URBAN RETROFIT: PRESSURES, POLICY AND PEOPLE IN DOMESTIC

RETROFIT AT THE CITY LEVEL

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Submitted for the qualification of Doctor of Philosophy

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September 2015

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iv. Acknowledgements

I would like to extend enormous thanks to Professor Will Swan, for his patience and encouragement in getting me to the end of the PhD journey. I would also like to thank the Engineering and Physical Sciences Research Council (EPSRC) for funding the research, and SURF for starting it all off. Next, I would like to acknowledge all the people in my life who have supported me: Mike and the boys, Mark and my mum - for their understanding and unwavering flexibility, my sister and my dad, and most of all my girls, Jodie and Abby, who have been waiting a really long time for me to resume normal mothering activities. My stellar friends and their continuous support deserve a mention too, especially Stephanie (the awesome voice of reason and experience), Lydia, Dianne, Penny, Lorna, Helena, Shirin, Pip, and Dav. Of course, without boxing at Narna's gym and hot chocolate at Booboo Coffee and Arco Lounge I would not have remained sane, so thanks to them too. Finally, I offer huge gratitude to all the interviewees and participants in the case studies and elsewhere, who were so positive and accommodating, and a special mention to Michael Hemingway, for having the best beard in retrofit.

v. Abstract

URBAN RETROFIT: PRESSURES, POLICY AND PEOPLE IN DOMESTIC RETROFIT AT THE CITY LEVEL

This thesis adopts a socio-technical approach to studying the issues and responses around domestic retrofit. Firstly it examines the broad drivers around domestic retrofit, ranging from climate change to energy security and fuel poverty, to the impacts of neoliberalisation and the economic crisis. It also explores the particular social, technical and political pressures upon this issue in urban contexts, exploring issues such as interurban competition, urban governance and experimentation, as well as their interaction with the specific socio-technical challenges of domestic retrofit. It then explores how this problem has been approached by UK policy through a combination of marketization, technical specificity and localised delivery.

Empirically, it employs a comparative case study approach using three domestic retrofit responses in three different cities in England to explore the range of responses that have emerged from this policy climate and the different forms and effects that these can have. These included a householder co-operative in Manchester, a multi-stakeholder business co-operative in Birmingham, and a council-led scheme in Bristol. It explores how each of these responses is, in its own way, experimental and contingent, involving an assemblage of actors and factors ranging from the macro level, through the meso, city-regional level, to the micro-or-individual level, which create a time and place-specific response with a particular set of priorities, activities and outcomes.

It then explains that it is both horizontal, local relationships, and vertical relationships with factors and actors at the macro and micro levels that affect the case studies' form and orientation. It shows how the policy context can both enable and limit change and learning from localised projects, by supporting certain aspects such as funding particular technologies, but not others such as consistent finance and subsidy. It concludes with some reflections for retrofit policymakers and some possibilities for further research in the topic.

Chapter 1 - Introduction

1.1 What to expect from this thesis – exploration, synthesis and critical analysis.

The research being presented in this thesis is a qualitative socio-technical exploration into how and why different groups of people and organisations have constructed responses to a particular challenge in different urban contexts. In this case, that challenge is how to improve the energy efficiency of existing domestic properties in the UK. It seeks to answer questions around what the underlying motivations and overarching pressures for acting on this issue are/were and how they interacted, how the issue has been constituted through UK policy, and what features and capacities of different urban contexts caused different responses to have emerged in different places, with different effects. It will explore a range of academic approaches to the different facets of this complicated problem and illuminate the trends and tensions in the political and policy context in which those responses operate. A comparative case study approach will introduce you to a range of city-based actors and organisations from the grassroots activists of Manchester's Carbon Co-op, to the business brains behind the Energy Saving Co-operative and the local authority officers and charity workers involved in the Bristol Home Energy Upgrade, and immerse you in their struggles and successes as they attempted to address this challenge.

The key aims of the thesis are:

i. To understand how and why different responses to the issue might emerge from different urban contexts, despite operating under the same policy context.
ii. To understand how the policy context in which these responses operate acts as both an enabler and a limitation to the transformative potential of these responses.

In order to achieve these aims, there are a series of objectives that the thesis will address:

- Explore and identify the key sociotechnical issues around domestic retrofit in urban contexts,
- Create a framework that synthesises these issues,
- Analyse how these issues are manifest in the policy context in the UK,

- Compare urban domestic retrofit responses to highlight and explain unevenness in responses, and the role of the issues identified above in shaping these responses,
- Investigate how these responses are affected by the macro-context in which they operate,
- Use the findings to critically analyse the global socio-political landscape and policy context and argue for improvements.

The thesis will address these objectives using the following format. **Chapter 1** will continue to frame the issue in terms of the key interwoven macro-societal drivers for domestic retrofit – climate change, energy security and economic concerns, which form an energy efficiency 'nexus'. It will also describe and outline the scale and nature of the retrofit problem in the UK in terms of energy use and housing tenures, and outline the basic socio-technical issues and approaches to dealing with it. **Chapter 2** explores a range of literatures and perspectives on the various aspects of urban approaches to energy issues broadly, and to the specific issues with domestic retrofit itself, including the technical risks, roles and influences of people and behaviour, and the various ways of organising retrofit responses. **Chapter 3** examines a range of theoretical approaches to both socio-technical and urban energy issues, synthesising them into the hybrid framework of 'experimental assemblages' which will be used to examine the policy context and the three cases in more detail. **Chapter 4** explains and justifies the research design employed, from the epistemological approach to the comparative case study methodology employed and the data analysis strategy. **Chapter 5** presents the first empirical chapter with an exploration of national policy affecting domestic retrofit, understanding how the energy efficiency 'nexus' is manifest in policy and what effects this has on practices and responses in urban contexts. **Chapters 6, 7 and 8** describe and explore the three case studies, three experimental assemblages which represent different urban responses to the issue of domestic retrofit: the grassroots response of Carbon Co-op in Manchester, the business experiment of Energy Saving Co-operative in Birmingham and the policy experiment of the Bristol Home Energy Upgrade in Bristol. **Chapter 9** discusses the processes of assembling these three domestic retrofit experiments and explains how city-regional relationships, priorities and resources produce different approaches in different contexts which produced varying forms of

change, as well as explaining how the different 'experiments' and forms of learning were encouraged by, but ultimately limited by state policy.

The **original contribution** of this thesis is threefold. Firstly its comparative, city-based approach to studying domestic retrofit brings together issues of place, politics and governance with a socio-technical problem. Secondly, the contribution of this thesis lies in its unique synthesis of multi-scalar issues and research areas, which enables a holistic investigation into how retrofit responses are constituted, incorporating a vast range of factors from individual motivations to macro-societal pressures, technical issues and context-specific features of the places in which these responses occur. Most importantly, it also presents a new multi-level theoretical framework in 'experimental assemblages' which incorporates real appreciation of the impact of different urban contexts on practical responses to policy issues, explaining variation and unevenness through processes of mediation and negotiation of interests through city-based actors. This framework could provide a basis for understanding not only the particular issue of domestic retrofit, but any place-based socio-technical issue.

1.2 Why bother talking about domestic retrofit?

In order to answer the questions and meet the objectives posed above, the starting point must be to explore and frame the nature of that problem. The approach to this has been to ask an obvious and pertinent question: why is there a debate about domestic retrofit? As it turns out from initial literature searches, observing at events and talking to people involved in domestic retrofit (which formed the first few steps towards defining a research problem), there are a multitude of reasons, from climate change to economic development, to policy approaches, energy security, anti-capitalism and fuel poverty. The aim of this section is to introduce the overarching debates and use them as the starting point for understanding the many ways in which the problem of domestic retrofit can be constructed, understood and approached.

1.2.1 The main drivers of domestic retrofit.

In terms of *energy issues,* there are two key macro-societal energy-related debates that domestic retrofit is involved in: climate change and energy security. Anthropogenic climate change, caused by the emission of certain gases into the atmosphere – a large proportion of

which are carbon dioxide from burning fossil fuels - is considered by many to be moving to dangerous levels, causing problems such as extreme weather, droughts, floods, disease and agricultural failure (Anderson and Bows, 2011 and Hansen et al, 2012). Many debates around tackling climate change through adapting the energy system focus on reducing carbon emissions through changing methods of energy generation and supply – moving from fossil fuel power stations to renewable energy sources, for example. The connection between climate change and domestic retrofit, though, is instead focussed on the reduction of end-use energy as one of the key tools for carbon emissions reduction. The logic of this position is that emissions from each unit of end-use energy are multiplied by efficiency losses through its generation, transmission and supply, so cutting energy demand can yield vast carbon emissions reductions quickly across the whole energy system (Anderson and Bows, 2011). Energy use of the existing housing stock makes up over a quarter of the total energy use of the UK, around the same as that of road transport, more than that of heavy industry and far more than that of air transport (DECC, 2012). Naturally, improving the energy efficiency of the housing stock is considered a significant component of efforts to reduce overall energy use and start to counteract the process of climate change (James, 2012 and Kelly, 2009).

Energy security is a different, but not unrelated issue. Good energy security refers to the supply of affordable, accessible, reliable energy to consumers, from state organisations and industry end users to businesses and household end users (IEA, 2014). There are concerns over the finite, dwindling reserves of oil and gas left in the earth, and about what this scarcity of fuel means for energy prices and the availability and reliability of energy supplies at both a national level and at an end-user, consumer level such as the household (Hodson and Marvin, 2010 and Bradshaw, 2010). Energy security is affected by relationships between energy importing and energy exporting countries (the UK is an energy importer), with energy importers somewhat vulnerable to supply problems and price fluctuations and demands from energy exporters (Bradshaw, 2010). Again, moving from reliance on finite sources of energy like oil, gas and coal, to renewable sources of energy such as solar, wind, biomass and tidal, is considered a way of improving energy security and reducing energy vulnerability. However, the connection between energy security and domestic retrofit is, again, in the role of improved energy efficiency as a further means of reducing energy use:

the lower the demand for energy from consumers, the less dependent on imported fossil fuels the nation is, and the less exposed the consumer is to price hikes and fuel scarcity.

1.2.2 How energy and economy are entwined

It seems that domestic retrofit forms part of climate change and energy security debates in the same way – it its ability to reduce end use energy and therefore reliance on and consumption of fossil fuels. However, both climate change and energy security are also tightly entwined with economic concerns and debates – the third factor in what Bradshaw (2010) describes as the global energy 'nexus'. In the case of energy security, part of the issue with the relationship between importers and exporters of energy, and the dependence of modern society on secure energy – particularly electricity (Graham and Thrift, 2007) - is that secure energy supplies are strongly linked with economic productivity and international competitiveness. Conversely, energy vulnerability can be viewed as a major source of economic instability (Huber, 2009). Altvater (2007) characterises this relationship as 'fossilism', indicating the meshing and interdependence between capitalism and fossil fuels.

This strong link between energy and economy also brings a set of further sub-issues that augment the importance of end-use energy in security/economy debates. One such issue is fuel poverty, which relates specifically to the vulnerability of householders to energy price fluctuations (specifically price rises). Fuel poverty has risen to prominence as a political issue over the last fifteen years in the UK and in some areas of Europe. Its definition has changed from being households spending over 10% of their income on fuel costs, to a more complex, subjective definition concerning low income households with high fuel costs (Moore, 2012). Worrying consequences of fuel poverty include households being underheated to reduce costs, or householders encountering serious financial issues such as mounting debts (Thomson and Snell, 2013). Underheating has a direct link to health issues such as asthma and other respiratory diseases (Peat et al, 1998), increased winter deaths (Darby and White, 2002), and the strain of struggling to pay fuel bills can have devastating physical and mental health impacts particularly on children, the elderly, low income households and other vulnerable people (Liddell and Morris, 2010). Consequently, fuel poverty has become the subject of much political debate over the last decade (Rudge, 2012) and domestic retrofits that produce fuel bill savings, improved comfort and improved health for the householder

are considered a tool in protecting vulnerable people from the effects of fuel poverty (Guertler, 2012).

A further energy-economics issue that affects domestic retrofit is that under broad Western political and economic shifts towards 'free-market' or neoliberal capitalism, energy markets in the UK and Europe have become fully deregulated: what used to be a national service industry from source, through network and supplier to the end user, is now a liberalised trading market (Eyre, 2013). One consequence of this is that a small number of large multi-national energy 'giants', colloquially known as the 'Big Six', comprise over 80% of the market share of domestic energy suppliers (Nationwide Utilities, 2015). These energy suppliers, particularly in the UK, have powerful roles in shaping national government responses and local domestic energy efficiency schemes addressing the problems of energy security, climate change and fuel poverty, but their agendas are not always compatible, leading to conflicts of interests and political battles around policy and regulatory approaches (Catney et al, 2014).

Climate change is similarly bound with economic concerns. Previous debates such as the 'limits to growth' thesis have suggested that economic growth and environmental protection are mutually exclusive, but a dominant mode of thinking conceptualised by 'ecological modernisation' (Hajer, 1995) claimed that economies and societies could develop and grow in a manner that was simultaneously protective of the environment and of natural resources, exploring and advocating notions of 'green growth' and 'low carbon economies' as win-win scenarios (for example, Janicke, 2012). Thus, the 'green agenda', which historically in the 1970s was seen as a value-driven movement concerned with nature and ecology, has now discursively been consumed by climate change as the single issue and economic growth as the primary goal (Meadowcroft, 2005), resulting the incorporation of carbon control and climate change targets into economic strategies and growth opportunities (While, 2011). This co-option of the environmental agenda has been even more acute in the light of the recent financial crisis, with publics' and governments' concerns about economic decline, inflation and unemployment at heightened levels (Hodson and Marvin, 2014). For domestic retrofit, it logically follows that if improved energy efficiency is seen as a 'solution' to both climate change and energy security issues, and both of these are strongly aligned with economic priorities, energy efficiency is naturally

absorbed by this agenda as well, and indeed, energy efficiency is often lauded as a market opportunity which will generate jobs and boost economic growth through the 'green' sector (see the Carbon Plan, HM Government, 2011).

A further sub-debate arises when considering the technical aspects of domestic retrofit – energy and building technologies and products, for example - in relation to climate change and its entwinement with economic agendas. Technological development is often linked to economic growth, particularly in boosting the competitiveness of states, cities and regions worldwide (Castells, 2011 and Massey, 2007). Reflecting the combination of climate and economic agendas mentioned above, the development of 'low carbon' technologies such as electric cars, smart meters, smart networks, low carbon buildings, satisfies both of these agendas and is often viewed as an ultimate 'fix' (Janicke, 2012). As part of this agenda, strong pressure for the development and demonstration of some form of climate-and-economy-friendly form of energy efficiency 'innovation' drives down upon domestic retrofit as well. As shall be shown in the following section, domestic retrofit is a complicated socio-technical problem involving multiple technologies such as heating, building fabrics, controls, human behavioural habits and many other practical issues, so an innovative 'fix' such as those above is extremely difficult to produce (Tweed, 2013).

1.2.3 Governance, politics, and scale.

Having discussed how the two broad energy issues of climate change and energy security affect domestic retrofit, and how these are entwined with and even dominated by economic concerns, important questions are raised about how and why this is so, and what this means for the organisation and orientation of political and practical action around domestic retrofit. Significant changes in economic policy in Western countries in the last thirty years have shifted government approaches away from Keynesian fiscal policies characterised by high government spending on public services, towards free markets and competition-based policies with economic growth as a single, overwhelming priority (Crouch, 2011, Hall, 2011 and Harvey, 2012). There is broad consensus that with this shift the authority and position of nation states – including in relation to climate and energy issues - has shifted from a hierarchical, state-led govern*ment* arrangement to a multi-level gover*nance* arrangement that now incorporates the interests and practices of private and corporate interests and actors, with less direct provision and a focus on markets (Bulkeley

and Betsill, 2005, Bulkeley and Schroeder, 2011, Massey, 2007). The significance of this is not only in the dominance of economic concerns, but is also in the implications this has for the practical organisation of climate, energy and therefore domestic retrofit-related activities (Theobald and Shaw, 2014). With blurred distinctions, roles and capabilities between individuals, markets, states, public and private sectors, who is responsible for retrofit? What organisations, actors and networks of organisations and actors can and might act upon it and how do these political conditions affect how they go about it? Broad issues of governance and politics that may at first glance seem far removed from retrofitting houses to improve their energy efficiency are in fact crucial in setting the context in which the case studies in this thesis are acting. Along with these shifts in Western economics and politics have come changes in, and debates about scales and forms of governance and practical action on climate, energy and economy-related issues, with different pressures, perspectives, options and actors in different contexts at different scales (Bridge et al, 2013, Hodson and Marvin, 2013). There are multiple scales of engagement with all of the key issues raised: at the global scale through governance institutions such as the World Bank and The International Panel For Climate Change (IPCC), at the national scale through state policy and regulation, and at various subnational scales from the regional right down to neighbourhoods and the individual household (Bulkeley and Betsill, 2005 and Bulkeley, 2012). Low carbon 'zones', eco-villages, eco-cities, energy 'regions' 'local economic partnerships', 'green buildings', 'community energy', transition towns and so on depict climate, energy and economy-related activities in various spatial forms that are not always clearly defined, all of which could be deemed as 'local' - a contested and flexible concept (Catney et al, 2014).

For cities, these multiple scales of engagement and the contested nature of the local bring particular pressures and issues: the potential for sub-national spaces to take control of their own governing lead to questions about the capacity and capability of different places to define their own future visions and strategies around the triad of energy, climate and economic issues (Hodson and Marvin, 2010). There are also peculiarly urban pressures in relation to the climate-energy-economics nexus explored above: cities are deemed as both responsible for these *problems* in terms of high concentrations of populations, energy consumption and carbon emissions, and responsible for *solutions* in terms of high

concentrations of skills, industry and potential sources of social and technical experimentation and innovation (Gossop, 2011 and Bugliarello, 2011), whilst also under pressure to remain economically competitive in an emerging international urban economy (Jonas et al, 2011). Cities also house multiple potential spaces of activity. Decentralised energy strategies of the Greater London area, district heating systems in Sheffield, and a sustainable living community group in a neighbourhood in Stockport, for example, mobilise different spatial dimensions of UK cities to address energy-related problems. For domestic retrofit, activities configured in different spaces at different scales mean different things conceptually and practically: 'retrofit' could mean whole cities or urban areas - their buildings, infrastructures and energy networks (Eames et al, 2013), 'communities' (Karvonen, 2013), neighbourhoods or streets, or the intricacies of individual buildings. With these very different scales and spaces of activity it is important to consider the scale and spaces of retrofit activity, and how that affects and reflects the interpretation of the broad issues of energy security, climate change and economic concerns outlined above.

1.2.4 Summary

This section has illustrated how the three broad issues of climate change, energy security and economic concerns work together to create a suite of pressures on domestic energy efficiency as a problem and domestic retrofit as a solution. These large and varied debates around climate change and energy security, along with changes in the political and economic landscape bring a number of sub-issues such as fuel poverty and technological innovation, as well as particular pressures in urban contexts, and variations in scalar and spatial engagement with all of these issues. This creates multiple facets to the issue of domestic retrofit, which is seen as having the potential to: 1) reduce carbon emissions 2) decrease dependency and vulnerability to energy supply and pricing issues at both individual and national scales, and 3) protect people against ill health and financial hardship as a result of fuel poverty. Figure 1 below illustrates these issues and their interdependency in a triad: climate change, energy security and economic concerns merge as the key drivers for domestic retrofit, modified by other issues such as governance and political debates, place-based issues, and technological issues.

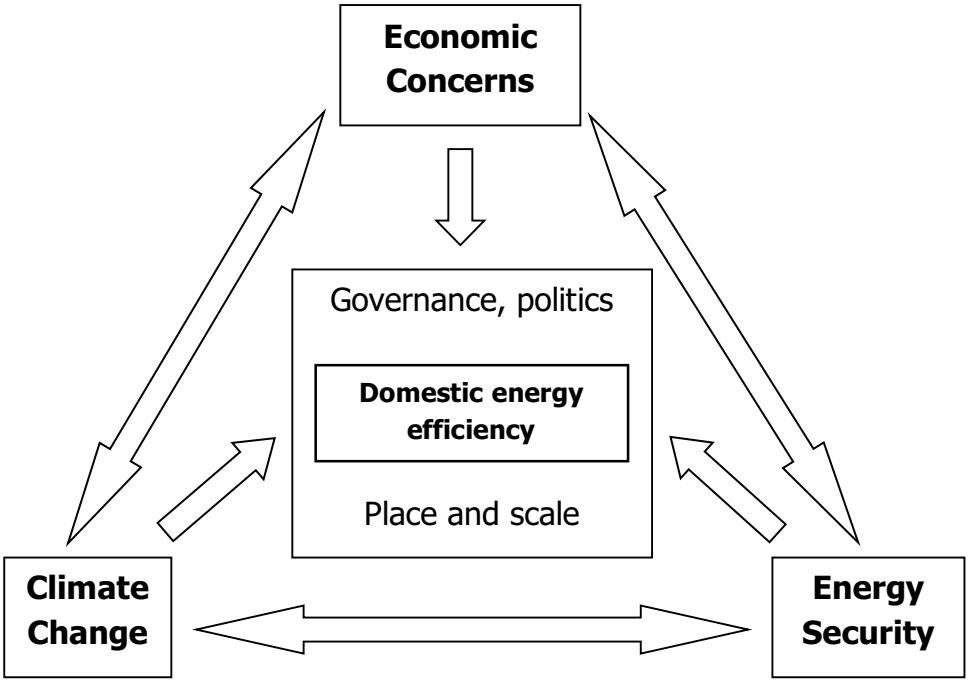


Figure 1 Urban Domestic Energy Efficiency nexus

However, there is both pressure and opportunity for effecting these changes at various spatial scales which mean different things practically and conceptually. A lot of issues and options arise through these broad debates around domestic retrofit, so one of the tasks of this thesis is to explain how different actors in different urban contexts interpret and prioritise these varied pressures and opportunities and make choices about how to approach domestic retrofit?

1.3 What is the nature of the domestic retrofit problem in the UK/England?

1.3.1 Bricks, gadgets, people and politics: An introductory framework

The previous section showed how domestic energy efficiency sits within a number of broad and highly complex energy-related debates around climate change, economic concerns, security of supply, health and fuel poverty. It introduced and explored some of these debates in order to demonstrate the range of influences on the 'problematic' of retrofit, and to situate end-use energy and the housing stock as both problem and solution to these various big issues. However, a basic understanding is needed of what the physical, practical problem of domestic retrofit looks like to those discussing, debating and addressing it:

whichever angle the problem is approached from, there are some characteristics of the problem that are common. To help define and begin thinking about the process and practice of domestic retrofit it is useful to view it through a basic framework: a conceptual, interlinked combination of four broad components, which provide a foundation for further discussion. As shown in Figure 2 below, these components are the external pressures, the building fabric, the building systems, and people.

