govrn/cocom/resources/2010%20November%20Safeguarding%20Children%20&%20VA's.doc>

If you have answered 'yes' to any of the above questions please outline (in an attached ethics statement) how you intend to deal with the ethical issues involved

Data Protection:		Yes	No	N/A
9	Will you tell participants that their participation is voluntary?	x		
10	Will you obtain written consent for participation? If "No" please explain how you will be getting informed consent.	x		
11	If the research is observational, will you ask participants for their consent to being observed?	x		
12	Will you tell participants that they may withdraw from the research at any time and for any reasons?	x		
13	Will you give potential participants a significant period of time to consider participation?	x		

If you have answered 'no' to any of these questions please explain (in your ethics statement) the reasons for your decision and how you intend to deal with any ethical decisions involved

Possible Harm to Participants:		Yes	No	N/A
14	Is there any realistic risk of any participants experiencing either physical or psychological distress or discomfort?		x	
15	Is there any realistic risk of any participants experiencing a detriment to their interests as a result of participation?		x	

Research Governance:		Yes	No	N/A
16	Does your study include the use of a drug? You will need to contact Research Governance before submission (resgov@cf.ac.uk)		x	
17	Does the study involve the collection or use of human tissue? You will need to contact the Human Tissue Act team before submission (hta@cf.ac.uk)		x	

If there are any risks to the participants you must explain in your ethics statement how you intend to minimise these risks

Data Protection:		Yes	No	N/A
18	Will any non-anonymised and/or personalised data be generated and/or stored?	x		
19	Will you have access to documents containing sensitive ⁷³ data about living individuals?		x	
	If "Yes" will you gain the consent of the individuals concerned?			x

Data protection Act Guidelines

<http://www.cardiff.ac.uk/socsi/research/researchethics/>

If there are any other potential ethical issues that you think the Committee should consider please explain them in an ethics statement. It is your obligation to bring to the attention of the Committee any ethical issues not covered on this form.

<u>Health and Safety:</u>	Yes
----------------------------------	-----

<p>Does the research meet the requirements of the University's Health & Safety policies?</p> <p>http://www.cf.ac.uk/osheu/index.html</p>	<p>X</p>
---	-----------------

Please provide following information for the committee:

<p>Funding Source</p> <p>ESRC Student Research Training Support Grant.</p> <p>What are the main objectives of this research?</p> <p>The current low-carbon energy transition is predicted to impact different households and communities within the UK in different ways, influenced largely upon their relative geographical location, level of wealth, energy needs and consumption. The impacts of transition are also likely to be diverse making some households and communities energy vulnerable while others may become more secure. Through adopting qualitative data collection methods and energy justice and energy vulnerability perspective, this project aims to establish the socio-economic impacts of low-carbon energy transitions on vulnerable peripheral communities in the Brecon Beacons National Park, Wales. It will largely focus on: what households are energy vulnerable and in what ways; how are different households experiencing low-carbon energy transition; how does this impacts upon their day to day life and general community life; and how governance arrangements affect who experiences the transition in certain ways.</p> <p>In order to achieve these aims the project seeks to address the following questions:</p> <p>1. How are (low-carbon) energy transitions experienced by different households in peripheral places?</p> <p>1.1 Why are some households actively involved with low-carbon energy innovations while others are not?</p> <p>1.2 How are those households involved with low-carbon energy innovations energy vulnerable?</p> <p>1.3 How does engagement or non-engagement with low-carbon energy practices and innovations impact upon energy transition experiences?</p> <p>1.4 How does engagement or non-engagement with low-carbon energy practices impact upon energy vulnerability?</p> <p>2. How do (low-carbon) energy transitions interplay with the socio-economic evolution of peripheral places?</p> <p>2.1 How do energy transitions affect community and regional economies?</p> <p>2.2 How do energy transitions affect how places and community relationships within the BBNP are experienced by those who live there?</p>

2.3 How do the presence of different social groups and population sizes influence how energy transition is enacted in different places within the BBNP?

3. How do multi-level and multi-actor governance arrangements and inter-relationships affect where, who and how (low-carbon) energy transitions are experienced?

3.1 How are governance structures arranged in the BBNPA?

3.2 How do inter-relationships between institutions, authorities, innovators, communities and households influence energy transition processes, locations and technologies?

3.3 How do existing governance systems and structures impact upon energy vulnerability?

4. What theoretical and methodological advancement can be made with respect to energy vulnerabilities in peripheral places?

4.1 How can the relationship between energy justice and social justice be further understood and advanced through the conceptualisation of energy vulnerability?

4.2 How far can energy vulnerability, as a concept derived from energy and social justice, enhance understandings of energy transitions and possible uneven impacts?

4.3 How can the nature and influence of peripherality be unpacked with respect to energy transitions?

4.3 How can the findings from the research be used to affect a change at a policy or community enablement level?

Who are the research participants?

The project will examine a number of Wales-based case studies, particularly involving homeowners and communities that have been involved in some form of low-carbon energy production and/or energy efficiency activities. It will also investigate the informal and institutional structures surrounding them. As such, it is expected that participants will include, individuals who live in the selected areas, individuals working in local and national government bodies and the Brecon Beacons National Park Authority. It will also involve consultancy and for-profit organisations, charities or not-for profit organisations and community groups specialising in low-carbon energy production or energy efficiency activities. In order to gain perspectives of households indirectly or passively experiencing energy transition, participants will also be sought via non-energy related project groups for example, social clubs, food banks or community farms etc. All participants will be adults (aged 18 and over), who will be competent to give informed consent.