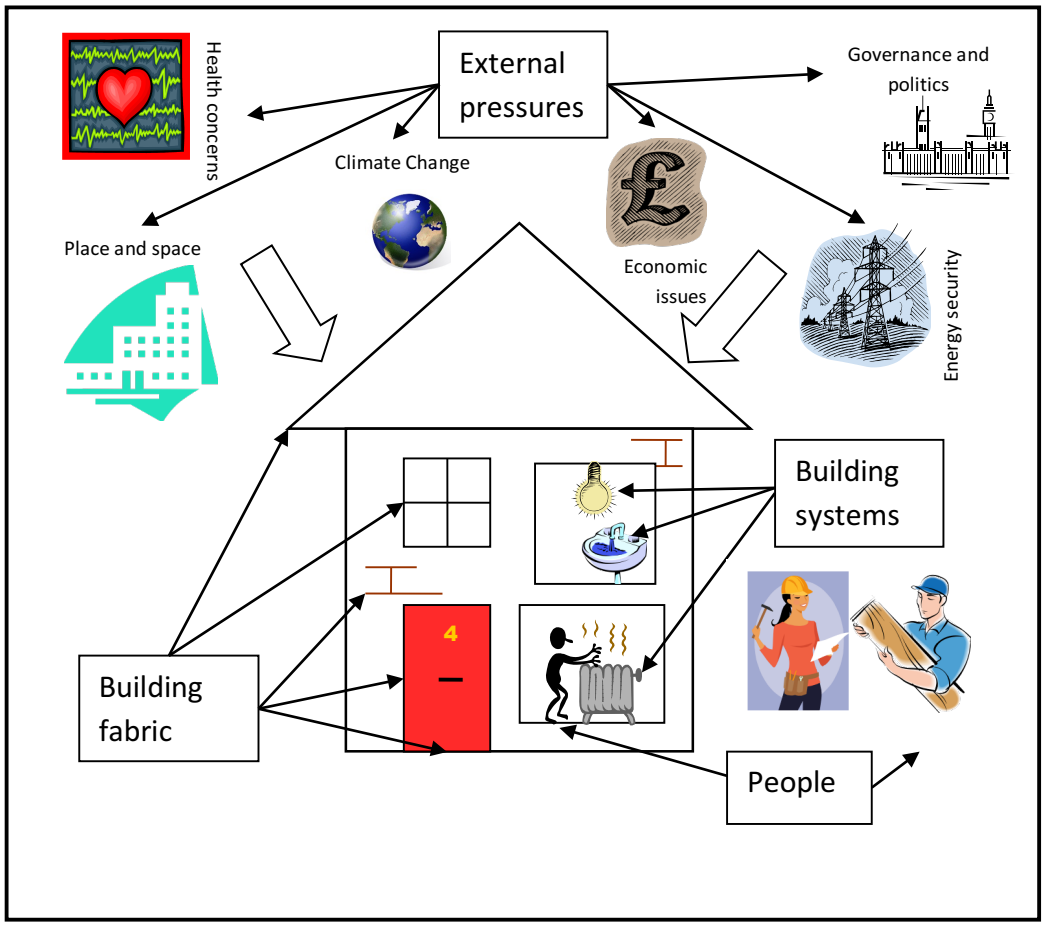


Figure 2 Domestic retrofit framework

1.3.2 What actually is 'domestic retrofit'?

Simply put, domestic retrofit means people making structural or technological alterations to an existing domestic property, for the specific purpose of improving that property's energy efficiency performance, by reducing its energy use/demand. As discussed in section 1 and shown in figure 2 above, there are *external pressures* that drive domestic retrofit practices, comprising broad, interconnected debates and discourses around domestic energy efficiency concerning climate change, energy security and economic concerns, health, fuel poverty, technological innovation, and spatial debates. These determine the various

perspectives from which the 'problem' of – or 'need' for domestic retrofit activities can be viewed and approached in terms of policy, practical action and in terms of academic understanding. In this thesis the combination of these macro-societal social, political, economic and environmental pressures acting upon and shaping domestic retrofit activity is conceptualised as the 'landscape' in which domestic retrofit is operating. This term is explored in further detail in chapter three.

In terms of practical action, domestic retrofit can involve a range of activities and types of alterations that can be divided into two broad categories: those concerning the building *fabric* and those concerning the building's *systems*(Swan et al, 2013) . Retrofitting the building *fabric* includes adding to or changing the fixed, structural elements of the domestic property. This includes insulating walls, lofts and floors in order to reduce heat losses from the property, replacing or improving areas of glazing, and draughtproofing or making building alterations that improve air tightness and reduce heat losses in other ways. Retrofitting the building's *systems* includes modifying the mechanical and electrical systems in the property, such as those providing heating/air conditioning, lighting, small power (i.e. to kitchen equipment and sockets) and water – particularly hot water (because this uses energy). Modifications to these systems include upgrading or replacing boilers and central or electric heating, altering the fuel source for these systems (e.g. from gas/electricity to biomass) installing microgeneration technologies such as photovoltaic (solar) panels or heat pumps that can provide power, air heating/cooling, or hot water, replacing light fittings with more efficient ones, and many others.

However, the two categories of building fabric and building systems alone are not sufficient to examine the issues around domestic energy use in a holistic academic manner. The third component of the overall system of domestic energy use is *people*. This refers both to the people involved in organising and carrying out the domestic retrofit works such as advisors, suppliers and installers, and the people who live in the property. The occupancy habits, number of people in a household, demographic characteristics such as age and economic status, preferences, values, political views and - as a product of all of these - the *behaviours* of the people that live within the building's fabric and use its systems, has an enormous impact on the energy use and efficiency of a property (Summerfield et al, 2010) and upon their decisions to retrofit or not to retrofit.

1.3.3 What is the scale of the problem?

In England, there are approximately 22 million households (DCLG, 2014). Both the overall population and the number of households are growing, and the built environment in general is expanding to accommodate these increases at an estimated rate of around 1-2% per year (Ravetz, 2008).

For various reasons, improving the energy efficiency of the housing stock in the UK has become a serious priority, and for *new* domestic properties, there are a series of UK Building Regulations covering building fabric, building systems, components and controls as well as overall building performance that aim to set the energy efficiency of these properties at a high level, and keep their energy use low (HM Government, 2010). With new buildings comes the opportunity to design and build the property's fabric, systems and controls with energy efficiency already in mind, and with a regulatory framework to guide that design.

However, the vast majority of properties – around 90% - that stand now in 2014 were built more than 20 years ago (DCLG, 2014), and these properties were almost exclusively **not** built with energy efficiency as a priority. At a demolition rate of around 0.3% per year of the existing housing stock, most of those existing properties – around 75% - will likely still stand in 2050 (Ravetz, 2008). With the majority of the housing stock not going anywhere, any intention to improve the energy efficiency of the UK housing stock with any significance therefore has to address the *existing* housing stock, which is an entirely different scenario to new buildings. This means working with, adding to and modifying existing fabrics, layouts and systems. Furthermore, English Housing Survey data also shows that 83% of all properties are in urban or suburban areas, a figure which is increasing with time, placing increased onus on cities as sites with especially high need - and potential – for domestic energy efficiency improvements.

1.3.4 Energy use of domestic buildings.

Given that the 'problem' of domestic retrofit is rooted in an underlying desire to reduce its overall energy use), it is important to understand some basic facets of domestic energy use, to set the scene for why particular sectors of domestic retrofit such as privately owned and occupied properties, and particular technologies such as solid wall insulation and boilers have become a political and practical priority.

Domestic energy use is made up of five components: space heating, hot water, appliances, cooking and lighting. Estimates of the proportions of total household energy use for each component depend on the model used, and of course in reality these vary considerably between property types, but generally speaking, by far the largest proportion of domestic energy use in the UK is for space heating, at over 60% of total household energy use (DECC, 2014, see table below).

Component of domestic energy use	**Estimated proportion of total energy use**
Space heating	63%
Hot water	18%
Appliances	13%
Cooking	3%
Lighting	3%

Table 1 - Domestic energy use by component

(adapted from UK housing fact file, DECC, 2014).

Given that space heating makes up the highest proportion of end use domestic energy, an obvious conclusion from this is that in order to get the greatest improvements in energy efficiency, efforts should be concentrated on improving the efficiency of space heating systems.

Whereas the energy efficiency of electric lighting and appliances is largely dependent upon the efficiency of the appliances, systems and fittings themselves, such as light bulbs, white goods, computers, and switching and controls, the energy efficiency of space heating is more complicated. Firstly, it is dependent upon how much heat is lost from the building, which is determined by the thermal performance of the building fabric. Secondly, it is dependent upon the efficiency of the heating system and controls in use, which can range from gas central heating boilers, (of which there are many types with different efficiency characteristics, and are generally less efficient the older they are), electric storage heaters,

wood burners, oil burners and alternative fuel systems such as biomass (Energy Saving Trust, 2015a). Thirdly, the energy use of all of these systems and controls are in turn, of course, dependent upon how occupants use them: how often, which rooms, at what temperatures and for how long the heating is on, and so on (Summerfield et al, 2010). Furthermore, the efficiency of hot water systems – the second highest proportion of domestic energy end-use - is often connected to the age and type of heating system. This is because many of the older, less efficient space heating systems are associated with older, less efficient water heating systems such as coal fires with back boilers for hot water, or electric storage heaters and immersion heaters for water (Energy Saving Trust, 2015a).

The majority of heat is lost from buildings in two main ways: by conduction through the fabric of the building and by convection through gaps in the building. Therefore, options for reducing heat losses from buildings involve either improving the insulation properties of the fabric to reduce heat lost through conduction, or through improving the air tightness of the building to reduce heat lost through convection. The basic measures for doing this involve:

- Insulating lofts, cavity walls and solid walls (and sometimes floors)
- Replacing inefficient single glazing with double or triple glazing
- Reducing what are known as 'thermal bridges' where materials or services penetrate the building fabric and increase conduction between inside and outside
- Draught proofing.

(Baker et al, 2013)

The options for improving the energy efficiency of space heating systems include:

- Replacing whole old, inefficient heating systems such as warm air vents and storage heaters with central heating and radiators.
- Where central heating is already in use, replacing old, less efficient standard gas boilers with newer, more efficient condensing and/or combination boilers (which can also improve the efficiency of hot water heating) (Energy Saving Trust, 2015a).
- Improving heating controls and the length of time heating systems are in operation using thermostats, timers and thermostatic radiator valves (TRVs) so that spaces are heated only at certain times, when they drop below certain temperatures or only heating the rooms that are occupied, as opposed to heating the entire dwelling for

long periods, although the actual effects of heating controls on reducing energy use in space heating are varied (Shipworth et al, 2010).

This particular issue of space heating and building fabric, as the main component of domestic energy use, is indeed where the focus of current UK energy efficiency policy, and the focus and intent of the main case studies involved in this thesis lies. However, these aspects of domestic energy efficiency are not consistent between property types, tenures and ages, which also affects how the issue is approached.

1.3.5 Domestic property types, tenures and ages and what this means for energy efficiency.

It is estimated that the vast majority of dwellings in England in 2012 were owner occupied, at 65% of dwellings, with the remaining dwellings fairly evenly split between privately rented dwellings (18%) and social housing (17%, which includes both local authority and housing association properties) (DCLG, 2014). Despite considerable improvements in energy efficiency in all properties in the last fifteen years, owner occupied and privately rented dwellings tend to be the worst performing and the least improved, as shown in figure 3 below, with far fewer dwellings having an Energy Performance Certificate (EPC) rating of A-C, and far more dwellings falling in the lowest band of F/G than in social housing.

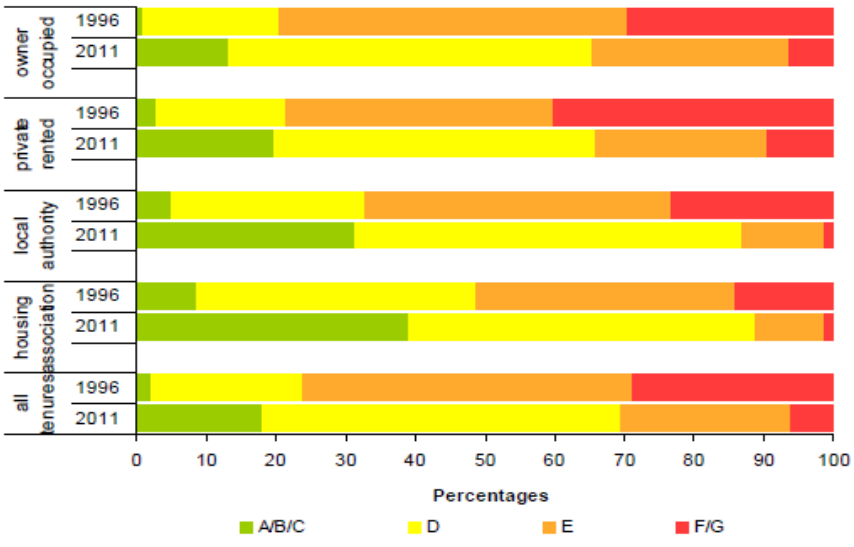


Figure 3 EPC Ratings by tenure in 1996 and 2001

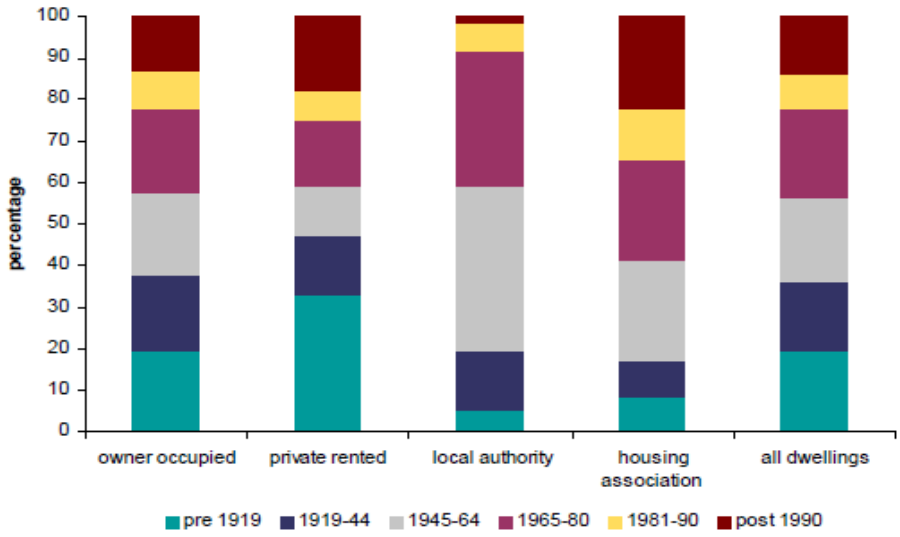


Figure 4 Age of households by tenure

There are a number of factors contributing to this, which relate to both external pressures and aspects of the buildings' fabrics. Taking the buildings' fabrics into consideration first, a much greater proportion of social housing than private dwellings are flats, which are inherently more compact and more energy efficient than houses. Conversely, a far greater proportion of private dwellings than social housing are houses that were built before 1945 (see figure 4 above), which means they are more likely to have solid walls. Older properties with solid walls are far more difficult and considerably more expensive to insulate than newer properties with cavity walls and fall into the 'hard to treat' category (explained below) - a very approximate guide is £250 for cavity wall insulation as opposed to between £5000-£18000 for external wall insulation (Energy Saving Trust, 2015b). Private sector homes also lag behind social sector homes in terms of other basic energy efficiency improvements: fewer private sector homes have more than 200mm loft insulation and fewer private sector homes are fully double glazed. Furthermore, more private sector homes (particularly rented homes) are not centrally heated, and when they are, private homes are more likely to have older, less efficient standard boilers than social housing (DCLG, 2014). Social housing has also benefitted from a number of programmes such as Decent Homes, CERT and CESP, which have improved the energy efficiency of the stock.

1.3.6 Retrofit principles

Underlying this framework and emerging from some of the key features of domestic energy efficiency are some key principles that it is important to outline when researching how and why retrofit may or may not be approached in different ways.

1.) Whole house retrofit:

It is widely agreed that the most effective way of improving the energy efficiency of a home is to do so by considering the house as a whole, with all of its fabric, systems, controls and people considered as part of a domestic energy system together (Baker, Smith and Swan, 2013). Retrofitting homes with single measures such as insulation, solar panels or boilers separately, are unlikely to yield significant energy savings alone. Furthermore, the installation of one component can sometimes affect the performance of another, either in a complimentary way such as by improving its effectiveness (e.g. insulating walls means that the benefits of a more efficient heating system are even greater) or in a negative way by creating further problems (e.g. overinsulating can cause problems with air quality), both of which further support the need to consider the building as a whole.

2.) Fabric first

There is a commonly accepted logical order in which retrofit measures should be installed in order to maximise the energy saving potential in a dwelling. Given that most of the heat is lost through the fabric of the building and the goal is first and foremost to reduce the energy *demand* of the building, the building fabric is the first aspect of retrofit that should be addressed (Heaslip, 2013). After this, boilers or fuel burners and controls can be retrofitted to make the heating system more efficient and beyond that, microgeneration technologies can be installed to improve energy supply efficiency. This ensures that systems and technologies are not fitted and then the energy savings from them wasted on heat losses through the building's fabric.

As mentioned, however, there are some dwellings that are easier to retrofit than others. Modern homes with cavity walls and simple loft spaces that can be quickly filled or fitted with insulation materials, for example, are relatively easy and cheap to bring up to higher standards of energy efficiency. Other properties are not so easy to modify, and in England 43% of properties can be defined as 'hard to treat'. These are usually dwellings with solid

walls or dwellings off the gas network, with a few that are dwellings with no loft or high-rise flats (Wetherall, Swan and Abbott, 2012). This creates different issues in different property types and areas, which require different approaches in terms of installation but also in terms of financing.

1.3.7 Risks in retrofit

It should also be noted that retrofit does not have automatically positive consequences. 'Good' retrofit involves balancing external pressures such as reducing carbon emissions and improving comfort and health, and not creating other problems as well. Improving the building fabric and space heating, for example, may reduce energy costs and carbon emissions in some cases, but there are possibilities that perceptions of comfort could deteriorate or that the aesthetics of a building have been altered negatively by insulation. Risks include:

- Hygrothermal risks (Gupta et al, 2014) - these relate to air quality and moisture levels in dwellings. Overinsulating properties can cause mould and damp and increase the need for ventilation – there is a need to balance air tightness with air movement and this requires technical skill and competence in selecting retrofit measures and in installing them in the appropriate order, especially in older properties that tend to have poorer air quality (Baker, Smith and Swan, 2013).
- Workmanship and lack of technical expertise – poorly installed or inappropriate retrofit measures can result in lower than expected energy savings, making draught or air quality problems worse, or creating new problems such as unattractive aspects on or in the property that need to be repaired afterwards, particularly in older, hard to treat properties where householders wish for original features like cornicing or decorative windows to be retained (Mallaband et al, 2013).
- Implementation gap - the use of the building and behaviour of occupants can result in lower than expected energy savings when expectations have been based upon the technical performance of components rather than how they might be used, which should be considered when selecting technological options in retrofit. For example, people may heat their dwellings to higher than expected temperatures, use spaces

differently, or continue old habits such as using baths instead of showers (Walker, Lowry and Theobold, 2014).

1.4 Summary

In conclusion, private owner-occupied and rented homes in older properties with old heating systems are the poorest performers in terms of energy efficiency. These properties make up a considerable proportion of the UK housing stock and due to the concentration of populations and the density of housing in urban areas, the vast majority of them are found in cities and towns. Space heating makes up the highest proportion of energy use in a dwelling and as this is dependent upon heat losses through fabric and the efficiency of a heating system, potential retrofit measures that address these (insulation and heating) are generally prioritised in both assessing the energy performance of buildings and in trying to improve them. Many English properties are not conducive to easy improvements to building fabrics (mainly solid-walled properties) and even so, many that could have been insulated easily in lofts and cavity walls have not been. On top of this, many properties in the private sector do not have the most efficient heating systems or controls. Due to these trends and characteristics of the English housing stock, the energy efficiency performance of the private, owner occupied housing sector has recently attracted a lot of attention in terms of political rhetoric and debate, and in particular the specific aspects of insulation and heating systems.

But as we know from the framework outlined above, the physical characteristics of buildings and the statistical 'facts' around domestic energy use are just one part of domestic energy efficiency in terms of policy and practice. This 'problem' is not a static, objective entity: it is a continually shifting function of the different components of the framework: fabric, systems, people and external influences, a problem that has been constructed through historical social, political and economic processes around domestic energy use in the UK and beyond. This thesis aims to look at domestic retrofit holistically, acknowledging the suite of social and technical issues outlined above, but particularly in urban contexts. It explores firstly the unique pressures upon and opportunities within cities that shape retrofit activities, and secondly how the peculiarities of different cities and their place-specific features, people and relationships can produce quite different responses within the same

basic framework presented above. The importance of this research is in looking not for one 'solution' to the issue around domestic retrofit, but exploring multiple approaches, their outcomes and effects, and the things that limited them. It is also important because it uses this particular socio-technical issue to discuss some key urban issues such as trends towards experimentation and uneven development that are not specific to domestic retrofit but nonetheless are embodied in the examples of urban domestic retrofit experiments in this thesis.

The next chapter will present the key academic themes that converge around domestic retrofit in cities, explore how a range of literatures engage with the suite of issues involved, and discuss how these varied themes and approaches can contribute to the holistic synthesis in this thesis.

Chapter 2 - Literature Review

2.1 Introduction – what work is this literature doing?

The previous chapter sought to outline the macro-level drivers for and pressures on domestic retrofit, as well as define the particular nature of the problem in scale, tenure, and technical elements, in the UK context. The purpose of this literature review is to provide a thematic review: identifying a range of ways of understanding the issues raised in Chapter 1 such as the nexus of climate change, energy security and economic concerns, the particular problems of privately owned and occupied homes with solid walls, and the peculiarities of addressing these issues in an urban context. The intention is to illuminate the possibilities for understanding different aspects of both the national policy context and the three case studies, and how they relate to this range of themes and issues. This research is not attempting to 'fill a gap of knowledge' in any of the specific disciplines explored, but instead to synthesise literatures from different research areas addressing different parts of the problem of domestic retrofit in English cities and using different ways to understand them: this is the original contribution to knowledge. Because of the tension between the array of issues this very specific topic encompasses, it is important here to draw on a broad, but targeted literature base: first setting the scene in terms of understanding how the organisation of energy related issues in cities is affected and shaped by political issues and governance trends, then understanding of how the features and organisations in particular places, and the specific people and interests that are involved, can shape responses to energy related issues, thus linking the macro-issues to localised responses. The chapter concludes by looking at how domestic retrofit specifically has been researched in various socio-technical ways, and what helpful perspectives and important issues have emerged from these studies.

2.2 Understanding the macro-context: how landscape issues create experimentation and unevenness.

2.2.1 Global changes

We have already identified that macro issues and processes such as climate change, peak oil and economic crisis act variably as pressures and drivers for domestic retrofit of privately owned houses in English cities. However, there are other macro-issues – particularly socio-political ones - that have affected the way that people, places and organisations may respond to the triad of energy related issues, including that of domestic retrofit. This section will outline how some of the main contextual pressures and issues around the governance of, and pressures on, contemporary world cities have been understood across various literatures, and the conditions and possibilities these create for domestic retrofit activity in cities.

Without delving too far into a debate about the exact features of globalization, it is commonly acknowledged that some key global societal shifts that have taken place in the latter half of the twentieth century have some overarching and wide-reaching effects worldwide, and it is these processes that this section will highlight. Firstly, from a political economy and cultural studies perspective, the rise of free markets and competition as economic principles as opposed to Keynesian fiscal policies – particularly through the Thatcher and Reagan governments of the 1980's, has had major, irreversible impacts on the relationship between government, politics and economy in different nation states, and particularly upon the UK as one of its original proponents (Crouch, 2011, Hall, 2011 and Harvey, 2012). These include the distancing of nation states from their roles as providers to citizens, towards new roles as proponents and 'managers' of markets, alongside shifts in cultural and social thinking away from the collective (which was traditionally rooted in national identities) towards a socially fragmented and largely individualised conception of social and political life (Beck, 2008 and Ritzer and Ryan, 2004). Alongside this, the process of rapid technological advancement in information and communications technologies enabled emblematic features of neoliberal, market based economies such as new virtual spaces of communication and information flows between people, places and organisations to become the 'cornerstones of contemporary society' (Castells, 2010). The combination of these

processes results in what appears to be a rather diminished regulatory role for the nation state, and a heavy reliance on private markets and competition as tools for governing. However, the state, despite its changing role, is still instrumental in channelling and distributing these global changes and shifts, through institutions such as local authorities, legal systems and state buildings: historically created to represent authority and territories, but through these new global trends now provide vehicles for market and network managing (Castells, 2010 and Sassen 2006).

The relevance of this for exploring domestic retrofit responses in cities is firstly, to explore whether or not UK retrofit policy of existing, privately owned and occupied housing does reflect these shifts towards markets and competition as tools for governing, and secondly, to explore the particular impact these trends have on cities and the networks of actors within/around them in terms of how this might enable, constrain and shape (or any combination of these) domestic retrofit responses that emerge in these contexts. Bumpus and Liverman (2008), While (2010 and 2011) and Whitehead (2013) argue that wider processes of marketising economic and social policy have steered discourses around energy issues and climate change towards the economic aspects of carbon pricing, offsetting and trading, alongside individual consumption and energy behaviours. They argue that this is because these are the aspects of the environmental agenda that are most easily incorporated into dominant neoliberal discourses around capital movement and accumulation, as opposed to those aspects concerned with caring for nature, ecology and the planet. Through investigating how the case studies align with, interpret or balance these competing discourses and political interests we can tell a story about just how the broad pressures above impact on and interact with practical, local-scale activity, thus affecting the kinds of change that may occur as a result of this activity.

2.2.2 How do these changes impact urban governance?

As mentioned in chapter 1, for cities tackling energy issues, their position is complex and in tension: cities are cited as major polluters and sources of carbon emissions due to the density of populations, energy consumption and industrial activity in and around them, and yet at the same time, are viewed as sites of techno-economic and socio-political innovation and change (Eames et al, 2013, Bugliarello, 2011, Gossop, 2011) – even revolution (Harvey, 2012) - and the potential sources of solutions to energy-related problems. Simultaneously,

they are also some of the most vulnerable places due to the effects of climate change such as sea-level rise and extreme weather, having dense populations and often vulnerable locations (Satterthwaite et al, 2009), as well as housing some of the most economically deprived and socially isolated communities at the greatest risk from energy security and related fuel poverty and health issues. However, the result of the widespread policy trends in the economic West towards marketisation, decreased regulation and decreased public spending, as explained above, is to weaken nation states' powers to act directly on serious issues of economic development, energy security and climate change (Gossop, 2011, Hodson and Marvin, 2010 and 2012 and Jonas et al, 2011), opening up *"spaces for alternatives and local, voluntary and charity sector responses to be given oxygen"* (Hodson and Marvin, 2014, p7), in short: new ways of governing.

There is broad consensus in the geographical and political economy literature that with these processes, and the emergence of supra-national scale institutions such as the World Bank and the European Union, as well as international scale agreements and regulations, the authority and position of nation states has moved from a hierarchical, state-led govern*ment* arrangement to a multi-level, multi-stakeholder gover*nance* arrangement that now incorporates the interests and practices of private and corporate interests and actors at multiple scales from the local to the global (Bache and Flinders, 2004, Jessop, 2008, Bulkeley and Betsill, 2005, Bulkeley and Schroeder, 2011, Massey, 2007). Examples of this are the prevalence of private finance initiatives in the UK, and the increasing practice of subcontracting private firms to perform both national and local state activities from health, to security services (e.g. G4S), housing, waste services and many others.

It is argued by critical urban theorists that this shifting of state responsibilities away from central government, either into sub-national state institutions, non-government organisations and the private sector or upwards to supranational bodies means that new spaces of state activity are being formed at a sub-national, regional territorial scale – often with cities instrumental in these spaces (Brenner, 2004 and 2009 and Swyngedouw, 2004 and 2010). These new scales of activity are characterised not only by these public-private networks of governing but also by the positioning of cities and regions in competition with one another in global circuits of capital, a position often deliberately encouraged by neoliberalised national and supranational policy which distributes state funding on a

competitive basis (Brenner, 2004 and 2009, Jonas et al, 2011, Gossop, 2011 Swyngedouw, 2004, Massey, 2007 and Marcuse and Van Kempen, 2000).

As Jonas et al (2011) explain, these competitive trends create considerable economic pressures for cities and sub-national spaces: adapt (and play the competitive game), or face economic ruin. In these spaces, it is thought that people, local state actors, corporates and third sector actors coalesce, in varying, place-specific and often temporary configurations, around particular issues such as climate change and energy, in order to attract external investment and manage resources and economic activity, thus engaging directly from local level with global circuits of capital and governance structures (Brenner, 2004 and 2009). Swyngedouw (2010) highlights the differential levels of influence of different social groups and interests, actors at different scales and their roles and inputs into these struggles of shaping space, place, economic activity and territory, highlighting the "geometries of power" that are created by these networked, multi-level coalitions of actors under the conditions of economic competition.

The importance of these perspectives for understanding the emergence of domestic retrofit responses in cities is in highlighting that those responses are likely to have been produced through a dynamic process, dependent on the relationships, networks and entwinement with issues and events within, around and outside those cities: these forms of networked, multi-level and multi-sector governance that are now a 'normal' part of urban activities, particularly in marketised Western cities such as those in the UK. What this acknowledgement of the 'new normal' does is beg an exploration of whether these contemporary urban pressures and forms are present in the examples of urban domestic retrofit responses that we study in this thesis. With such strong trends of rescaling, public-private networks and interurban competition, does the governance of domestic retrofit also incorporate this multiplicity of public and private actors at different scales? Are these initiatives concerned by or affected by the urban pressures of external reputations, vulnerability and competition for investment? If so, how has this affected and directed their focus and their transformative potential?

2.2.3 Space and place – new understandings of cities.

The increasing interconnectedness between individuals, businesses communities and organisations across the globe and the associated mobility of information, knowledge and capital in its various forms has changed, or even annihilated, as Harvey (2005) would argue, societal perceptions and instrumental roles of space and time and their relation to economic and social life, resulting in new and varied conceptions and arrangements of places, contexts and their relation to state structures (Swyngedouw 2004). This creates a condition in which, it is argued, that space and place - and therefore their role in practices and activities such as those around domestic retrofit - are no longer appropriately defined by national state boundaries, or by 'fixed' or 'absolute' cartographic representations of space (maps of boroughs, districts, city borders and so on) which can be exclusionary and lack a depth of understanding of how that space has been constructed and is experienced (Harvey, 2005). Instead, when viewing spaces of activity as constructed 'relationally' (Ward, 2010) – i.e. by their internal relationships and networks, and 'relatively' – by their relationships, networks and reputations with other places and spaces at different scales and in often physically distant locations (Massey, 2005 and Harvey, 2005), it allows a deeper and more complex view of place-based activities that does not assume their spatial elements to be predefined and uncontested.

However, the construction of urban spaces in particular can be seen not only as products of human relationships and networks, but of an entanglement between those relationships and networks and the elements of the built environment that characterise cities. People, organisations and territory combine with energy and water infrastructures, buildings, roads, and so on, as well as a meshing with the wider political processes outlined above, temporal events, social norms and different cultures and power relationships. This multiplicity of socio-technical elements of the city has been captured particularly helpfully through assemblage thinking (for example, McFarlane, 2011, Farias and Bender, 2012 although this idea is explored further in the next chapter) and through the framework of splintered urbanism (Graham and Marvin, 2001) in which privatisation, technological advancement and the interconnection of global cities create political and power divisions within and between cities through the physical elements of marketised infrastructure and service provision.

The importance of understanding how space is defined through the relationship between people, places and the physical built environment for the domestic retrofit case studies is in understanding how the spatial elements of domestic retrofit – as one element of the responses - are constructed differently in different places through these socially, relationally and contingent assemblages of space.

2.2.4 Products of the global context at the urban and local scale: unevenness and experimentation.

Unevenness

Exploring these multiple global pressures and new conceptions of space is not solely descriptive. They also mean that development and investment are, as a result, geographically uneven, with hotspots of development and activity, concentrations of resources and investments in certain spaces (such as economic 'corridors' in Europe – see Brenner, 2009) and as a result, less development and investment in others. Smith (1985) and Harvey (2005) illustrate with a Marxist approach how flows of capital through both state and private hands into certain urban development, construction and regeneration processes increases economic dependency on these areas whilst draining other areas. Swyngedouw's concept of 'glocalisation' (2004) with its spatial politics, networks, the forging of territories and uneven, place-specific power dynamics and relationships also captures this dynamic nicely. Energy-related issues and changes relating to them are argued to be equally geographical and scalar in their nature (Bridge et al, 2013, Bradshaw 2010) with concerns over peak oil, increasing energy demand from developing countries, energy security and 'processes of globalisation', playing out differently in different places and spatialities: multiple interests and stakeholders presents multiple possibilities for interpreting, defining, researching and responding to these global pressures and trends and pressures, as well as multiple visions of what these responses might produce.

Hodson and Marvin (2014), for example, explore competing discourses around what the term 'sustainable cities' means through a variety of research approaches: it could relate to 'smartness' or 'resilience' of cities, with varying degrees of technological, ecological and commercial focus, it could relate to localised experimention around sustainable urbanism, the management, securitization and bounding of urban resources and flows, or be

approached through 'carbon regulation' enmeshed with existing urban governance processes. These varied ideas around what a 'sustainable city' might be demonstrate the multiplicity of problem framings around urban energy issues and secondly, how complex the drivers for, and motivations for any kind of transformations in urban contexts are, depending on the framing of the problem. This is synonymous with the multiple framings of the broad issues surrounding domestic retrofit. Notions of carbon control (While et al, 2010, 2011 and 2013), and the positioning of a 'green' and 'low carbon' economy as an opportunity for rebuilding after a global economic crisis (Luke, 2014 and Hodson and Marvin, 2010) drive many aspects of the policy, but there are also pressures from international carbon emissions reduction targets, international energy markets and energy supply vulnerability. Furthermore, when connecting 'new state spaces' and relational, relative forms of space, with these multiple framings of energy issues, Hodson and Marvin (2013) illustrate how different configurations of social interests navigate the economic, industrial and social legacies of the places in which they operate alongside these new global pressures and tensions in different ways. Within the United Kingdom, they show how the notion of a 'Low Carbon Nation' is interpreted and constructed in geographically varied ways, through regionally specific processes of development, management of local resources, financial flows, place-based identities, visions and strategies. These produce specific responses and interpretations, from environmental economics in Greater Manchester, to strengthening infrastructures in Wales, and recirculating wealth from oil reserves back into sustainable community projects in the Shetland Isles.

With a specifically urban focus, Hodson and Marvin (2010) also explain how in World Cities from San Francisco to London and Frieburg among others, strategic responses to ecological issues and resource constraints have become vehicles for pursuing a common goal of producing secure and resilient infrastructures. As well as articulating an important shared agenda which embodies the global pressures on cities discussed above, they raise concern, along with Meadowcroft (2009) about the elite - and primarily economic interests - that often constitute these varied strategies whilst excluding others: who, in terms of social groups, values and visions of change, is represented when strategies about sustainability are constructed? This issue is also highlighted by Ernstson and Sorlin (2013) when they demonstrate how 'ecosystem services' in cities such as Cape Town – decisions about land

use, parks, transport services, energy infrastructures, preservation of resources, and so on - are socially produced through contestation and negotiation between different social groups, and often result in uneven geographies of access to and benefits from these services and infrastructures. Dierwachter and Wessels (2013) make a similar point, showing how municipal and institutional choices in funding, planning and organising climate experiments across the metropolitan region of Seattle resulted in uneven involvement of its multiple boroughs, because of uneven resources, skill levels and institutional capacities at these hyperlocal levels:

"the uneven localisation of climate action across metropolitan regions can be as much about ability to pay, as willingness to play"(Dierwachter and Wessels, 2013, p1382

Crucially, they argue that this is exacerbated by the entwinement of neoliberal state restructuring with climate 'control' and sustainability 'fixes' - structures of competitive funding at municipal and state level create 'non-choices' for localities lacking in capital and resource through no fault of their own. Whitehead (2013) similarly links this unevenness directly to global processes by hailing this variation as a demonstration of how entwined global trends of urbanisation and neoliberalism have shaped the framing of the environmental agenda and climate governance in their image, through such structures as environmental entrepreneurialism, competitive funding for local projects, outward-looking exemplars and so on. Swyngedouw (2007 and 2009) would similarly argue that climate change and environmental catastrophe, under the post-political context of neoliberalisation, simply creates an opportunity for capitalist, private sector actors to gain greater control of urban development processes.

In terms of further uneven impacts not just geographically but practically, as a result of differential representation of interests, Bulkeley and Schroeder (2011) demonstrate how an effective, inclusive intermediary resulted in a strong and widely representative guiding vision that enabled the construction of a citywide sustainable stormwater drainage system in Los Angeles. However, Hodson and Marvin (2011), illustrate the alternative in Greater Manchester: that limited representation in the network charged with developing an energy system transition resulted in the pursuit of a narrow vision, and little practical action, but show in London's case how an agenda and strategy around decentralised energy was

composed and implemented through the particular strengths and power of the Greater London Authority and associated regional governance structures (Hodson and Marvin, 2010). Rutland and Aylett (2008) show how the construction and implementation of a climate change mitigation strategy in Portland, Oregon came about through the constant negotiation of different actors' visions of the problem of climate change, identification of the spheres in which the local intermediary and municipal authority could act, and the resultant inclusion and exclusion of various spaces in the city, as well as parts of what actually constituted Portland's carbon emissions.

These practical, urban-focussed examples of common pressures, varied responses, contested social interests and geographically uneven effects together act as good illustrations of the pressures of interurban competition, spatial and territorial contestation and the contingency and entwinement of urban assemblages. These literatures, although not relating specifically to domestic retrofit, show us how urban responses can demonstrate, *through their variation*, the many possibilities for action and different 'geometries of power' or negotiations of interests under the context of what Hodson and Marvin (2014 p7), deem an "era of multiple crises": climate change, economic and cost of living, peak oil and governance.

The point of exploring these multiple discourses and multiple interests is again, to highlight the multiple ways in which localised, urban activity around energy and sustainability issues can interpret the 'landscape' pressures on energy efficiency and domestic retrofit, and how these interpretations are not free of political and social pressures and effects: the idea of some discourses and interests outweighing others in strategy decisions and networked activity is particularly important to note when exploring why domestic retrofit cases have tackled the many facets of domestic retrofit in one way and not another, or why certain areas of the problem have been deemed more important than others.

Experimentation: the 'answer' to urban sustainability questions?

The second key trend that it is argued has emerged from these pressures and changes at the global level is that of experimentation as a form of governing and approaching sustainability, energy and climate change related issues, particularly in cities.

Both Hoffman (2011) and Bulkeley and Castan-Broto (2013), focussing on climate change governance specifically, situate the experimental trend as a product of – or response to – the multi-level governance of climate change and changing roles of state institutions. They argue that this is a product of what Hoffman (2011) describes as "disillusionment with international policy negotiation and fragmentation of political authority", which has created the conditions for an "era of governance experimentation". Evans (2011) similarly argues that urban sustainability experiments or what he calls 'living labs' are borne from governing coalitions giving up 'modernist' ideas about total control and instead embarking on what he terms 'adaptive experimentation' with a clear view towards improving resilience to the pressures of climate change, economic instability and energy vulnerability. These experiments in their many conceptions, are thought to operate outside of formal or mainstream policy and economic activity (Hoffman, 2011 and Bulkeley and Castan-Broto, 2013), thus representing novel and open-ended possibilities for low-carbon or sustainable futures.

Evans and Karvonen (2011) in Bulkeley et al (2011) explain how 'urban living labs' offer the promise of working out complex solutions to complex problems in 'real life'. They connect technological innovation with already existing users and behaviours, linking processes at the hyperlocal, individual technology or building level, with a variety of stakeholders living and working in and on the experiment from local government and third sector, property development or educational institutions, and also avoid the tensions between top-down and bottom-up initiatives by creating lateral, local relationships akin to the 'middle-out' retrofit strategies explored later in the chapter. Karvonen and von Heur (2014) highlight three key elements to urban experiments: 1) their situatedness, in which the tensions between already existing places and their new functions as sites of knowledge production is negotiated, 2) their change-orientation, i.e. that they are deliberately intended to make a significant change to a socio-technical system, and 3) their contingency – their embrace of the risk, unpredictability and messiness of 'real life' laboratories as opposed to natural science 'labs'. These features make urban experimentation and its grounded, practical knowledge immensely appealing as sites of knowledge production. However, both Evans and Karvonen (2011) and Karvonen and von Heur (2014) issue a warning: to be cautious of

viewing urban laboratories as producing a superior form of knowledge when it is in fact just one form of knowledge among others, and is highly political and contested in its production.

Evans and Karvonen (2014), for example, show how the 'living lab' of the Manchester Oxford Road Corridor, which tests energy use, flood protection and pollution amongst many other things, creates new interplays and relationships between city actors, and novel ways of feeding technical knowledge from measurement and monitoring into urban policy, but it does not open up this space of knowledge production and its governance to new actors in the Manchester 'scene', thus excluding certain actors and reinforcing dominant governance networks. Castan-Broto and Bulkeley (2013) also show how the state of experimentation can be maintained differently in different sites, for different purposes depending on the context: for example in attempting to securitize water supplies in an elite housing development in Bangalore, and in protecting residents from violence in a social housing development Monterrey. These processes of maintenance both attempt to normalise experimentation and retain its novelty, and involve the negotiation of different configurations of actors and social interests who have been included or excluded from the site of experimentation and from the knowledge produced by it, highlighting some important contextual and political tensions around experiments once they are in situ.

What is also interesting about these notions of experimentation is the varied function and form of these local-level activities: Bulkeley and Castan-Broto (2013) demonstrate, through their international database of 627 climate experiments, a range of local-level initiatives addressing issues from adaptation, the built environment, infrastructure provision to transport and carbon sequestration, and involving various actors from national to local government, private actors and sub-national or third sector organisations including international agencies. These initiatives were often conducted by partnerships and nearly half of them focussed on energy supply or use. Evans and Karvonen (2011) discuss experiments ranging from an entirely new low-carbon city (Masdar City in the UAE) to reworked buildings and small neighbourhoods in an 'urban landscape lab' New York. Some are newly fabricated and some work with existing urban sites, with varying emphases on technical innovation and lived experience.

Drawing conclusions from this exploration of experimentation it is reasonable to expect that the domestic retrofit responses under consideration may be to some extent experimental, whether explicitly or not, as a product of the global and national policy and governance context in which they are situated, and that they have political implications regarding the knowledge and change they intend to produce. To what extent this is the case, and to which conceptualisation of an experiment: a niche, a living lab, or a policy experiment, they most closely align, will become clearer through the analytical process (these terms will be explored in detail in chapter 3). Viewing the domestic retrofit case studies as experimental in general is helpful in many ways: it captures the emerging nature of their endeavours: to 'try out' ways of addressing the various problematic areas of domestic retrofit, given how multi-faceted and complex it is, and it is a helpful way of illustrating how the many pressures described above are brought together in a particular way of governing at national and supra-national level, that then opens up the possibilities for uneven and varying responses at the local level.

Looking inside localised experiments

Looking at localised activities in more detail, though, it is important to note that this thesis seeks to link the global pressures outlined above, with the particular characteristics of the urban context, with the actual experiences of localised initiatives, to better understand the interplays between these levels of activity. For that reason, it is important not to simply explain away localised experiments as products of the global environment, but to recognise them as also the lived experiences and passions of individual people, and seek further clarification of the role of local actors, organisations and people in shaping these experimental, uneven, varied activities into the responses to domestic retrofit that emerge, and what the challenges of that are.

The view from inside these local experiments or niches is therefore likely to be different from the view upon them: looking in more detail at the construction and dynamics of local initiatives, the key messages are that they have to deal with multiple pressures, often coming from different value bases, and negotiate these pressures based on who is involved and what capacities and resources are available to them, which is a complex process. For example, Middlemiss and Parrish (2010) compare the wildly different, but still 'local'

networks involved in two radically different contexts: firstly those involved in establishing community owned renewable energy in indigenous tribes in Northern America and secondly, the organisation and participation in an energy efficiency education campaign in a rural UK town: both of which had broadly similar energy-focussed priorities, but manifested very differently because of the wildly different priorities of the tribal alliance versus a small English town. Similarly in a case study of the transition to a biomass-fuelled regional energy system in Murau, Austria, there were particular features of the region such as a local, plentiful source of biomass, a detachment from the national regime (i.e. a lack of threat to any political or business elites), and the participation of a powerful range of actors including businesspeople and the media, that drove this to success (Spath and Rohracher, 2010). Further examples include Peters et al (2010), who look at the development and impacts of a low carbon advice centre in Islington, London, and it's relationship to local government, Holm et al (2011) who investigate different local eco-housing and construction projects constructed by different configurations of local actors in Denmark with varying effects and interests, and Seyfang (2009) in her case study of a straw-bale sustainable housing initiative in Canelo, Arizona. They all highlight the particular capacities of places to act differently in response to these issues, through the mobilisation of local resources, expertise and knowledge, and the creation of context-relevant rationales of what these local initiatives are for. Whilst not all of these studies relate to specifically urban contexts, they do point to key local features and circumstances that steered and enabled significant transitions and they highlight the vast variation in local responses.