What methodologies will you be using?

As the study aims to develop the in-depth understanding of how vulnerable communities experience energy transitions, the adopted methodology will employ qualitative methods.

This is consistent with the nature of qualitative research, the primary concern of which is to develop an understanding of unexplored social phenomena. Specifically, the project will use the following methods:

1. Documentary Analysis – this method include searching, selecting and reading written material including socio-demographic-economic details of the areas and populations living there in addition to both cultural and geographical characteristics of the areas. The purpose of the method is to establish facts about the areas, households and geographical communities in general. Geographical characteristics will help provide an understanding of the restrictions and opportunities available to those communities with regards to low-carbon energy production projects and also their predicted physical peripherality in relation to urban centres. This will help with the selection of case sites.

2. Semi structured Interviews – these will involve asking open-ended questions aiming to explore the perception of participants and allowing them to express their point of view.

4. Group Discussions – this method includes focus groups with shareholders and institutional partners. The method will aim to gather the perspective of the group and identify points of agreement, potential areas of disagreement, and further actions required. The results of discussions may be also used by participants, which makes group discussions less extractive method of research.

5. Participants Observation – this method will aim for researcher to visit the sites and attend meetings in order to learn about the activities taking place and process of making decisions in the natural setting.

Ethics Statement

Obligations to research participants and safety

I understand that as a social science researcher I have obligation to research participants to ensure that they are protected, that risks are not created and existing vulnerabilities are not exacerbated. Therefore, Cardiff University's Code of Practice will guide this statement and the research. It will also comply with Cardiff University's Research Ethics Guidance and following ESRC Key Principles for Research Ethics (2015):

1.) Research participants should take part voluntarily, free from any coercion or undue influence, and their rights, dignity and (when possible) autonomy should be respected and appropriately protected.

2.) Researchers should aim to maximise the benefit of the research and minimise potential risk of harm to participants and researchers. All potential risk and harm should be mitigated by robust precautions

3.) Research staff and participants should be given appropriate information about the purpose, methods and intended uses of the research, what their participation in the research entails and what risks and benefits, if any, are involved.

4.) Individual research participant and group preferences regarding anonymity should be respected and participant requirements concerning the confidential nature of information and personal data should be respected.

5.) Research should be designed, reviewed and undertaken to ensure recognised standards of integrity are met, and quality and transparency are assured.

6.) The independence of research should be clear, and any conflicts of interest or partiality should be explicit.

In addition to the above principles, all reasonable measures will be taken to ensure that the risks of harm to participants will be minimised. I will adhere to any additional safety guidelines in the places and organisations I visited, and I will ensure that someone knows my whereabouts when on site.

Recruitment and Consent

I will ensure that key contacts of the chosen energy related projects or institutional partner (e.g. chair, director, project manager, key consultant or lead volunteer) will be formally approached to explain the research and to request their cooperation. Subject to their agreement, those people regularly involved in the particular scheme or community shares projects will be informed about the research and their participation requested.

The vital recognition of this research process is that although young people, people with disabilities and people for whom English is not a first language may be present in a community projects this study aims to research, these people are not a target group of the research in the present study. Interviews and focus groups will be only conducted with adults over the age of 18 years and capable of giving informed consent. Nonetheless, acknowledging that it is very difficult for the researcher to have a full knowledge of each participants' vulnerabilities, the researcher will treat any such cases with sensitivity.

All primary data collection, that is semi-structured interviews, focus groups and participant observation, are aimed to be taken upon informed written consent of individuals involved. Each participant will receive copy of **Participant Information Sheet**. This document describes the purpose of the study, what it entails, what will happen with data obtained and the right of each participant to withdraw from the study at any time. The Information Sheet contains the contact details of doctoral researcher and her supervisors, should any participant wish to contact them to raise any issues.

I will also discuss the purpose of the study and right to withdraw at any time without providing a reason with each participant individually and allow time for reflection before asking if he/she agree to participate and asking them to sign up the **Participant Consent Form**. Each participant will be given a copy of consent form.

I remain open to the possibility of using verbal consent in situations where recording equipment is being used, emphasising in advance, but I will use such eventuality only in the situations when written consent is not possible or impractical (high number of participants at the annual shareholders meetings). In case of such eventuality, I will mitigate lack of written consent by being in constant contact with the participants. If a participant expresses any concern (directly or indirectly) in any aspect of the research, I will acknowledge this and discuss it with them, reminding them of the option to withdraw.

Confidentiality and data security

In the context of my study the most significant dimension relating to the privacy of participants involved will be with regards to recording of data. Recordings and all other electronic data will be stored in on the password protected personal computer and only student will have access to the password. The paper data will be kept in a locked drawer in a locked office. Data will be used for academic purposes of the student only, and audio recordings will be destroyed by permanent deletion after completion of this project.

All the personal data will be anonymized consistent with the Data Protection Act 1998. All care will be taken to ensure that quotations and other data is not individually

attributable. For the case studies, should they feel they require anonymity, each scheme will be allocated a pseudonym.

Attachments:

Participant Information Sheet

Participant Consent Form

Any changes to the nature of the project that result in the project being significantly different to that originally approved by the committee must be communicated to the Ethics Committee immediately.