However, the other key aspect of grassroots-based literature is its attention to people and their agency in relation to these kinds of strategies. Rutland and Aylett (2008) document in detail, using actor network theory, the way in which different individuals' views, feelings, motives and beliefs were incorporated into the climate change strategy in Portland, Oregon, and in Brown and Vergragt's 'bounded socio-technical experiment' in Boston (2008), they highlight the leadership of an individual project manager who created a clear guiding vision for a zero carbon building development, and an alignment of values and worldviews with the rest of the design team involved. Middlemiss and Parrish (2010) also highlighted the individual skills and capacities of particular members of the intertribal alliance, in accessing and negotiating legal information, for example, and their powerful, shared motivation for

energy autonomy as a community. Seyfang (2009) highlights the personal value-base around civil society, pro-environment values and community empowerment from which grassroots transitions to sustainability emerge, in contrast with top-down attempts that begin with state-defined priorities. What is important about individuals in these cases is the recognition that activity in places is not just a product of the macro-conditions in which they exist: there is still the potential for individuals to act based on particular reasons and beliefs of what those actions represent, that are intrinsic to them (Davidson, 1963).

Finally, this body of literature highlights issues around forms of knowledge similar to those raised in the exploration of experiments. These literatures illuminate the particular strengths of context-specific knowledge and it's ability to be relatable, practical and have potential for higher order learning, like the zero-carbon building experiment in Boston, which challenged local construction practices (Brown and Vergragt, 2008), and the various housing and construction 'niches' in Denmark (Holm et al, 2011), each of which tested different areas of the housing energy efficiency problem, from technologies, to regulation, to radical ways of living, and produced different forms and foci of knowledge accordingly. The transformative potential of place-specific knowledge from such experiments sounds promising, but its influence in practice can be limited by other contextual features: perhaps a response is too place-specific, or governance and policy arrangements limit wider learning and change (Seyfang, 2009 and Seyfang, Park and Smith, 2013), particularly under narrowly constituted policy conditions, with the prioritisation of scientific or 'expert', and economic forms of knowledge. This undervaluing of contextualised knowledge in urban development, in favour of the prioritised scientific and economic forms (Atkinson and Klausen 2011) is an imbalance that Perry and May (2010) argue stifles meaningful progress, and is an important consideration when linking these more nuanced accounts of local responses to sustainability issues to the political elements of urban living labs explored above.

Relationships between local experiments and mainstream policy: the dangers of co-option and dependency.

Questions emerge from this exploration of experiments and localised initiatives around how they relate to wider processes and what this means for the changes they might effect. Localised experiments can show how grassroots initiatives stimulate successful changes to existing regimes: acting as the 'seeds' for transitions to more sustainable, lower carbon

living and governing (Kemp et al, 2007, Geels and Schot, 2007, Kemp et al, 2001, Smith et al, 2005 and Seyfang and Smith, 2007). Other cases show that local practices can be very much context specific and limited in their ability to stimulate change beyond their contexts, as mentioned above. North and Longhurst (2013) suggest that learning from grassroots experiments could be greatly enabled by the peculiarities of the urban context, due to the intensity of networks and resources in cities, i.e. the 'institutional thickness' of the city, and through this the possibility of generating knowledge that quickly moves beyond the hyperlocal scale. Geels (2011) in Bulkeley et al (2011) highlights the role of cities in transitions to sustainability as being sites for experimentation for the same reason, as well as their political connections to existing 'regimes' and their visibility as exemplars (Spath and Rohracher, 2012), and Hodson and Marvin (2010a) describe cities as sites in which multiple 'regimes' or systems – infrastructures for energy, waste, water, travel and so on, converge, therefore offering a space of opportunities to strategically direct systemic change rather than just engage in a scattering of piecemeal experiments.

However, these perspectives also raise a tension between localised activities and the broader issues and context that they sit within: grassroots projects 'on the ground' - because of their appeal to incumbent governance networks - are in danger of being co-opted into broader strategies with mismatched values and priorities, often through dependencies on state funding and pressure to align with existing economic, organisational and technical priorities in order to 'upscale' or retain financial support (Evans and Karvonen, 2014, Catney et al, 2014). Radically inclined motives, desires and goals – particularly value-based ones that challenge powerful existing governance configurations and markets - can be diluted, dominated and diverted when local initiatives are *too* inclusive, not political enough, and, particularly when they become dominated by economic growth priorities, resulting in rather less radical changes than might have been hoped (North, 2010, Mason and Whitehead 2012, Catney et al, 2014). For example, the LILAC ecohousing co-operative in Leeds, a radically different model of low-impact living, was dependent upon central government funding and had to fight for its autonomous place amongst 'normal' housing and planning processes (Chatterton, 2013). Seyfang, Park and Smith (2013) investigate a range of community energy projects across the UK and identify a number of factors in their operation and success, one of which is their relationship with policy and funding, which

often assumes that community energy projects want to grow and expand, when some are often happy to remain at grassroots level. What kind of commitments and compromises are localised initiatives prepared to make to attract continued policy support and funding and can they retain their radical roots and strong values when they 'upscale' or are used as exemplars?

This question demonstrates the importance not only of the 'horizontal' relationships within the initiative being studied but also what we might term the 'vertical' relationships between place-specific actors/processes and outside actors and processes, such as state institutions, corporations, funders, and so on. Smith and Raven (2012) articulate this tension between radical change and co-option into the existing norms beautifully through their distinctions between sustainability niches that 'stretch and transform' existing regimes or those which 'fit and conform' to adapt into the dominant, existing configuration (Smith and Raven, 2012).

The point is that whether we view these localised initiatives as experiments, transition places, as radical alternatives or as part of broader strategies, (or all of these in different measure) we ultimately find the local sustainability or energy initiative to be a locus in which the broad pressures of global changes, changes in urban governance, and peoples genuine personal values and motives coalesce. This provides the perfect site for which to investigate what this coalescence means in practice for actors and interests at these different levels, and what it means for the effects these initiatives have on these big issues. The next stage of this is to channel these investigations through the specific topic of domestic retrofit

2.3 Socio-technical issues in domestic retrofit.

Having highlighted that the issue of domestic retrofit, at any scale, is inherently a socio-technical one, it is important to note that there are a number of ways that the 'socio-technical' approach has been, and can be used, to approach its study, illuminating different facets and aspects of domestic retrofit.

2.3.1 Technical complexity and risk

One of the key aspects of the domestic retrofit 'problem' though, at any scale, is the technical complexity of it, as highlighted in chapter 1, and the risks and challenges this

presents for the people involved in retrofit installations. At each stage of the retrofit process, the technical and the social are entwined and interdependent. Firstly, at the assessment stage there are significant challenges in the surveying process measuring homes' energy consumption, heat loss and overall efficiency performance, as highlighted in a recent report by DECC (2014a). The report, forming part of the Green Deal and ECO evaluation process, showed a variety of issues at the assessment stage, from trouble finding assessors, to inconsistency (in the same property) in basic input data such as floor area, in output data and results such as EPC ratings (which varied across two bands) and in wildly varying recommendations for installing energy efficiency measures as a result of the assessment, based on the personal rationales of different individual assessors. Additionally, certain surveying methods such as the method preferred in the UK government's Green Deal retrofit policy framework – Reduced Data Standard Assessment Procedure (RdSAP), may fail to pick up on particular house-specific details. This can result in inappropriate recommendations or energy saving predictions that produce different results from those intended, or cause practical issues such as a lack of co-ordination and feasibility when they come to the design and installation stage (Gupta and Chandiwala, 2010, Baker et al, 2013 and Fitton, 2013). There are similar issues in installation as Baker et al (2013) illustrate in examples of condensation, building physics issues from internal wall insulation being installed near floor joists, regulatory issues and lower-than-expected energy savings if measures or materials are inappropriately ordered or applied. They advocate an integrated and detailed project design and management approach that is sensitive to these survey and installation risks, highlighting the 'human' decision making human elements of the process at the design and installation stages. Davies and Oreszczyn (2012) similarly highlight some 'unwanted' outcomes emerging from retrofit projects, in particular, poorer indoor air quality of dwellings and health concerns as a result of overinsulation, but also the differential impact of comfort 'take-back' (increasing the use of heating after retrofit rather than reducing energy use wholesale) on those in fuel poverty, who may have been underheating their properties for cost reasons. This shows us the link between a physical or technical issue, and a social or behavioural impact, and relates back to the complex macro-framing of retrofit - oversimplifying energy efficiency as an issue can lead to an ignorance of differential effects and impacts between social groups and individual properties.

Investigating specific retrofit measures such as solid wall insulation, Forman (2013) highlights issues with providing a consistent quality of solid wall insulation across the retrofit industry, from the impact of short-term targets, to inconsistent levels of training and knowledge in practitioners and a lack of quality assurance processes. Shipworth et al (2010) investigate the specific use of controls and how this impacts on energy performance, finding discrepancies between not only the technical performance and actual impacts on energy use in homes of controls, but with assumed and actual heating controls behaviours by the occupants. For example, heating control habits are primarily driven by comfort rather than energy efficiency, and the occupants' role is often second to the installer's in decisions about which controls are installed and where (DECC, 2014b). Furthermore, the installation of heating control technologies such as TRVs, clocks and room thermostats, whilst having a significant impact on the amount of time and space heating is used for, are not the sole factors: key behavioural factors such as a lack of understanding of controls, housing tenure, number of occupants and occupancy patterns as well as comfort needs greatly affect the way that heating is used, and the authors of the report deduced that there is a significant dearth of evidence from the UK about the interplay between these factors (DECC 2014b). What this suite of literatures do together is to demonstrate the technical complexity of the domestic retrofit problem through interactions between specific measures and stages of the process. These complexities are unavoidably linked to the social 'end' of the socio-technical spectrum, involving not only occupant behaviour, but also the behaviours, experiences and decisions of installers and designers. For the case studies in this thesis, the resulting question is of how these socio-technical issues such as surveys, heating behaviours, risks and unwanted impacts are addressed or managed in different contexts, and why they may be addressed in different ways.

2.3.2 People, behaviour and motivation

Complementing these studies above and acknowledging the 'human' factors in retrofit, a number of scholars have highlighted a fundamental flaw in overly technical accounts of retrofit 'problems', that focus too heavily on the technologies involved and assume that the 'error' in the system is in how people are or are not using those technologies. Some of the reason that this element is of importance is that with the focus on carbon savings, there has been a preoccupation with why actual savings don't always match up to predicted savings –

a so-called ‘performance gap’, that has recently been attributed to a lack of understanding of occupants’ behaviour (Stevenson and Leaman, 2010 and Gupta and Gregg 2012).

Janda (2011) points out that ‘buildings don’t use energy, people do’, which, whilst potentially underplaying the role of the technological elements of the energy efficiency problem, does raise an important point and a number of attempts have been made to build on this idea and better understand the role of people in this performance gap. Walker et al (2014) try to tackle this using the idea that energy efficiency *behaviours* of occupants in social housing programmes are a balance of their competence, social image, and the material available to change energy use, and that any retrofit design needs to harmonise these three key areas in order to achieve maximum energy savings. Heaslip (2013) uses the concept of useability in a similar way – arguing that the performance gap often unfairly blamed on unsatisfactory ‘user-behaviour’ can be better understood as a mutual interaction between the householder and the technology, and that retrofit programmes should be designed for a non-expert, i.e. a ‘normal’ householder, rather than with complicated interactions between measures and technologies and householders. These approaches highlight not only the householder’s role in realising the energy related benefits of retrofit, but again, that of the designer as well.

Other approaches focus on another part of the process: the householder’s fundamental decision of whether or not to embark on a retrofit installation, or, in another words, motivation. One of the key issues with retrofit under the UK’s policy climate of the market-focussed ‘Green Deal’ has been of engaging and incentivising householders with the process and purpose of retrofit: in the owner-occupied housing sector, each homeowner is the sole decision maker and any carbon emissions savings, fuel poverty impacts or economic benefits can only be realised if retrofit gains the buy-in of multiple homeowners, which has proved very difficult. Mallaband et al (2013), Brown (2013) and Haines and Mitchell (2014) all find that policy approaches aimed at increasing motivation and engagement through financial incentives and information provision alone is deficient, with the situation in practice far more complex. Tweed (2013) also supports the findings of Brown (2013), Mallaband et al (2013) and Haines and Mitchell (2014) that a simple lack of capital cost should not be assumed to be the greatest barrier to retrofit, with the cost factors far more nuanced, ranging from prioritising holidays over home improvements, to what Tweed

(2013) terms ‘affordances’ in terms of daily experiences of the home - decisions and priorities about energy use, daily living and comfort. Brown (2013) seeks to develop an understanding of this situation by characterising the motivation to undertake retrofit as a ‘complex purchasing decision’. By understanding these decisions as an interrelated set of psychological processes including social motives and norms, and the way that feedback on energy efficiency behaviour changes or retrofits is provided (through energy bills and monitoring, for example), he argues that better use could be made of psychological knowledge, by encouraging and incentivising retrofit through careful, accurate communication of the issue and the benefits of retrofit that incorporates these many facets.

Haines and Mitchell (2014) and Mallaband et al (2013) both investigate personal attitudes and ‘personas’ around home improvements and explore how retrofit is entwined with attitudes towards both DIY and energy efficiency. Both find that in the home improvement decision-making process, energy efficiency is never a sole motivator. Decisions can be based around social and aesthetic preferences such as not wanting to replace inefficient wooden windows with UPVC double-glazed ones for style reasons. There are considerations around selecting construction professionals, the time cost of retrofit, life events, and non-standard features of older properties such as intricate brickwork etc. that either make retrofit measures undesirable or very difficult practically. But there are also personality differences in terms of motivation that do not just involve information and skills or cost or hassle but also levels of passion and inclination towards undertaking large-scale home renovations (Haines and Mitchell, 2014). These literatures advocate a retrofit process that is sympathetic and considerate of a suite of socio-psychological factors, habits, norms and preferences. These include preserving the character of older properties, informing the householder of realistic time, hassle and financial costs of retrofit, being able to incorporate trusted professionals into the process, and managing expectations of dramatic, immediate change.

Again, for the case studies in this thesis these behaviour and psychological elements raise the question of how – or even whether – different urban responses address these issues of motivation and barriers, preferences and post-retrofit behaviour and why they do so in any particular way.

These individualised, practice-based approaches focus on behaviours and preferences, mostly in household micro-contexts. These works highlight the importance of householder experience, values and motives, the use of technologies and buildings, and the interplay between different parts of the retrofit process. However, other than highlighting the 'social' elements of the designer and householder, they pay limited attention to the wider range of organisations and actors involved in those decisions and processes of retrofit, or to the dynamics created by the policy and regulation context outlined in chapter 5. To address this gap, a more holistic view of the issue in practice is needed.

2.3.3 Holistic approaches to domestic retrofit

One approach to this is to use a socio-technical systems approach (Geels, 2002, 2007 and 2010), which will be explored further in chapter 3. There are two such approaches relating specifically to domestic retrofit that attempt to capture the different parts of the domestic energy/retrofit issue and their interrelations. The first is Swan's (2013, p41) depiction of the existing domestic energy system in the UK (for a more detailed theoretical exploration see chapter 3). Figures 5 and 6 below illustrate the multiplicity of socio-technical factors and elements involved in domestic retrofit, from policy and subsidies in the government regime to the tools and processes involved in the non-government elements, the multiple interrelated components in the manufacturing and production of domestic retrofit, and the research processes behind it. What Swan denotes as the 'technical regime' (figure 6 below) alone comprises multiple technologies and elements of the building from its structure, lighting and heating, to microgen and various materials and systems. Swan uses this framework of elements to conduct a retrospective analysis of socio-technical initiatives around retrofit in social housing, which demonstrates firstly the immense complexity of the socio-technical system around domestic energy use, and secondly explores socio-technical experimentation (in this case in the social housing sector) in creating innovative approaches to domestic retrofit, particularly in the technical, research, production and markets and user practices elements. However, he finds that in the absence of changes in the other areas – such as the government, and infrastructure regimes, these innovations tend to focus on small components of one or two regimes, and be incremental in nature rather than radical.

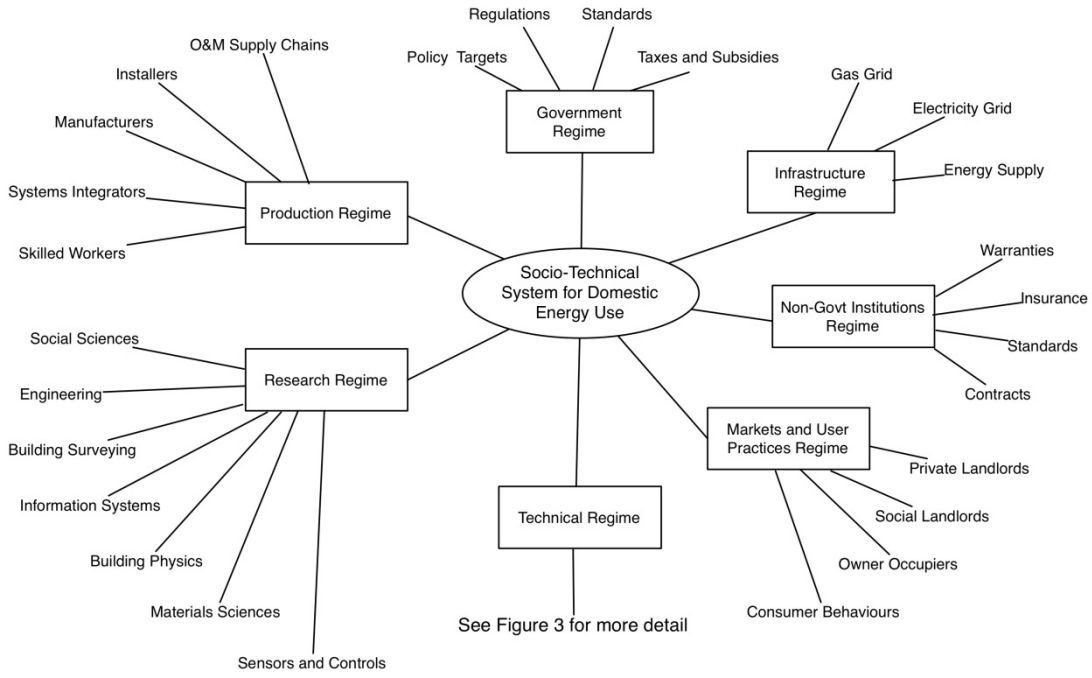


Figure 5 Socio-technical system of domestic energy use (Swan, 2013, p41)

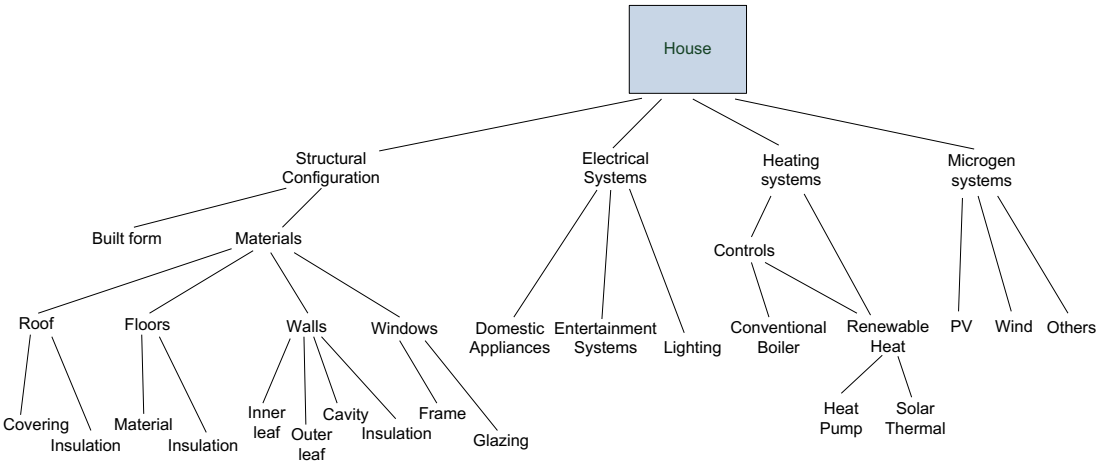


Figure 6 Technical regime for domestic energy use (Swan, 2013 p42)

The second is Vergragt and Brown's (2012) framework describing the challenges of energy efficient retrofitting of the housing stock, generated from a case study of Worcester, Massachussetts. Many of the component's of Swan's framework can be recognised here, but the framework itself is made up of four broader elements, the purpose of which is to develop a more prospective view of the problem in terms of co-ordinating these elements in future responses to domestic retrofit. The components are:

1. Technology (which in the case of domestic retrofit is shelf-ready and has not changed much in recent years)

2. Professional expertise and know-how (access to trustworthy and competent professionals – an issue also raised by the behavioural approaches above)
3. Mandatory and voluntary regulations and standards (tools for training newcomers to the field and building trust are required, but by institutionalising these radical change can be limited)
4. Markets and consumers: the need for market-pull (householders need to want the change)

Their case study again highlights that many of the energy efficiency retrofitting programmes in existence only address one or some elements of the issue, or 'system'. For example, many top-down government programmes – like the Green Deal - assume the barriers to energy efficiency to be finance-related issues in the market-pull component, and therefore only address this, where in fact the barriers are much more complex, as mentioned above. In order to effect a change in the whole system, each component should be tackled harmoniously:

"Identifying the dimensions of the socio-technical system of the housing stock reveals the interdependencies between its elements and the drags in the system. It shows how enhancing market pull does not work in the absence of professional knowledge and know-how; and how standards do not work in the absence of a market pull. It is clear that change in one element, or one component of an element, is not sufficient to affect the system."

(Vergragt and Brown, 2012, p414)

Both approaches start to bring together the components of the domestic energy system and link some of the issues emerging above together: from motivation (akin to market-pull in Vergragt and Brown's framework or user behaviour in Swan's) to inconsistent installation standards (akin to professional know-how or the production regime), to socio-technical risks (linking to both professional know-how and the research and production regimes). These linkages, and the illustrated interdependencies show that the total challenge of effecting change on domestic energy use is more than just the sum of its parts: in order to effect change on the system overall, all of these components must change. In terms of possibilities for achieving this kind of systemic change, both Swan (2013) and Brown and Vergragt (2008

and Vergragt and Brown, 2012) also highlight localised experiments as opportunities for richer and more in-depth, higher order learning, but recognise the limited ability of localised experiments alone to change the entire system, especially under unsupportive or limiting policy contexts.

However, it is important to note that no single response or actor has control or power over all of these elements. Reddy's (2013) assessment of the barriers to energy efficiency highlights barriers at three levels: those at the individual project or end-user level, those at the organisational and local governance level, and those broad barriers at the state, civil society or market level. Only actors who actually have control in those levels can effect change on those barriers, by either permanently removing them (e.g. a regulation or mandatory requirement), reducing them (such as fast-tracking planning applications), or temporarily avoiding them (e.g. subsidising expensive SWI). This again highlights the limitations of any single response to generate systemic change, but also highlights the different possible roles and responsibilities of actors within a networked response, based on their position, capacity and capability. This helps us to understand why many responses only address one or some of the elements of a system, depending on who is involved and the power/control they have. These limitations are important to note when considered in contrast with the trends of contemporary, developed cities to 'govern' change by experiment, and start to expose the strategic challenges of organising retrofit responses.

The emerging issue from this exploration of both the holistic, systems approach, and the opportunities and limitations of localised experiments is one of exploring firstly which aspects of this multi-faceted problem or system do these experimental responses intend to address, and secondly, what aspects of this problem do they actually have the agency and ability to address with the actors and organisations involved. This is essentially a question of governance, and calls for a more in depth exploration of how retrofit responses might be governed in city contexts.

2.3.4 Governing and organising domestic retrofit

Roles, responsibilities and knowledge

Some approaches to this start by looking at the actors in domestic retrofit responses themselves, can help to effect change through their involvement. Janda (2013) studies the role of what she calls 'middle-actors' particularly focusing on building professionals and designers in the retrofit process who can generate learning and change through their practical experience that can have effects in many directions: upwards to policy, downwards to the householders involved and sideways to other professionals. Gupta et al (2014) and Karvonen (2013) investigate 'community-led' domestic retrofit programmes, with particular attention on the relationship between individual householders' attitudes and practices, and community organisations termed 'intermediaries'. They suggest that a prominent, instrumental role for local low carbon or sustainability related community groups can both enable the production and distribution of relevant technical, policy, financial and practical knowledge, and foster commitment and positive attitudes towards domestic retrofit in their local context. This resonates with broader views on the role of intermediaries in urban governance, who balance and negotiate the needs of multiple actors and issues at different levels (Hodson, Marvin and Bulkeley, 2013 and Perry and May, 2010). Jones et al (2013) discuss the financial elements of three retrofit programmes in South Wales, focussing on the difficulty of balancing the pros and cons for external investors of attempting more 'shallow' retrofits – i.e. single or fewer retrofit measures with lower energy savings, but at a lower cost, or fewer 'deep' retrofits – i.e. whole house, comprehensive retrofits that yield higher energy savings, but at higher costs. Their attempt to model the economic viability for investors from shallow to deep retrofits is less important for this thesis than how the paper highlights the use of economic knowledge in strategic priorities, decisions and trade-offs between carbon savings and capital costs in governing and organising retrofit, which could be an important factor in defining responses in the case studies.

These approaches complement the systems approaches and issue-based approaches above firstly because they begin to situate the domestic retrofit problem practically, and secondly because they highlight the importance of different forms, and dynamics around, knowledge and learning as part of the responses. The specific roles and elements focussed on provide pointers for important elements of the case studies in terms of understanding how each

response tackles these various parts of the domestic retrofit 'problem', but more is required to make sense of the complete response, linking our awareness of the network involved in domestic retrofit responses, from policy down to individual people.

Networks and relationships

Eames and Dixon (2013) look at domestic retrofit more broadly as part of an integrated urban strategy, focussing on the development of guiding visions at the city scale that explicitly encourage change in all parts of the system involving both experimental, grassroots activities, strategic leadership, a supportive political and policy context, and governance at city scale as recommended above by both Swan (2013) and Vergragt and Brown (2012). However, there is little detail on how a city-regional approach might approach the detailed social and technical issues highlighted above at the household level, or practically organise and balance the multiple priorities of carbon, scale and fuel poverty through such a framework.

One very helpful study instead does attempt to address the governance issue in terms of the interconnected roles of central government, local actors/government/agencies and householders involved in governing retrofit in a suburban space (Williams et al 2013). The study highlights the importance in suburban responses of understanding place-specific risks (e.g. flooding), housing types and options for action available, based partly on the decision making capacity and capability of local citizens. They also find a key issue to be a lack of awareness of who is responsible for what – i.e. 'weak or confused governance', which illustrates in context the ideas raised above about roles and responsibilities in retrofit, but this time collectively. The combination of this with the other issues they found: the overwhelming scale of the 'problem' (framed through carbon targets and large numbers of retrofits required to address them), the lack of public involvement with climate issues, and a lack of local resource (largely financial), again highlights the tension in the UK context between a lack of leadership, policy support and regulation at national level, and the expectation for innovative 'solutions' from localised responses with limited resources.

Williams et al (2013) present three potential local governance scenarios – one 'top-down', led by central government through policy and regulation and 'delivered' by local agencies to households, one 'middle-governed', led by local agencies with more financial resources and

greater remit to define supportive local policy, as well as a change in their role, which would move from advice and information provision to more active implementation, and a third as a 'bottom-up', householder-led scenario in which householders take control of their own retrofits which are interwoven with other home renovation processes, thus creating a greater demand for retrofit services and demand for how local agencies provide support for this. Whilst somewhat crude in the delineation between these three scenarios (more nuanced accounts of urban governance - of many issues besides climate - highlight the messiness and contingency of place-specific responses to energy issues - see Bulkeley and Schroeder, 2011 and North and Longhurst, 2013), these characterisations are helpful for starting to identify the shape of the network and the balance of roles in multi-stakeholder responses to domestic retrofit. This is valuable because one of the most important parts of this thesis is to examine the effects that these styles and forms of governing and organising retrofit may have had on the strategic decisions and priorities of the organisations and actors involved.

Incorporating greater attention to context

Hodson and Marvin (forthcoming) explore these different shapes of retrofit governance in the specific context of Manchester, not just in terms of domestic retrofit but also for infrastructure and energy system retrofits such as district heating and redesigned transport routes. They also explore the relationships and networks around these responses, outlining two broad kinds of governance responses: Retrofit *on* the city (similar to top-down responses), which is the dominant response and tends to be techno-economic and elitist in its network of stakeholders and interests, and retrofit *in* the city (more bottom-up responses) which were highly localised, grassroots, community-embedded responses that often struggled with capacity and resource. These were also often excluded from broader regional governance structures and processes. They offer a possibility for an alternative response: retrofit *with* the city. Retrofit 'with' responses would represent more networked, collaborative responses, focussing on the range and interests of the stakeholders involved, from those very local actors to those more connected with regional governance and those in national policy. This chimes with the middle-out form of governance identified by Williams et al (2013) and has some synergies with the ideas above about the importance of functioning, representative intermediaries in terms of inclusivity and connectedness.

What this typology is helpful for is in highlighting how the nature of relationships around the retrofit responses both between actors at the local level, and between actors at the local and national or even supranational level can affect their shape and form and the effects that the response has.

2.4 Conclusion and emerging questions

We have discussed the pressures on cities and activities within cities in terms of addressing carbon and energy related issues, of which retrofit is one. We have discussed how this often becomes amalgamated with economic concerns because these are one of the heaviest and most immediate landscape pressures of the contemporary time. We also illustrated a strong argument for how shifts in governance have resulted in two key trends: that of experimentation as a form of governance of these issues and that of uneven development, unevenness in the shape of responses and unevenness in the resources available to address these issues. We have also looked, through examples in the literature of grassroots sustainability or energy initiatives, at ways of identifying what it is about places and their features, networks and resources that makes these responses so uneven and context-specific. Rather than attaching this to a general trend resulting from landscape or macro-issues, it is important to look at the local processes, people and roles that produce different responses under different local circumstances even in the light of broadly similar landscape pressures. We also explored the tensions between localised responses and dominant macro-priorities in terms of producing knowledge and change, retaining their radical nature and being dependent on, or co-opted by policy processes through funding streams and vertical relationships. Finally, we have examined the problems and considerations in addressing retrofit outlined in the literature, from technical to financial, social and psychological, and the various ways that responses to retrofit can be organised, from top-down policy responses, to bottom-up community responses, and middle-out hybrid responses. We explored the kinds of organisations that might get involved with this and focussed on intermediaries whose intention is to bring together the various stakeholders and interests around retrofit in an urban area.

Having come to understand localised responses as experimental, acknowledging the role or potential of experiments or localised initiatives to generate change, this thesis seeks to understand how these initiatives came to be, what the challenges and dynamics are of

these projects and responses that are contingent upon the very context-specific factors connected to them, and how they approach the issue of domestic retrofit specifically.

A multitude of questions emerge from this exploration that can guide the requirements of the theoretical approach in the following chapter, and start to generate a set of themes to guide the analysis of the case study data about urban domestic retrofit experiments. In terms of a general framing, it starts to ask about what these cases might tell us about unevenness in urban responses, demonstrated through the differences between urban experiments and their organisation. Using the holistic approaches explored above, questions are also raised about how and why each retrofit 'experiment' approach and prioritise the different areas of the retrofit problem, from people and behaviour to technical issues and organisational approaches. From the grassroots niches literature encouraging considerations of context, people and agency, we might want to explore how local actors and organisations in terms of expertise or capacity contribute to the differences in place-based responses to sustainability and energy issues, and how the different interests of the organisations and networks involved have been contested and negotiated over time. We also might ask whether there is any evidence of co-option and limitation of the cases by dominant priorities and what this means for the effects and changes they can generate. It is the task of the theoretical framework to give a series of lenses through which to answer these questions and it is to that which we now turn.

Chapter 3 - Experimental assemblages: A hybrid theoretical framework for understanding urban domestic retrofit responses.

3.1 Introduction: Interactions between people, technologies, and the built environment.

This chapter will explore and synthesise a range of theoretical approaches into a framework which incorporates the range of overlapping themes and issues explored in the literature review. The literature review identified a number of themes and issues surrounding domestic retrofit in urban contexts. These ranged from the global or macro-societal issues of climate change, energy security and economic trends, to new forms of governance and spaces of activity. It outlined particular pressures on contemporary world cities, including interurban competition, resource constraint and being responsible for finding solutions to energy issues and highlighted, as a product of these pressures, a tendency towards urban experimentation and huge variation and unevenness in place-based responses. It also highlighted the contestation of social interests involved in these experiments and the context specific, situated and personal – even value based - nature of localised activities such as these, which can become co-opted into broader policy processes when they are held responsible for finding solutions to issues such as that of domestic retrofit.

Three key areas of particular relevance to domestic retrofit were also identified, in order to outline the kinds of issues that any place-specific response might have to tackle. Firstly, there are technical issues and risks with retrofit, from damp and poor workmanship, to inaccurate predictions of energy savings and inadequate surveying or design processes. Secondly, it highlighted the importance of understanding the role of behaviour, values and motivation for householders in enabling or preventing retrofit, exploring the range of factors involved in retrofit decision-making processes. Finally it outlined ways of understanding the organisation and governance of retrofit in cities, from top-down policy approaches to bottom-up grassroots approaches, and involving varying degrees of collaboration with local, national and individual actors.

The framework adopted must be able to accommodate all of these issues, from the macro, through the organisation of the issue and technical issues, to individuals and interests, politics and urban pressures. This is a broad and diverse set of issues and requires a framework that can bring a number of heavily researched complex areas in their own right into the same picture. It needs to allow an exploration of how these issues are manifest in policy, and how they are approached and tackled through the individual case studies and through their comparison.

The aims of this research are a) to understand how and why different kinds of domestic energy efficiency retrofit responses emerge in different urban contexts within the same national policy context and b) to understand how the landscape or 'macro-context' in which those responses both enables and limits the change that they can effect. In order to create a framework that is appropriate for this task it is important to first outline what it must achieve.

3.1.1 Requirements of the theoretical framework

As a starting point, it is clear from the range of themes emerging from the literature review that the research 'problem' is, as aforementioned, an inherently socio-technical one, but that it leans towards the social 'end' of the socio-technical continuum. Its focus is on the choices, interactions and desires of city-based networks of actors, organisations and institutions around the particular socio-technical problem of domestic retrofit. With this in mind, there are three components to this framework that are required to satisfy the research: 1) a **descriptive tool**, which seeks to capture and depict the many human and non-human elements of the socio-technical relations in each of the domestic retrofit initiatives; 2) an **explanatory framework**, which seeks to explain the differences between the initiatives as a product of their multi-level contexts and varying networked relationships and 3) a **critical perspective,** that can illuminate the dynamics between different sets of priorities and interests surrounding domestic retrofit, focussing on the policy environment as a source of both new opportunities for, and constraints on radical change.

A clear starting point emerging from the literature, though, is that the three case studies should be broadly framed in the following way:

- They present examples of urban experimentation, because they attempt to 'try out' in specific urban contexts, ways of responding to the particular issue of domestic retrofit, focussing on and producing different forms of knowledge for different purposes.
- We can use the varied ways that each case study approaches the domestic retrofit-specific technical issues, the facets involving people and individual behaviour and motives, and the organisational challenges and choices presented, to show how these trends manifest in practice, how geographically uneven results are produced, and how the macro-issues and landscape surrounding domestic retrofit in cities both enables and limits the possibilities emerging from the cases.

However, despite this starting point of accepting the case studies as representing some form of urban experimentation, which provides a loose framework from which to start, further conceptual work is needed. There is no single framework for understanding the socio-technical complexities of domestic retrofit in cities, with place relevance and particular attention to policy and economic context. The task here is to piece together helpful theoretical strands from different disciplines to create a hybrid theoretical framework that articulates and captures the different components of these urban experiments, in a way that the initial research aims can be addressed and answered.

3.2. Socio-technical relations

There are a number of theoretical strands that attempt to find ways of describing and explaining the relationships, interdependencies and entwinements of people and their behaviours and practices, institutions and organisations, with technologies and technological artefacts, and the peculiarities of these relationships and their many effects and influences in different contexts and situations. The three key strands: The social construction of technology, (SCOT), the social shaping of technology (SST) and actor-network theory (ANT) largely emerge from the science and technology studies (STS) tradition, and these together provide a broad base upon which to construct a descriptive tool for understanding.

3.2.1 Social Construction of Technology

Social Construction of Technology (SCOT) theory, introduced by Pinch and Bijker (1984), in "The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other" was initially generated as a response to what were perceived as narrow understandings of technological innovation and change – generally termed technological determinism. The premise of the SCOT perspective is that the emergence of technological products, or artefacts, could – and should – be explained by the social processes surrounding its construction rather than by the inherent technological characteristics of the artefact itself. Traditional notions of technological determinism are defined by a positivist attitude to knowledge that assumes scientific data to be absolutely 'true'. The SCOT approach, rather, assumes it to be socially constructed – essentially applying a principle from social constructivism to technological studies (Pinch and Bijker 1984). A number of examples were used to demonstrate this perspective in a series of theoretical and historical case study essays in Bijker et al's 'The Social Construction of Technological Systems' in 1987, such as the development of the lightbulb, the development of the air tyre for bicycles, and later the development of Bakelite (Bijker, 1997). SCOT theory highlights the personal and social forces surrounding the development of technology. The key concepts involved are:

1. Relevant social groups – different groups involved with the development of a technology, artefact or system. Meanings and interpretations vary between groups, and technologies, systems and artefacts are a product of negotiation until a point at which the artefact or system under consideration is deemed to meet the needs of all relevant social groups.
2. Interpretive flexibility –the process by which the above groups are able to determine different framings and outcomes of a technological issue. In the Bakelite example, there was, for example, a dispute over the patenting and development of a key chemical component of Bakelite, cellulose (Bijker, 1997), which was viewed differently by two different scientists, thus affecting the production of the final item.
3. Stabilization – this is when a particular technological option becomes more accepted in a relevant social group, normalising its presence and function. In the example of the bicycle, Bijker (1997, p93) talks about the reporting of the bicycle in an

engineering magazine which ceased to specify the type of bicycle, indicating that the word 'bicycle' denoted, without dispute, a *"low wheeled bicycle, with rear chain drive, diamond frame and air tyres"*. These details were now deemed 'normal', thus demonstrating stabilization.

4. Closure – different social groups attach a consistent meaning to the item, resulting in one 'obvious' solution, either achieved by 'rhetorical' closure, or by redefining the problem to suit the solution that has emerged, such as when air tyres on bicycles that started to win road races, modifying the problem definition to include racing and speed (Bijker, 1997). Closure is very difficult to reverse as it marks a widespread socio-psychological departure from a previous 'norm'.

By explaining technologies according to their social contexts using these four key concepts, SCOT advances the role of agency and the impact of both individual and group interpretations and negotiations upon a technological development. For understanding domestic retrofit in cities, what is helpful about these concepts is that they begin to bring together various heterogenous components of a socio-technical change process over time, incorporating social interests of individuals and groups, multiple interpretations of the same phenomena, key temporal events, an underlying challenge to the objectivity of scientific knowledge, and attention to the contexts in which decisions and developments are made. The concepts of stabilization and closure start to illuminate potential resistances to other technological options, which is a good starting point for studying the possibilities of and challenges to the kinds of experimental initiatives that form the case studies in this thesis.

However, when studying something such as domestic retrofit that has a multitude of technical components, from bricks and mortar to heating controls, insulation and microgeneration, rather than one particular component, the historical case study SCOT approach is less helpful and a somewhat wider perspective is required. Hughes's (1987) contribution approaches this by theorizing and analysing instead the social construction of large technological systems (the widespread adoption of the electric lightbulb), which not only incorporates the micro-activities of individual technologies and the peculiarities of decisions surrounding them, but also the economic and political circumstances surrounding

the item or system being developed along with all the other components of it, in a 'nested' hierarchy of systems and sub-systems. For example:

"people who build electric light and power systems invent and develop not only generators and transmission lines but also such organizational forms as electrical manufacturing and utility holding companies. Some broadly gifted and experienced system builders can invent hardware as well as organisations, but usually different persons take these responsibilities as the system evolves" (Hughes, in Pinch et al, 1987, p 52).

This quotation depicts a heterogenous network around electricity, but adds focus on the wider infrastructural developments surrounding that technology. However, despite its usefulness, SCOT theory is not without its criticisms. The late Stewart Russell responded to Pinch and Bijker's initial paper with a series of concerns over the deficiencies of the approach: firstly in its lack of attention to the politics of negotiations between 'relevant social groups' – highlighting the naïve assumption that all social groups were attributed the same status and degree of power and control. Winner (1993a) similarly highlights the lack of attention to voices of social groups, technological framings and social interests that were *not* considered. Both Winner (1993a) and Russell (1986) and later, Klein and Kleinman (2002) also warn of an overly 'localised' view of the process without adequate attention to wider political, cultural and social structures and processes that affect the various groups' interpretations, calling for a more critical position regarding the after-effects that these technological development processes may have on society. Callon (1987) also highlights the inherent assumptions that the political, economic and social circumstances and pressures on the development of technologies in the SCOT approach are static and predetermined, rather than dynamic and interdependent with the technology. Furthermore, there are connotations to Hughes' large technical 'systems' approach that imply a certain stability and boundedness that is difficult to define in practice, especially when researching a socio-technical issue that is emerging, rather than established (Russell and Williams, 2002).

In summary, as useful as the large systems approach and the contextual detail of SCOT are as a foundation, there is not enough criticism or consideration given to either the power dynamics at play surrounding socio-technical change, or the impacts and entwinement of the socio-technical artefact or system on and with the wider world. Furthermore, in the

case of domestic retrofit in cities, there remain two key issues: firstly, that there are so many technologies, actors, institutions and materials involved in domestic retrofit – as opposed to single technologies or systems - that it would be very difficult to track and account for all of them using a framework that uses technologies as its starting point. Secondly, the focus of this project is on the decisions, practices and organisation of people around a broad socio-technical issue *in a particular place*. SCOT does little to address socio-technical relations in places, and this is crucial to understanding the formation of domestic retrofit initiatives in the cities where they have emerged. Nonetheless, SCOT's approach generated momentum in STS which produced more nuanced and politically sensitive approaches, such as the Social Shaping of Technology approach explored next.

3.2.2 Social Shaping of Technology

Alongside the development of SCOT theory emerged a slightly different view of socio-technical developments, broadly termed the Social Shaping of Technology (SST) approach. SST is not a single method or approach but a collection of approaches that share common priorities: they are concerned with the socially produced form and content of technologies and processes of innovation from a political perspective (Edge and Williams, 1996). What distinguishes this approach from SCOT is its greater emphasis on the political, economic and social structures embodied in technologies and artefacts, and the mutually shaping effects that those can in turn have upon society (Mackenzie and Wajcman, 1985). This complements the internal relations that shape the development of artefacts, systems and technologies as emphasised in SCOT theory, arguing that those localised, internal processes are also shaped and constrained by external ones, so cannot be separated in analysis (Mackenzie and Wajcman, 1999). Langdon Winner's (1993b) article entitled "How technologies reweave the fabric of society" uses the example of the Clinton administration's approach to redeveloping infrastructures – specifically highways and ICT networks - in the United States. It shows how the narrowly constituted assumptions and attitudes of those in positions of power – the administration - about the functions and ends of those technologies and systems exerted significant changes affecting those who did not occupy positions of power – the citizenry.

Other SST advocates raise further socio-political issues in relation to technology and society. These include: Russell (1993) who adopted a broadly Marxist approach to his analysis of the

political shaping of decisions around technology, particularly when concerned with environmental issues; Wajcman (1991 and 2010) who adopted a feminist approach in her analysis of how male bias in socially constructed views of technology has shaped the perceived capabilities of men and women to use and develop technologies, particularly ICT, affecting work roles, practices and male-female power dynamics over time; and Mackenzie (1990) who highlighted the impact both at the time, and in terms of the technological trajectory of missile designs, of designers avoiding politically sensitive design options when developing U.S. submarine ballistics systems. Knut Sorensen (2004) and in conjunction with others (e.g. Gansmo, Lagesen and Sorensen, 2003) has been preoccupied with intersections between technology policy, culture and gender, particularly multimedia and ICT, and later sustainability and climate change and innovation, arguing that the role that the SST approach can play is in exposing the power dynamics in the development of new socio-technical systems and in doing so, helping to focus technology policy on protecting and nurturing more socially sensitive and democratic innovations.

In a similar way to SCOT, SST has been used to analyse both large socio-technical systems as well as localised, specific technologies or innovation processes. As Mackenzie and Wajcman (1999) argue, this is because whatever the 'size', the processes and dynamics are still between the social and the material, and are still embedded in particular contexts. They point to two particular case studies to illustrate this: firstly, Cerruzi's (2003) historical analysis of the development and widespread adoption of personal computing. This was shown to be the result of many parallel and enmeshed factors; the behaviour of the computing firm IBM, the development of programming languages, the political will of certain social groups to make computing more accessible and less exclusive to industries and corporations, political decisions around research and development funding in ICTs, and many others. The second case study, of Kranakis's (1997) analysis of the development of designs for a suspension bridge, documented the process by which two engineers in two different local contexts produced two different solutions to the same problem, because of different social structures and interactions such as the reward structure for professional engineering associations in different places. The contrast between the large system and the specific issue demonstrates the broad applicability of the SST approach.

The SCOT and SST approaches both reject of technological determinism, acknowledge a range of actors and factors involved in socio-technical developments, as well as the competing interests and priorities of different social groups at different levels. However, whilst there are many divergences even within the SST field alone, there are some common concepts and preoccupations that characterise the social shaping, rather than the social construction approach to technology and make it more appropriate for this particular research:

1. SST highlights the *mutual shaping* of society and technology, rather than one on the other, which is a key concept in terms of appreciating the effects that the domestic retrofit initiatives are intended to have, have had, or may have, upon the people and places involved in them.
2. SST is more concerned with the choices in and *negotiability* of socio-technical developments, whether they were selected or not, and how those embody contextual political and power dynamics, both locally and in a broader sense. As Edge and Williams (1996, p866) term it, technological innovation under the SST approach is *"a garden of forking paths".* This begins to provide an explanatory element to understanding why different domestic retrofit responses may have emerged in different English cities.
3. Alongside the acknowledgement that socio-technical developments are negotiated, non-linear and are a result of more than one factor or actor, there is a greater appreciation of the constraints upon choices and change, as a result of political contexts. This aids our understanding of how the policy context and its particularities shape and direct the decisions made at individual levels within the formation of the domestic retrofit initiatives.
4. Similarly, there is greater focus on the irreversible effects of lock-in to particular choices once they are made and a particular technological trajectory has been adopted – not necessarily because that path is 'the best', but because of historical events or the 'success breeds success' phenomenon. This again has a political dimension in both its construction and its effects (Russell and Williams, 2002 and Edge and Williams, 1996), and addresses issues around why radical changes could be less accepted beyond the initial experimental stage of the domestic retrofit

initiatives under question, or why certain more conservative choices may be made within those initiatives.

5. The range of SST-based studies identify a number of socio-technical relationships that shape, direct and constrain change, which connect well with the broad pressures identified in chapters 1 and 2. These include relationships between technological development and the state, the economy and the different organisations that coalesce around it, and how these relate to different knowledge priorities (Edge and Williams, 1996, Mackenzie and Wajcman (1999) and Russell and Williams, 2002).
6. SST has been particularly commandeered by those interested in 'innovation', that is: technologies, artefacts or systems at the beginning of their development, whether that be green 'niche' technologies, or industrial innovations (see Vergragt, 1988, Kemp et al, 1998, and Jorgensen and Jorgensen, 2009a and 2009b) As a result, it has focussed on the different routes and paths that innovations can take, which can have significantly different outcomes and effects both technologically and socially for different groups of society (Edge and Williams, 1996). If we understand innovation as experimental and novel responses to a particular 'problem', we can see how this perspective might highlight the different options and opportunities that these responses might face and negotiate in their creation.

For this research on domestic retrofit in cities, the increased focus of SST perspectives on the political context of the construction of, and responses to socio-technical issues, is most welcome. One of the goals of the research is to examine why such different responses to an issue that has been constructed by global and national priorities have emerged in different local contexts, and in order to do this a framework is required that can address the interactions between the local interactions and processes and their entanglement with national and global priorities and issues, and SST goes some way to providing this. It is also useful to delineate the aspects of socio-technical innovations in terms of contributing factors and relationships, as well as in terms of the different directions, forms, outcomes and impacts that these innovations may have, both during their development, and once they are established. However, there have been criticisms of the SST approach, there are alternatives, and there have been more recent developments and embodiments of it in

newer theoretical frameworks. Mackay and Gillespie (1992) identified what they felt to be a lack of attention on the appropriation or use of the technologies as part of the story, particularly in relation to domestic technologies, which is a relevant and important point. They also point out a lack of attention to marketing and semiotics around certain technological artefacts, and a lack of attention to ideologies as the foundations that shape choices and expectations during the innovation process. Furthermore, there is still an issue with the multiplicity of socio-technical elements to domestic retrofit – none of which have priority over the other in a holistic study of this nature (and in fact it is the multiplicity that defines this socio-technical problem in this particular way), as well as the distinct lack of place sensitivity and focus on the peculiarities of urban contexts that has not been addressed by either the SCOT or the SST approaches.

3.2.3 Actor Network Theory

Another overlapping strain of STS-based socio-technical analysis is Actor Network Theory (ANT), originating from Bruno Latour (1987) and Michael Callon (1986), who proposed that the traditional sociological conceptualisation of the 'social' world as a static, separate material or component of the world was a mistake, ignoring the dynamic nature of interactions between human and non-human elements, associations and materials that together constitute the social world. Actor-Network Theory, whilst overlapping considerably with both SCOT and SST, offers something slightly different. It does not attempt to delineate between people and things – giving equal status to both human and non-human actors through the principle of 'generalized symmetry' and the effects that both can have upon the world and upon each other, through attributing value and meaning to people, things, and the dynamics between the two. Law (2009) describes this as 'material-semiotic' – as in concerned with both things and concepts simultaneously.

As Bijker and Law (1992, p3) illustrate: *"our communication with one another is mediated by a network of objects -- the computer, the paper, the printing press. And it is also mediated by networks of objects-and-people, such as the postal system. The argument is that these various networks participate in the social. They shape it."*

Initially focussing upon nature as an assemblage of human and non-human factors, but later developed by others to incorporate elements of the built environment as equal 'actants' in

a network of components that make up a place, a phenomenon, a social world, ANT, with its roots in Science and Technology Studies, begins to give rise to a much more textured and dynamic depiction of the location and identity of people, ideas and behaviours in their environments. Actors are defined by the networks – material, human and semiotic, to which they belong, and in this way act together as a network (Law, 1992 and Callon, 1986). It is an inherently post-structural approach, describing a dynamic and constantly changing scenario with little intention or capability to explain rather than biographically describe the configuration of actants or the implications of this particular configuration (Law, 2009).

One of Latour's biggest gripes with the notion of 'the social' or 'society' as a disaggregated, static phenomenon is that it ignores the dynamism and constant remaking of any local interaction and it assumes that there is some boundary around that interaction. In his view,

"it is perfectly true to say that any given interaction seems to overflow with elements which are already in the situation, coming from some other time, some other place, and generated by some other agency". (Latour, 2005, p166)

One of the original propositions of Actor Network Theory was the idea of allowing global (macro) and local (micro) actors and factors to be considered in the same way when researching a particular interaction or situation (Latour, 1987, Law, 1992, Callon, 1986). This chimes with Hughes's ideas of nested systems, although ANT differs in its dogmatic refusal to separate people from things. When considering the range of actors, factors and influences in something as complicated as a small domestic retrofit initiative in and English city, what is valuable about this idea is that rather than picking a scale or social 'level' to research the problem at, the Actor Network incorporates multiple scales. Law's (1992) study into the development of a new military aircraft in Britain in the 1960's demonstrates how political changes, technical failures, balances between local and global networks of resources and some particular convergences of all of these things, politicised the aircraft's development, modified confidence and localised decision making, and ultimately led to the dissolution of the project. The lack of separation of scales, technology and people in this way allows a framework that can incorporate global, national, local, individual factors which is compatible with the blurred and indistinct relations between actors at different scales that we find in the multi-level governance of retrofitting modern cities.

Key concepts of Actor Network Theory are:

1. Flattening the social – the process of incorporating multi-scalar actants and dynamics into the same network without separating them.
2. Actants – the name given to a component in an actor-network, which can include both humans and non-humans.
3. Translation – attributing value and meaning to a technological system or phenomenon that affects the choices that can be made. According to Callon (1986) these had different stages or 'passage points', and in innovation-based studies, these can be also considered as important 'temporal events' (Vergragt, 1988).
4. Mediation – the passing on of that meaning and modification of translation through the interpretation and actions of other actants (Latour, 2005)
5. Intermediation – the passing on of that meaning without modification (Latour, 2005).

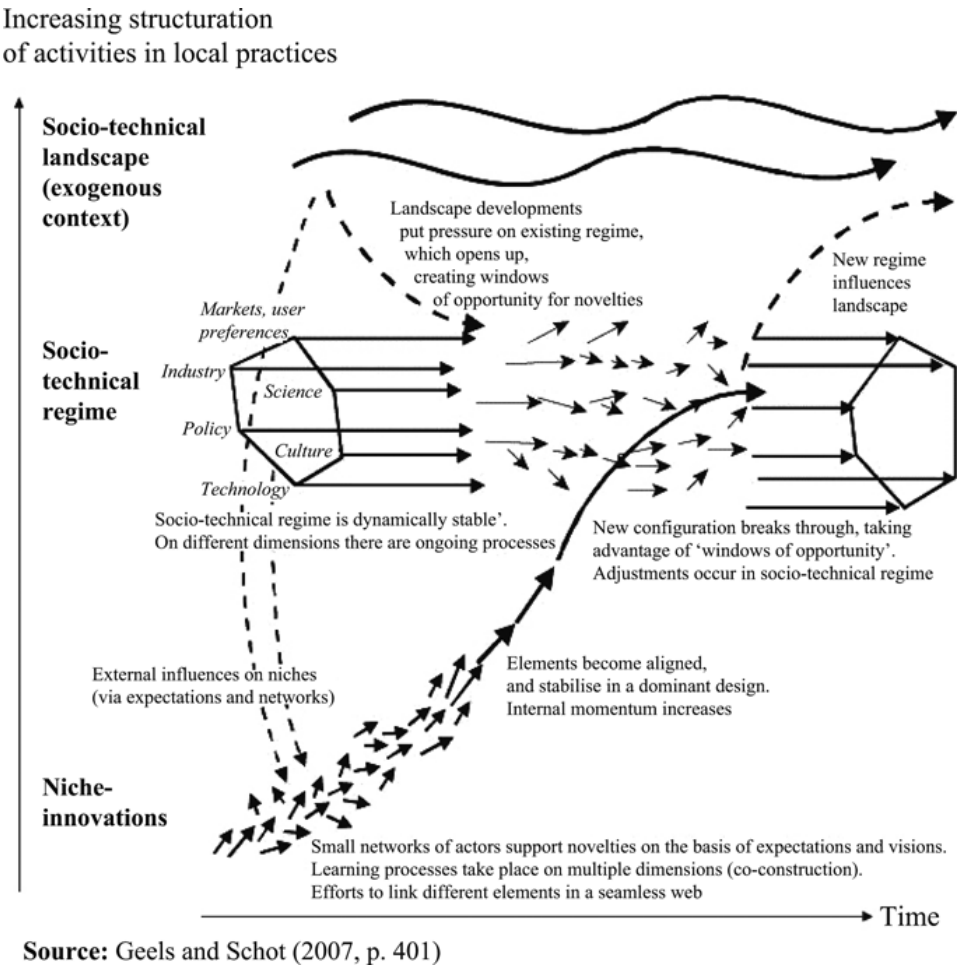
The proposition of merging 'actors' with 'context', flattening scales, and identifying key decisions and points on the journey of an actor-network at first glance may seem helpful and offer a politicised and power-dynamics sensitive approach to understanding socio-technical relations. However, it may be viewed that ANT is concerned with capturing instances: moments in a process of constant socio-technical change, and that the impacts of - and effects upon - more stable and obdurate contextual power dynamics that these moments sit within could be missed if there is too much separation from context. Also, by flattening and equalising the human and non-human agents one could be forgiven for thinking that material 'things' or artefacts, in this theory, have as much agency as people, which ignores the cognitive 'intentionality' of human actors as opposed to material ones: a strong source of criticism of ANT (See Murdoch, 1997, 1998 and 2001 and Whittle and Spicer, 2008). Murdoch (2001) also points out that the significant difference between the status of humans and non-humans is that of possessing powers of reflection, language and motivation that non-humans do not.

3.3. Articulating socio-technical relations

The three broad themes above have spawned in contemporary socio-technical research a number of different articulations of the relations between people and things in more recent research and theoretical debates including socio-technical webs, ensembles, networks, systems and configurations, which are all terms that are used to describe very similar things, but sometimes with different emphases. What is important here is to piece together the relevant and useful parts of these articulations to capture what it is that the domestic retrofit initiatives in different English cities embody, and tell us about socio-technical issues in cities.

3.3.1 The Multi-level perspective on socio-technical transitions

The multi-level perspective (MLP) on socio-technical transitions is one of the more recent articulations on socio-technical relations, that incorporates macro-factors, localised factors, a range of human and non-human factors and also focuses on the process of transition – i.e. gradual and incremental change to socio-technical systems over time. It attempts to deal with the constant batting between socio-technical approaches that focus on structure (SST) and those that focus on agency (ANT) by combining the two into one framework (Coenen et al, 2012).



Source: Geels and Schot (2007, p. 401)

Figure 7 The multi-level perspective on socio-technical change

It does this through the systematic analysis of a range of processes at three 'levels' (see Fig. 7): the 'landscape' – broad macro-societal configurations, the 'regime' – a stable set of existing configurations of people, technologies, governance structures and so forth that are established around a particular socio-technical issue, and 'niches' or 'niche innovations' which are localised, small –scale socio-technical experiments that provide potential alternatives to the existing 'regime' (Geels, 2002, 2005 and Geels and Schot, 2007).

The idea behind these three levels is that when changes in the landscape combine with the emergence of viable niches, the existing regime can be altered and a new stable norm achieved. A vast array of case studies of socio-technical transitions have been conducted using the MLP, from transitions from paper to email, from mixed farming to pig husbandry, and from sail boats to engine ships, but of particular relevance to this research because of its focus on sustainability and low carbon issues, is Verbong and Geels' (2007) case study of the transition of the Dutch energy system. It paints a picture of the changes and similarities

in key figures and actors in the energy system regime between the 1970s and the present day, investigates the visions that have changed over time, the drivers of a 'co-evolutionary', incremental transition which they claim is underway, and identify support for niche alternatives such as CHP and changes in the supply of electricity in a liberalised market as key factors in positive changes towards a more sustainable system. It also, however, highlights primary drivers for transitions in the electricity system as being Europeanisation and liberalisation rather than environmental concerns, and the resistance that this provides to radical shifts towards sustainability.

The MLP, with its focus on 'systemic' change being achieved through a change in the regime, provides an understanding of the difficulties in changing established, obdurate socio-technical norms, by acknowledging the issues of lock-in and path dependency (Geels, 2002, Sims, 2012 and Graham and Thrift, 2007). This is potentially helpful for assessing whether domestic retrofit schemes actually contribute to low carbon transitions, or preserve the current norms, by establishing the kinds of effects that each case study has on existing configurations around energy efficiency. It is also particularly helpful that the perspective is well established as a lens through which to view efforts towards sustainability and low carbon futures, and indeed has been used in specific relation to domestic retrofit: Swan (2013) used the MLP to firstly establish an existing energy efficiency regime (See Fig. 8) and secondly, to investigate innovation processes in domestic retrofit in social housing, finding that often domestic retrofit innovations were conservative or piecemeal rather than 'radical', because of the complexity of the issue and the existing regime, effects of lock-in, risk, and the policy climate they were acting in. He also found that innovations formed in networks rather than in isolation, as different niches worked on different parts of the problem such as financing, technical issues, behavioural change and so on, concluding that radical and speedy transformation of the existing domestic energy system would be unlikely.

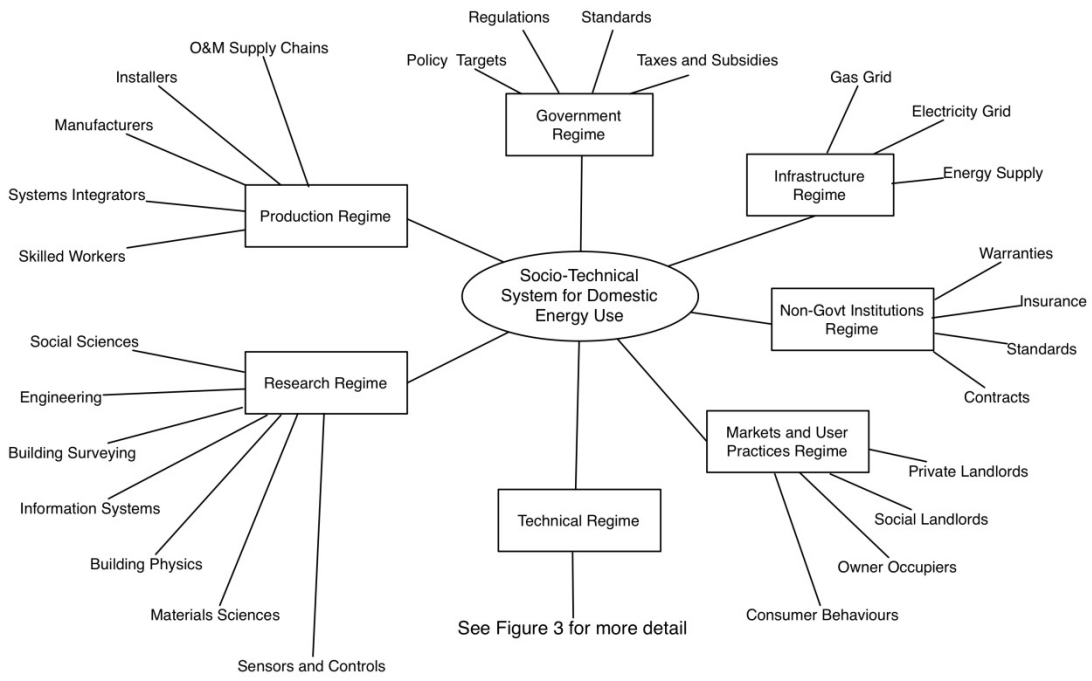


Figure 8 The socio-technical system for domestic energy use (Swan, 2013, p 41)

The MLP and related literature also provides a very useful differentiation between three different kinds of change processes: transformation, reproduction and transition (Geels and Kemp, 2007). Geels and Schot (2007) also differentiated between different transition pathways, from transformation, technological substitution, reconfiguration and de-alignment/realignment. These relate specifically to transitions, however, and also to more specific systems or technologies than the broader change processes in the first example. What both typologies have in common, though, is an appreciation of different components of change – directions, degrees and speeds, and different distributions of agency and power among the levels in terms of the changes generated. So a transformation – a change in direction - is likely to originate from a wholesale change in rules from within the regime than a reproduction, which changes incrementally, but along the same trajectory. A transition on the other hand results from a combination of landscape and niche pressures and regime shifts – as previously described. (see Table 2 below)

	Reproduction	Transformation	Transition
Levels involved	Regime dynamics	Pressure from landscape Adaptation and reorientation in regime	Pressure from landscape Increasing problems in regime, and attempts at re-orientation New innovation in niches that eventually break through
Role of actors	Incumbent regime actors	Pressure from outsiders Incumbent regime actors respond through re-orienting innovative trajectories	Pressure from outsiders Incumbent actors fail to solve regime problems Outsiders develop new innovations

Table 2 - Different mechanisms in change processes.

(Adapted from Geels and Schot (2007) p414)

However, the MLP has been criticised for placing heavy expectation upon niches alone to generate transitions, being too heavily focussed on technological rather than social innovation, and encouraging assumptions that transitions can be actively stimulated and/or managed (Shove and Walker, 2007 and Smith et al, 2010). It is also less helpful for understanding place-based transitions, due to a distinct lack of context-sensitivity, little clarity on spatial boundaries of landscapes, regimes and niches, or where cities fit in, and has been accused of being inherently apolitical (Smith et al, 2010, Hodson and Marvin, 2012, and Bulkeley, 2005). In later years the perspective has developed a greater sensitivity to political economy (Geels, 2010 and 2014), which acknowledges that the influences of dominant and vested interests often prevent meaningful systemic change because different forms of power from material and instrumental, to discursive and institutional, help to reinforce existing norms, habits and practices that preserve those interests – usually economic ones. The MLP is still lacking awareness of place (Coenen et al, 2012) in particular of cities, apart from as loci for experimental niches (Geels, in Bulkeley et al, 2011). Debates using the MLP in relation to cities as being part of, or enacting for themselves, low carbon

transitions (Hodson and Marvin, 2010 and Bulkeley et al, 2011) tend to focus on the processes of constructing visions and intermediaries that are specifically designed to enact these transitions and the voices and priorities that are or aren't included in these processes. This is a necessary component of the MLP analysis, particularly when investigating configurations of interests around socio-technical issues in cities, but it still finds place-based studies somewhat incompatible with literal applications of the MLP: regimes can be both national and regional, or indeed multi-scalar, and niches (despite the impression of being 'small') have no spatial limits (Smith et al, 2010, and Shove and Walker, 2007). Notions of space and scale as being politically or socio-technically constructed or – crucially – of that construction being relevant to the transition process, are also notably absent.

Nonetheless, the MLP provides many helpful concepts, encouraging a generally multi-level approach, and in particular introducing the concept of the 'landscape' to capture the broad pressures on domestic energy efficiency schemes and how they impact particular city contexts. It also is helpful for exploring different forms of sociotechnical change, and especially for exploring resistances and obstacles to change. Swan's (2013) findings that innovations and processes of decision making in social housing retrofits were conservative and piecemeal are helpful for articulating these effects on particular projects, and relating them to the issues of co-option and dependency emerging from the literature review. Furthermore, the concept of the niche experiment captures many of the experimental characteristics of the case study initiatives in this thesis. It is clear that, whilst working in an extremely similar area, the three case studies had very different ideas about the function of their experimental activities, with different kinds of relations between local actors, corporations, national policy and international issues/organisations. There is therefore a need to explore further the particular characteristics of niche experiments and their potential role in providing explanatory power to this framework.

3.4. Incorporating attention to context and people – paying closer attention to niche experiments.

Having acknowledged that the case studies are experimental and are therefore closely associated with the 'niche' concept of the MLP body of research, but that there is a lack of space, place and conceptual awareness in the MLP, it is wise to explore examples, different forms and elements of 'niches' and their roles in change processes, and then to focus on how people, place and politics affect these roles.

Holm et al (2011) for example, use a variety of localised construction experiments in green building technologies in different places across a region in Denmark to represent 'transition places' with different orientations, foci and forms of knowledge being produced. Their focus on different parts of the construction, energy efficiency and housing issue was a product of dynamics at the regional level as well as the individual and organisational expertise available in each 'niche experiment'. The embeddedness of the experiments in places presented a 'real-life' demonstration of the challenges and successes of actual attempts to manage a transition.

However, there is still a lack of acknowledgement of particular people and their views and motives as part of this view of niche experiments. Hielscher, Seyfang and Smith (in Cohen et al, 2013) highlight ideology as a key aspect of grassroots innovations for sustainable energy, demonstrating that many innovative projects are based on 'alternative' visions of economic life, such as new economics, rather than the mainstream. Part of what makes grassroots innovations successful within their contexts is the opportunity for people to engage practically with something that allows them to express these ideologies, so their importance cannot be underplayed (Hielscher et al, 2013). They also highlight an oversimplified relationship between niches and regimes in the MLP and call for a more pluralised account that acknowledges the learning processes involved and the complexity of this relationship. Geels and Raven (2006, see Fig 9 below) produced a particular conceptualisation of the local processes surrounding niches below, that shows – in an ideal world – the aggregation of different forms of learning from these local niches as part of a wider change process that actually produces a change in technological trajectory. Whilst this research is <u>not</u> aiming to track the process of technological developments or trajectories of singular technologies in the field of domestic retrofit - solid wall insulation for example - this concept of an

aggregation of learning from local processes is helpful. Firstly it highlights the variation in local initiatives and different forms of knowledge that they can produce. Secondly, it encourages thinking about where the localised knowledge and learning from these initiatives goes and what it might contribute to in terms of wider processes of change, and secondly it highlights the presence of a wider community or field constituted by interests, expectations and ideas about a particular topic, as a potential destination for this knowledge.

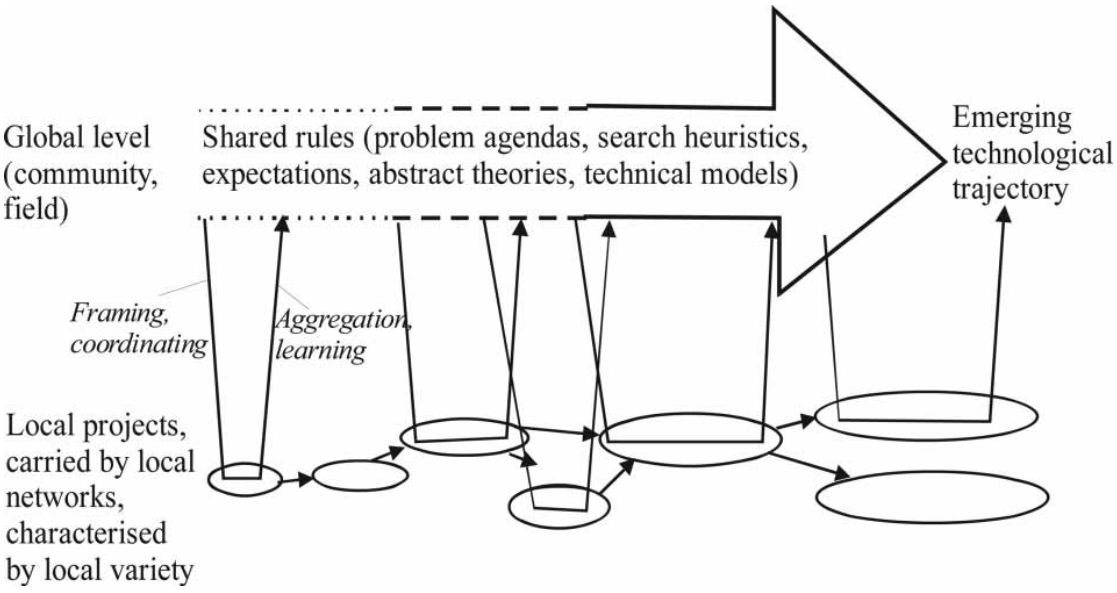


Figure 9 How local projects affect technological trajectories.

From Geels and Raven, 2006, p379

Similarly, Seyfang and Haxeltine (2012) and Seyfang and Smith (2007) view community-based, grassroots innovations as particularly socially innovative: part of a civil society and 'action-oriented' framework, rather than focussing on their role in markets, systems and technological innovation processes. This also draws attention to tacit social knowledge as a key aspect of these experiments alongside technical knowledge. Like Smith and Raven (2012) they highlight the need to investigate internal niche processes in order to understand identity and group formation and the effects that these have on the shape and impacts of the innovations, and therefore whether niches are effective, survive or not, and how they relate to more mainstream practices.

Smith and Raven (2012) do this by exploring the particular dynamics within and around niches that can create a 'protective space' around the experiment, which enables it to

'break through' into an established regime, usually depending on relationships with higher level powerful actors and institutions. They articulate this protection in three steps: nurturing a niche development through providing time, intellectual and financial resource, shielding it from 'selection pressures', and finally through empowering it to grow and establish itself as part of mainstream activity in its field, be that energy, transport, or other industries. This pays close attention to the politics surrounding the development of niche experiments, such as the narratives and discourses used to generate priorities, visions and decision-making, as well as the active or passive nature of that protected space: for example the strategic niche management approaches of subsidising particular technologies like solar PV is an actively protective space, whereas an experiment with new fuels for heating in a location that is off-grid anyway would be a passively protective space (Smith and Raven, 2012). These dynamics link to the nature of relationships between the experiment and its wider context – i.e. vertical relationships – which can make a difference to the nature of the innovation and experimentation and therefore to the outcomes and effects it may have (Raven et al, 2015). Furthermore, they found that the nature of these spaces and the internal dynamics and visions of niches result in a process whereby they either 'fit and conform' to the competitive environment around them (in which established norms and practices remain unchanged and unchallenged by the development of that niche), or they 'stretch and transform' – instead making changes to the established norms of production and consumption around them (Smith and Raven, 2012). These concepts help to highlight the pressures and compromises involved in niche development processes, illuminating in detail the dangers of dilution and co-option raised in the literature review and the 'socio-political work' needed to change incumbent regimes and ways of doing things in order for niche experiments to have any significant effects (Raven et al, 2015).

Whilst the concept of the 'niche' is extremely helpful, it is not the only way of viewing localised socio-technical interventions. A similar, contributing perspective is the idea of the Bounded Socio-technical experiment or BSTE, proposed by Brown et al and Brown and Vergragt (2003 and 2008). In this perspective, a BSTE is a purposive attempt to generate change and create something new, whereas niches can be either passively or actively involved in change processes. A BSTE can be defined as:

"an attempt to introduce new technology or service, on a scale bounded in space and time" (Brown and Vergragt, 2008, p112)

It is recognised explicitly that the activity is experimental, focuses on trying out innovative ways of solving larger societal issues rather than context specific issues, through a particular configuration of people and technology or materials, and through 'learning by doing'. Brown and Vergragt articulate three potential elements of a successful BSTE:

- That it "creates a functioning, socially-embedded new configuration of technology or service" that is then replicated elsewhere.
- That there is 'higher order' learning among the participants in terms of re-evaluating their view of the societal issues and needs (e.g. working towards a sustainable society) that the experiment addresses and/or their role in addressing these issues.
- That there is a change in interpretive frames or problem definitions in either the 'users' of the service or technology, e.g. being more open to using new domestic energy technologies, or the community of practice surrounding it, e.g. builders and designers changing design principles.

These successful elements of BSTEs contribute to specific ways of understanding or tracing how niches or experiments may influence wider processes in different ways, e.g. through replication, learning in participants, or changing practices.

They identify four cognitive levels that they use to articulate the differences in approaches and perspectives between the participants in a BSTE (in this case the design of a zero-carbon building): problem solving, problem definition, dominant interpretive frames (ways of viewing the problem, usually defined by experience) and the worldview (an ideal view of what is possible and who is responsible for acting).

These categories are primarily ways of capturing the different ways that actors – in this case those actors being individuals – can approach the same issue in the same project. These are helpful because they relate to the issues raised in the literature review about the ideologies behind niche or grassroots level initiatives, and how these may differ from ideologies at higher levels in state organisations at larger scales, with different priorities, again linking to processes of negotiation and compromise and the significance of the relationships in and

around the experiment for this. These also present another way of adding detail to the 'internal dynamics' of niches, and exploring the ideologies and group/identity formation highlighted by Hieschler et al (2013) and Seyfang et al (2013) above. This perspective is helpful because it addresses the built environment specifically and situates niche experiments in places and spaces with clear ways of looking at the impacts and effects which have been so heavily debated in the literature on niches above.

What these socio-politically focussed approaches to niche experiments and BSTEs do is threefold: firstly they call for greater focus on the internal dynamics of niches and the relationships that construct them in their particular ways. Secondly, they advocate a more fluid, contextualised and politicised account of the relationship between niches and established socio-technical configurations, in order to better understand the possibilities for and resistances to change, and the outcomes of different experiments. Finally, they pay attention to the ideologies and problem definitions of individuals involved in the internal decisions about the forms that these experiments and initiatives might take.

3.5. Incorporating the urban dimension – assemblage and space.

Up to now, this theoretical journey has focussed almost exclusively on the socio-technical relations, components and variants of these perspectives and processes of change. What has not yet been satisfied, however, is the need to focus specifically on the urban – as the context in which the case studies are situated.

In order to develop this, there are various literatures. Critical urban theorists such as Brenner (2009) Marcuse (2009) Massey (2005 and 2007) and Harvey (2005) view developments in the built environment predominantly through the lenses of capital accumulation and power divisions. The political construction of space and place are, to them, a result of redefined relationships between cities, and between states and cities, in which state roles, boundaries and governance structures relating to cities are being shaped by global circuits of capital and competition for investment in urban regions and places. The political economy of capitalism should not be ignored, because it is undoubtedly a huge 'landscape' influence upon activities in cities, but these perspectives generally offer less help when investigating the details and interactions in an urban environment around a socio-technical issue as complex as domestic retrofit, which Latour (2005) warns leads

sociologists' attention away from local interactions to search instead for grand explanations for why things are the way they are, distancing themselves from the phenomena under question. Conceptions of urban socio-technical relations that have a political leaning, but are more empirically rooted, include the Splintered Urbanism theory (Graham and Marvin, 2001) which introduced the idea of segmented and unequally positioned social groups within cities as a result of infrastructural arrangements – privileging upper classes in terms of access to services and excluding poorer communities in literal, physical and political ways simultaneously. This begins to align the situatedness that we now understand as being integral to the localised experiment, with broader political issues around inequality and representation in urban contexts.

Probably the most helpful of recent theoretical literature – a partial derivative of both splintered urbanism and actor network theory - is the urban assemblage literature (McFarlane, 2011, 2011a 2011b and Farias and Bender, 2012, and Dovey, 2011), which seeks to conceptualise the city as a loose and dynamic configuration of both human and non-human actors that constitute activities and practices in and on the built environment in some way. This is partly a specifically urban-focussed application of Actor Network Theory, but it also has elements of relational geography and critical urbanism entwined in it.

Assemblage thinking is based on notions that there can be multiple imaginaries of the same city that come into contact with each other, sometimes in conflict, sometimes in harmony and sometimes through a struggle. Relational geography refers to a particular way of viewing places – and in particular cities – not as defined by their delineated municipal boundaries, or by the edges of their built-up areas, but by the networks and relationships that constitute them:

"The city exists in, and manifests, a condition of relationality that defies territorial depiction" Jacobs (2012, p412).

Hodson and Marvin (2011, p109) argue that viewing space and place more relationally allows a greater appreciation of the *"dynamism involved in actively making and remaking space"* specifically related to the governing of cities, their infrastructures and their technical and material resources. However, North (2010) and Rutherford and Coutard (2014) warn against a too heavily relational view of space, arguing that although space is somewhat

socially constructed, it is still closely entwined with material forms. This helps in understanding urban domestic retrofit initiatives as a 'space' of activity constructed through the relationships between people and organisations, as well as the physical, built, fixed elements of the housing on which it actually works.

What is also helpful about the term 'assemblage' rather than 'system' or 'regime', when referring to the socio-technical relations defining an urban 'problem' is its openness and dynamism: urban assemblages in the way that McFarlane (2011a and 2011b) and Farias (2011) conceptualise them allow a view of how various activities, practices and experiences of a city can become entangled with one another, whereas socio-technical systems and regimes have an impression of being fixed and stable:

"an ontological reading of the city as assemblage underlines the potential of viewing assemblage thinking as both a process of assembling urbanisms through multiple socio-material histories and processes, and a name for particular urban objects—from policy and housing to social movements and infrastructure: the urban world, in short, composed by a series of overlapping socio-material assemblages." McFarlane (2011b, p377)

This openness and overlapping is appropriate when researching a problem that is still emerging and is constantly changing as a policy agenda, that is at an experimental stage in terms of its activity in cities, and around which relationships are constantly evolving between scales, within scales and between and within places.

Furthermore, it also allows an incorporation – like ANT – of both the micro-conditions in which the domestic retrofit initiatives have emerged, as well as the macro contexts – the 'landscape' in the MLP – within a place specific framework. McFarlane (2011a) acknowledges that there are multiple interpretations of assemblage as a term, but what is really important about his version, as supported by Dovey (2011), is the way in which he uses specific contexts, sites, and issues both to tell a story about that place, and to illustrate wider struggles and processes. In response to criticism from critical urban theorists, who argued that assemblage and critical theory could not be combined because of the ignorance of political economy (termed the 'context of contexts') in such site-specific studies (see Brenner et al, 2011) McFarlane argues:

"The context of contexts is produced and brought into question through assemblages, including assemblages that produce policy or modes of economic disinvestment, or the enactment of policy through different milieu, or mobilisation around iniquitous forms of policy or development in city streets and cyberspace. Understanding multiple sites allows us to see how the ordering of urban life operates across differences and enables certain possibilities over others". (McFarlane, 2011b, p385).

What is so valuable about this statement is that it begins to develop the explanatory part of our framework, moving beyond the descriptive and biographical and into the realms of using differences between context-specific assemblages for meaningful comparison. Farias (2011) and McFarlane (2011b) both feel that despite the criticism of critical urban theorists, assemblage as a process rather than a static entity allows an open exploration of the urban, through concentrating on the micro-interactions and practices of particular sites and networks, and of the real experiences of specific urban contexts and wider political pressures, without assuming a position on the effects of capitalism beforehand. This is termed 'thick description' and an example is of the destruction and reconstruction of water supplies to informal settlements in Mumbai (McFarlane, 2011b) in which the state acted as destroyer of illegal water connections and facilitator of new arrangements in which they held much greater power, mobilising large corporations and local slum dwelling women as labourers to reconstruct water supplies whilst selling them water from neighbouring villages. This illustrates both the site specifics and awareness of and sensitivity to general issues around state power.

Key concepts and themes in urban assemblage include:

1. The object of study being the place and its networks, not capitalism, whilst still accommodating the impacts of the political economy of neoliberal capitalism through the socio-material history of the site under investigation (Farias and Bender, 2012, Farias, 2011 and McFarlane, 2011a).
2. The explanatory concept of "immanent causality": that the causes of the construction of different assemblages take place within the assemblage not above it, but that relations with external factors are part of that causality. This chimes with

earlier points about the importance of both vertical and horizontal relationships in shaping the form, function and effects of grassroots initiatves.

3. "Relations of exteriority" (Anderson et al, 2012) that a 'thing' or a component of the assemblage is conditioned by, but not determined by its relations, but that those relations have a unique autonomy as a collective. This concept is similar to 'the sum of parts is greater than the whole'. Assemblages can in this way explain actions and impacts and change as a result of the connections and disconnections that characterise them, as well as the individual characteristics of the component parts.
4. Distributed agency (McFarlane, 2011a) refers to the idea that in a network, agency is not attributed to one central actor but is contingent on the other parts of that network. Agency is not always distributed evenly, between both human and material elements of the assemblage, and this unevenness produces unique capacities and capabilities for action.
5. Capacity to act – as a product of distributed agency, when referring to the resources and capabilities of actors, this refers both to capacities generated from interactions and the capacities of the component parts of the assemblage (McFarlane, 2011a)
6. "Territory" as an 'alignment of connections' as well as a 'hardening of boundaries' (Dovey, 2011). This incorporates elements of relational space as well as the fixed physical aspects of urban contexts, and can include and exclude.
7. "Imaginaries" of the city (McFarlane, 2011a and Dovey, 2011) being the lived experiences of the city by different actors and different assemblages, and these imaginaries can overlap or be quite different even within the same place. This can result in different territories, different relationships between formal and informal elements of socio-technical assemblages, and different relationships with wider political processes.

3.6 Connecting concepts with urban experiments

It is important at this juncture to link together the theoretical perspectives on experimentation offered by the MLP and niches above, with the urban context-sensitivity and embrace of complexity and contingency offered by assemblage theory. Returning to the theme of urban experimentation explored in the literature review we should remind ourselves that this idea represents a contemporary urban trend, offering a broad framework

within which these two perspectives can be combined to capture the nuances of domestic retrofit in places. A reminder of the key themes of urban laboratories and experiments shows us that they exhibit the following features, which dovetail nicely with the theoretical propositions of the MLP, niches and assemblage theory.

- Situatedness – as part of a place and as part of a wider context.
- Contingency on place and temporal events – acknowledging the messiness of urban change and the specific configurations of people and things in a particular place – this chimes with both assemblage theory and grassroots approaches, acknowledging the human, material and place-specific elements of domestic retrofit in cities.
- Change orientation and explicitly attempting to produce knowledge for a particular purpose – this has both political aspect in terms of the range of interests involved, what part of the socio-technical problem experiments are trying to address, and what kinds of change they wish to occur – linking to forms of change from the MLP.
- Situated outside of 'formal' policy processes – urban experiments are not simply enacting or delivering policy or regulation according to an established process – similar to the 'alternative' nature of grassroots initiatives.

3.7. Understanding urban retrofit initiatives as 'experimental assemblages'.

The task of this framework was to describe and articulate the domestic retrofit responses in their urban contexts, explain their differences, and critique the processes surrounding them. In this respect, the question is: what are they cases of? As a result of the above exploration, it seems that the most appropriate way to conceptualise the responses in their entirety is to describe them as experimental assemblages, which incorporates the impact of landscape issues, relationships at and between different levels and scales, with an understanding of experimentation and change.

3.7.1 Big picture, networks and synthesis thinking

There are two steps to the conceptual framework that shall be used to analyse the case studies and generate discussion around the literature review themes. The first is a descriptive network diagram which captures who and what is involved in the case, or

assemblage. The second is an explanatory framework which explains why the case turned out the way it did, based on the factors described in the descriptive framework, and incorporates a critical angle.

The conceptualisation of experimental assemblages utilises a broadly social-shaping of technology (SST) perspective, which attempts to reconcile structure and agency similarly to the MLP, whilst also capturing the fragility, messiness and complexity of place-based, politically heated and contested activities. Using assemblage thinking captures the messiness and contingency of place-based experiments, and allows thick description to be used to illustrate the complex processes of development involved in each domestic retrofit response. This is different from trying to describe or analyse each city, a 'system' or the issue of domestic retrofit as a whole, and is more sensitive and appropriate for capturing the complex and multi-scalar issues involved. Viewing the cases through the lens of experimentation captures the change orientation and intentionality of the case studies and generates questions about what is being tested and produced, for whom, and why. It does this by concentrating on the varied relationships, biographies, forms and effects of the initiatives and how they have tackled the particular aspects of domestic retrofit, in their particular contexts. It also presents an opportunity to explore and contribute to understanding one of the key trends in the governance of climate and energy issues identified in the literature.

3.7.2 Domestic Retrofit Experimental Assemblages - Part 1.

From the theoretical literature, the framework incorporates multiple elements. The concept of the 'landscape' from the MLP is very helpful for identifying the macro-scale issues, actors and factors involved in place specific domestic retrofit experiments, even though those issues may not be place-specific themselves, and retains a sensitivity to the political economy of neoliberal capitalism through the policy and macro-level actors involved. However, different elements of the landscape for domestic retrofit may be more or less important and influential in each case. It also incorporates spatial elements to a modified multi-level perspective, as shown in Figure 10 below, which is important for situating the domestic retrofit experiments in places, and acknowledging the importance of different approaches to space and territory around them.

It particularly focuses on the place-specific context and the relationships, issues and organisations in that particular urban context as being the vehicles for experimental activity of different kinds. Including a micro-level also allows the analysis to recognise influential individual or household specific decisions, preferences and ideologies, which are not always considered in larger 'systems' or political economy approaches. Paying attention to the micro-context of developing these experiments in this way incorporates people and agency as a strong factor as they have been in the literature on niches, grassroots initiatives and BSTEs.

The experimental assemblage, in network and narrative, also demonstrates the immanent causality of assemblages, showing that the causes of their formation take place within the assemblage itself, affected by factors and actors both inside and outside of the place where the assemblage acts. The framework also shows us the interrelations between relations of exteriority in assemblages and their capacity to act – each actor is not only defined by their own attributes but by their relationships to other components in the assemblage, both vertically and horizontally, and these produce unique capabilities to do particular things in that place and have particular effects.

Figure 10. below shows the product of this combination of concepts: a three-level framework incorporating actors (white boxes) and factors (green and red letters) at each level, with the macro-scale components in the 'landscape' at the top, city-regional, place-specific actors and factors in the place-specific context in the middle, and micro-scale, individual and detail-specific issues in the micro-context at the bottom. This multi-level framework acknowledges that domestic retrofit experiments are formed from a combination of elements at different levels, all of which need to be considered as a whole to properly understand and depict the nature of the response. The three levels are not fixed and easily delineated (denoted by the dotted lines), because the assemblage connects them in a network and blurs the distinction, but acknowledging them is important for highlighting the presence of actors with influence and power at different scales. Fig. 10 also shows that there are relationships between these components, both within the same levels (horizontal relationships), and between actors and factors in different levels. It is the nature of these relationships that gives the assemblage its unique character, orientation and capability.

(Please note that some examples, not all possible relationships have been shown on the diagram for visual simplicity).

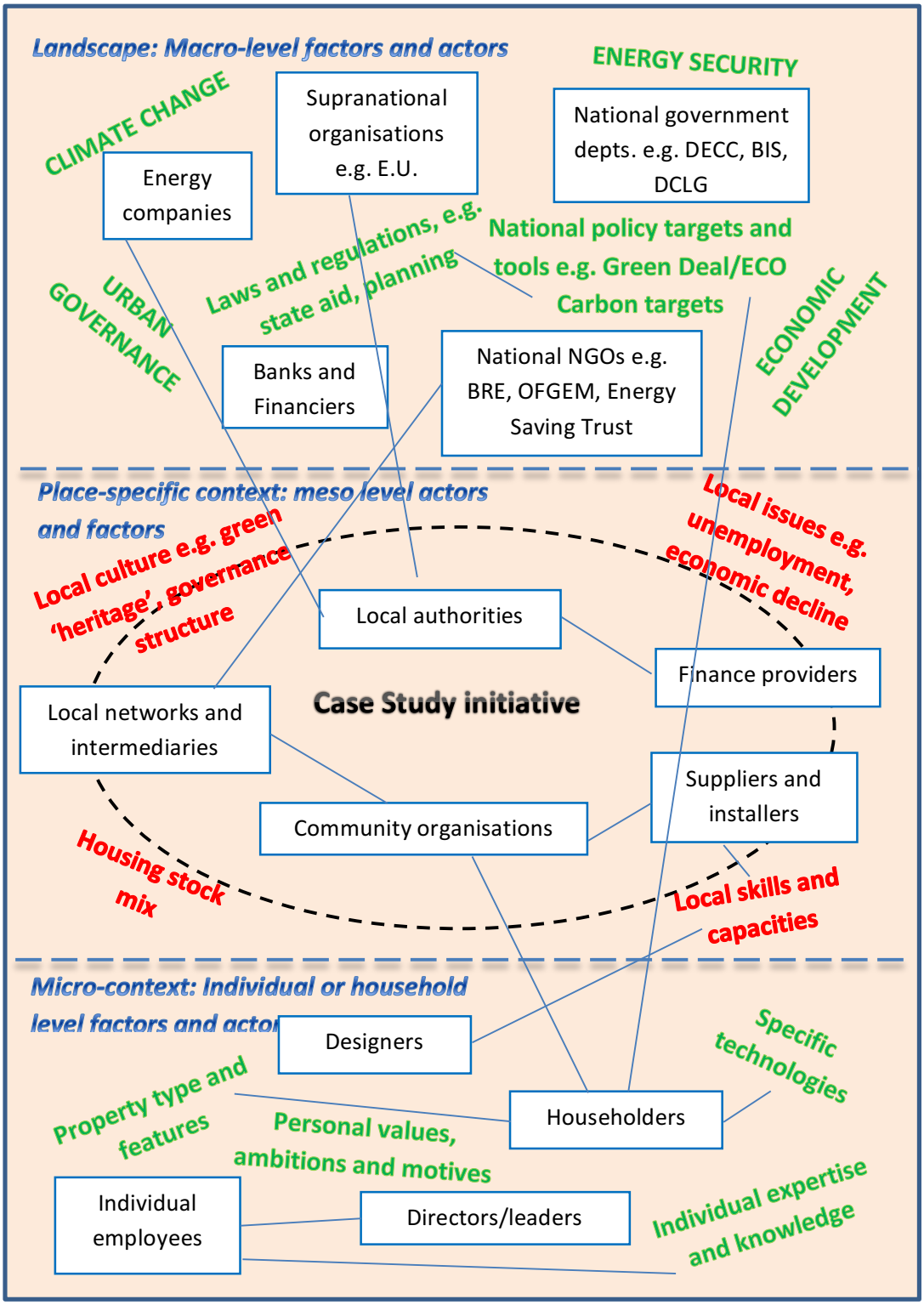


Figure 10 Experimental assemblage as description

3.7.3 Domestic Retrofit Experimental Assemblages – Part 2

This part of the framework moves on from a description of who and what factors hang together in the assemblage, and moves into explaining why those assemblages and processes of assembling the response produce differently constituted experimental responses and effects. Figure 11 below shows how the factors and actors at the three different levels described above come together through a process of negotiation and internal dynamics to produce place specific responses that approach the particular problems of domestic retrofit in urban contexts identified in the literature review in their own particular way, with their own particular outcomes and effects.

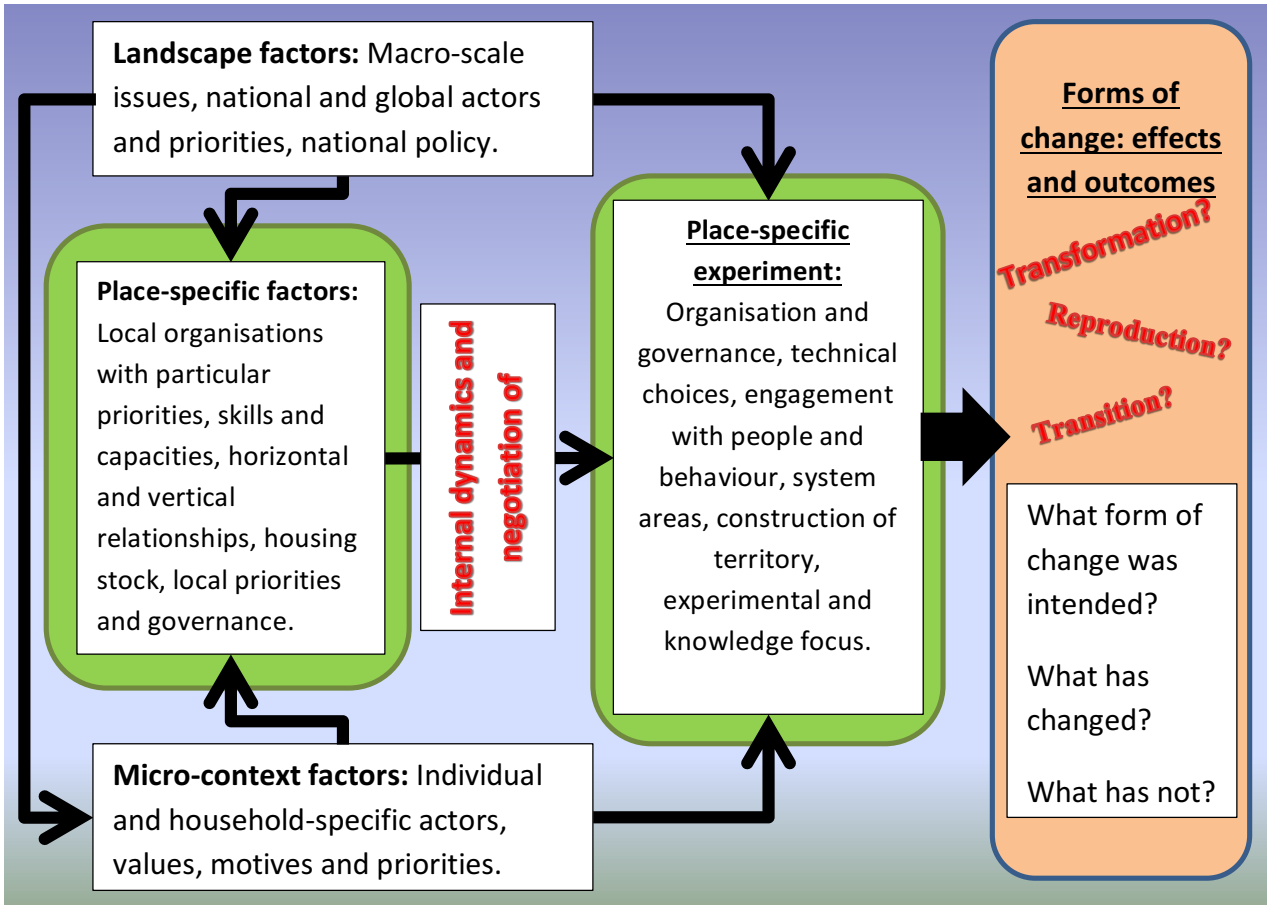


Figure 11 Experimental assemblage as process and explanation.

This second part of the framework links the helpful concepts of internal dynamics from the MLP approach to niche experiments, with the negotiations of interests highlighted in

literatures around urban experiments. This allows an explanation of why particular strategic decisions were made, which produce the place-specific experiment in its particular form, through these negotiations and internal dynamics. Different degrees of influence of actors and factors at different levels can be incorporated, illuminating the importance of the vertical and horizontal relationships that are described in part 1 of the framework.

The framework also includes typologies of different forms of change from the MLP literature -transformation, reproduction and transition - as a tool for capturing both the intentions of, and the outcomes and effects of the cases in a comparative way. It uses existing representations of domestic retrofit systems and the issues highlighted in the literature review to frame the form and focus of each experimental response, giving a sound basis for comparison, encouraging questions such as: which parts of this complex, multi-issue problem are the experiments addressing? What are its goals? How does each case approach technological risk, engagement with householders, governance and organisation, and engage with landscape issues and policy? These varied forms and foci on different areas are the products of the dynamics and negotiations between multi-level factors, actors and interests. This then allows an exploration of the nature of distributed agency from ANT and assemblage thinking – encouraging us to view each network as a series of components acting together to produce different effects and outcomes linking to varying change processes.

The final task of the framework was to incorporate a critical element. Looking at the outcomes and effects of the cases in terms of whether they were transformative, reproductive, or contributing to transition processes allows an exploration of how change in different forms has been encouraged or limited by the assemblages, through the relationships between factors that has been identified in the two parts of the framework. Ideas around whether the experiment could or did stretch and transform or fit and conform to existing norms are also helpful to guide discussions around limitations to and enablers of change, and for investigating the extent to which local priorities and individual values have been compromised by their relationships with other factors and actors. Dominant interests may be embodied in vertical relationships particularly with national policy and actors, but balanced and negotiated through the configurations of people, organisations and funding at other levels. This framework allows an exploration of where the resistances and obstacles to

change may have come from in the assemblage. It is through exploring the differential influences - in terms of power - of the multiple factors and actors at different levels, that a critical discussion of the limitations to change can be had.

3.8 Operationalizing the experimental assemblages framework

Applying these frameworks to fieldwork and case study analysis requires a number of steps to be taken:

1. **Populate the Macro-level.** Explain how landscape issues are manifest in the policy and political context that the case studies operate within, and the conditions it creates for constructing retrofit experiments. Identify some key actors at the macro level.
2. **Populate the meso and macro-levels of each experiment**. Through a biographical and thematic analysis of each case, identify the range of key actors and factors involved and the relationships between them, then produce a case specific multi-level experimental assemblage diagram depicting these using fig. 10 above as a template.
3. **Use key themes from the literature to describe and then compare the experimental assemblages**. Describe each case in terms of its governance, organisational form, goals and priorities, experimental focus, activities and projects and the strategies it used within these, the influencing factors and relationships involved, and its outcomes and effects. Compare the initiatives across how they approach the key parts of retrofit at a practical level: socio-technical issues such as technical risk, organisation and roles in retrofit, and engagement with householders.
4. **Explain why the assemblages produced different experimental responses**. Produce a case specific 'assemblage as process' diagram using figure 11 as a template to depict the process of assembling the experiments through their arrangement and mediation of multi-level factors and actors. Use concepts of internal dynamics, negotiations of interests and immanent causality to illustrate how the varied and actors and factors and their relationships created variation between the cases and highlight the key differences.

5. **Investigate the significant enabling and limiting factors** to the changes that resulted from the case studies, particularly through the dominance of certain ideologies and approaches at the macro-level.

This chapter has provided an exploration of possible theoretical approaches to the issue of domestic retrofit in English cities, and settled upon a hybrid approach of experimental assemblages in two different frameworks, designed to synthesise the multiple perspectives that could be taken, as well as incorporate a range of issues, scales, factors and actors into the analysis process, with the ultimate purpose of explaining the differences between the cases and their outcomes and effects. The following chapter will outline the research design adopted and how this research design has been constructed to provide the depth and range of data to appropriately address the research aims and objectives, and utilise the frameworks set out above most effectively.

Chapter 4 - Methodology

4.1 Realism – of the critical kind.

Before embarking on a detailed explanation of the particular methodology being adopted in this research, it is necessary to first outline the ontological and epistemological position underlying the methodological decisions that have been made (Henn et al, 2009). This position provides an intrinsic logic to the entire research process, allowing helpful elements from other perspectives to be incorporated into the research design, whilst remaining true to its identity and mindful of the original motivation for bothering to undertake doctoral research in this area in the first place. That perspective is rooted in critical realism, as espoused by Bhaskar (1997) and Sayer (2000) in particular relation to human geography. The reasoning behind this, and embracing the spirit of reflexive sociology advocated by Bourdieu and Wacquant (1992) and May and Perry (2011) is both personal and practical.

When reflecting upon my recent personal experiences of voluntary and research work in the environmental sector, I noticed how issues that operated at very large scales impacted a small community organisation in various different ways. For example: austerity governance and budget cuts deployed at national level in the UK resulted in a serious lack of confidence in employees that their jobs were safe, due to its effect on funding streams. It prompted the organisation to pursue fields of work that were not originally part of their vision or identity in order to secure funding and maintain stability. Furthermore, as a key focus of organisational activities, the global issue of climate change affected (and continues to affect) the staff's daily lives in a number of ways, including changes to organisational structure, resource use, mission statement and even family lives. But these people were not simply passive receptors of big issues. There was always a determination to carry on working towards change and progress of various kinds in the local community, relating to the needs and capacities of that particular place. Members of that organisation also sit on an advisory board designed to steer Birmingham's plans for reducing carbon emissions and energy use. The impact that this will have is uncertain, but the emerging picture is one of an interesting set of interactions between issues, places, scales and people, and a revolving relationship between wider structures, individual dispositions and organisational action.

These are anecdotal observations and personal interpretations of just one organisation in one neighbourhood of one city in one country. What these interpretations and observations represent, though, is a world-view that there is a set of processes and forces, which connect macro-scale issues to micro-scale individual and intentional action and vice versa, and contribute to certain activities in particular places or situations. These processes and interactions have been dubbed as “often unseen” by Lloyd (Lawson and Staelhi, 1991) and therefore leave a theoretical chasm between human agency and wider social structures.

In terms of an epistemology and rationale, this world view lends itself to an investigatory approach that attempts to uncover the patterns of activity between the micro and macro-scale. In terms of the goals of this particular research, this relates to a focus upon how a range of national – and sometimes international - issues, agendas and policies relating specifically to urban retrofit are manifest in what is *actually happening* in a given context, and perceived by the people who are *actually acting* in response to them. It also includes a desire to attempt to explain why those actualities exist, by identifying the causal processes applying to the activity under investigation. In this case it is the existence of different responses to a nationally defined ‘problem’ with energy-inefficient, privately owned housing stock. By investigating the dynamics of initiatives that respond to these issues and agendas and policies in different places, we can uncover a reality that is populated, but not saturated by those large-scale issues, in which other, context-sensitive issues combine, emerging as responses that can illuminate the connections – and disconnections - between policy, knowledge and practical action.

The intention is that by understanding what domestic retrofit means to the people involved in it in different contexts, and the variety of forms and effects it can have, we can explain how the construction of a domestic retrofit agenda through national policy has both enabled and limited experimental retrofit assemblages and different forms of change, which vary significantly between urban contexts.

4.2 Origins of research design and positionality.

It should be noted at this point that the construction of this research design has been a cumulative process of incorporating the predefined themes and intentions of the wider EPSRC Retrofit 2050 project from which my funding is drawn, with my own predefined ideas

about what is or is not interesting and relevant, as well as taking inspiration and opportunity from current changes and trends in the UK political context. For example, 'retrofitting the city' was given as a title, and the general idea of using a socio-technical approach to begin to understand low-carbon transitions (Geels, 2010). The interpretation of these starting points was up to me. Many of the guiding themes I used are rooted in my own preoccupations, professionally and personally, from experiences as a buildings design engineer (building regulations, climate change, energy efficiency), as a volunteer domestic energy advisor (values, energy efficiency, feed-in-tariffs, fuel poverty), and from previous research experience into motivations for volunteering (values, economic crisis). Concurrently, at the time that I was exploring the possibilities of this area of study, the UK government launched a significant new policy instrument: the Green Deal. This policy related specifically to domestic energy retrofit for the purposes of reducing energy use and carbon emissions, and a number of city-based initiatives became visible, providing an ideal and very timely opportunity to look at examples of retrofit strategies that encompassed my preoccupations as well as tying in with the predefined area of study.

My research background has its roots in policy-oriented research, and a hope that by understanding and illuminating the mechanisms and processes connecting the macro issues with the micro, there is an opportunity to influence and improve policymaking and local-level action. In particular, to broaden the range of individual voices, values, feelings and motives heard and incorporated into policies and plans, along a path that is realistic in terms of the capabilities of places to change and adapt to the enormous pressure of climate change, economic crises and the like. This reflection should illuminate the direction from which I approached the goals and structure of the research, before moving onto a description and discussion of the particular research design.

4.2.1 Why a comparative case study?

The research design adopted is both an analysis of the national policy context and landscape for domestic retrofit and a comparative case study of three domestic retrofit initiatives in three different cities: the Energy Saving Co-operative in Birmingham, the Manchester Carbon Co-op in Manchester and the Bristol Home Energy Upgrade in Bristol. For an exploratory research project such as this, highly structured surveying or quantitative methods would have been inappropriate, because they would have stifled the ability of the

research to respond to themes and issues as they emerged from the fieldwork. A more traditional qualitative research approach without the case studies may have given a good overall impression of the range of perspectives involved in domestic retrofit, perhaps at a national scale, but this would have missed some of the valuable place-based and specifically urban elements to the research. It could be argued that a single urban case study could have tackled these elements, but a desire to take some abstracted lessons with a hope of being able to tentatively generalize or transfer them to other research would have been more difficult with only one case. This section will outline the reasons for the comparative approach, the case-based approach, and the rationale behind selecting those particular cities and those particular initiatives.

Case-based approach

The decision to take a case-based approach derived from the need for an approach that would allow the depth and detail necessary to present a valid representation of the domestic retrofit initiatives emerging in each city context. As Bourdieu and Wacquant (1992) describe, in relation to reflexivity, it is the totality of the social phenomena under investigation that we are interested in, including our own ideas and views. Even at first glance at the community-based domestic retrofit initiative emerging in Birmingham, the network of organisations, resources and funding appeared extremely complex. With so many different interests at play, a case-based approach utilising a variety of data collection methods allows the illumination of varying and contested experiences of the same scenario (May, 2011). Arguably, it is virtually impossible to fully 'know' the social world however we approach the problem (Crang, 2002), but the idea of aiming for as full, open and frank an exploration of a given issue as possible is a positive one.

What was sought was not a consensus on the experience (unless it happens to emerge) but to understand how different social interests are represented by or embodied in retrofit-related activity in different places and in relation to particular contextual features that are multi-scalar and interconnected, such as incumbent organisations, funding structures, supply chains, household energy use and behaviour. It also seeks to clarify the relationships between these contextual features and different objects involved in the initiatives, such as houses, technologies, financial tools, etc (Sayer, 2000). Identifying, understanding and

explaining those complex interrelationships would be very difficult without gathering a wide variety of viewpoints, from within and without the initiatives, and engaging with a variety of sources, thus embracing the intersubjectivity that is unique to the case-study process (Henn et al, 2009).

But there are key aims and objectives that cannot be achieved by a single, in depth case study, and those relate to the goal of moving beyond describing the initiatives and their relation to contextual features and into the realms of explaining the differences between the initiatives as pertains to their contexts and scales of action, which requires comparison.

The Comparative Element

In keeping with the realist mantra, the case-based approach allows the data gathering process to be sensitive to contextual intricacies whilst retaining the relevance of 'bigger' processes in an 'encompassing approach' that looks at instances in different locations whilst reflecting on their relationship to the overall system (Ward, 2010). The statement that *"there are shared, universally identifiable pressures and trends working across all industrialised societies"*(Perry, in May 2011, p86) captures the importance of those wider processes and structures, which the 'landscape' concept is particularly helpful for articulating, without attributing a specific scale (national, international) to it until the data has been collected and analysed.

The comparative element to the research design thus enables an exploration of diversity in outcomes among similar cases (Ragin, 1994): the cases being experimental domestic retrofit initiatives in English cities. It is tentatively designed to allow the development of middle-range theories about interurban diversity within the UK national context, and deepen the appreciation for understanding the role of context and conditions at different scales within the wider body of knowledge about urban development (Ward, 2010).

The research does not generate grand theories for generalisation to all domestic retrofit experiments or all urban contexts, but develops explanations for different outcomes from a similar landscape, using domestic retrofit initiatives as a lens through which to examine the interactions between those structures, the mechanisms through which they work, and how the conditions and contexts that those mechanisms operate within affect the outcomes of the entire process to different extents and in different ways (Sayer, 2000). This aspect of

theory development would be impossible to do without a comparative element, but theoretical aims are modest: the decision to deal with fewer than Eisenhardt's (1989) 'optimum' of six cases has been taken in favour of retaining a greater level of depth and familiarity with the cases (Ragin, 1994), and the explanatory and descriptive concepts that emerge will naturally be closely linked to the empirical data. However, these theoretical developments may contribute to other comparative urban studies, or other forms of urban retrofit and organisational studies.

The need for theory development of some kind reflects a degree of Perry's (in May, 2011) 'foresight' type of comparative research, which is designed for lesson learning and improved understanding and is vital for critical policy-based research. However, lessons from this research are not meant to be replicated or transferred like-for-like: they are meant to provide worked examples of attempted change processes, as well as ideas about relationships that enable or constrain change and transition in urban environments.

Case Selection

Each case represents an experimental assemblage around domestic retrofit in an urban context. If the aim of the research is to illuminate the varying effects of different urban contexts and conditions upon the organisation and orientation of a domestic retrofit initiative, then it should follow that cases should be selected for their contextual differences. Comparing cases with similarities in other respects facilitates more confident pronouncements about the effect of context (Ragin, 1994). The relatively low number of cases was settled upon in order to juggle three goals: firstly, to enhance internal validity through depth, familiarity and closeness to the case data (Ward-Schofield, 1993), enabling the relationships and in and stories of each assemblage to be understood to a high level of detail; secondly, keeping the study within manageable limits for a lone researcher, and thirdly, enabling the development of useful ideas and concepts through comparative analysis.

The selection criteria also balanced theoretical and practical considerations (Henn et al, 2009). Whilst there is an element of convenience sampling in terms of a) what initiatives were available and operational at the time and b) their location and accessibility (feasible for travelling between three cities during the data collection process) there are also some

deliberate similarities between the cases, reflecting the effort made to distinguish between exogenous, landscape factors, and endogenous, context-specific factors (Ward, 2010).

A number of loosely defined, desirable characteristics between the cases were sought:

1. The initiatives must be in England, thus operating within the same national policy, cultural and political context, and within an accessible distance and travel time to Birmingham, where I am based.
2. The initiatives must be embedded in different urban contexts, to satisfy the original purpose and scope of the research.
3. The initiatives must concern the retrofit of privately owned or occupied domestic properties for the purposes of improving energy efficiency.
4. The initiatives should be community-based, to some extent. The insight into individual roles and values as well as their relationship to issues at various scales, understanding the impact of the landscape issues from macro, all the way to micro-scale and the importance of engaging with householders and their motives as highlighted in the literature review, could be more illuminated by focussing on community based initiatives rather than large scale social housing retrofits.
5. The cities should be of a similar population size to avoid reducing the causes of difference to this factor.

It should be noted that there were also personal and external influences on city and case selection: Some of the criteria were derived from initial observations of the Birmingham case study (The Energy Saving Co-operative retrofit scheme) in which I was already involved as a volunteer at a partner organisation. This was the first case to be identified, and it was partly from initial impressions of this case, along with guidance from the themes emerging from the literature, that a tentative set of interesting features were identified, such as organisational forms, the use of networks of local organisations in different roles, interactions with local authorities, etc, and from this point the comparative framework was built. The potential issues with this in terms of bias are acknowledged, and strategies to equalise the situation have been taken.

These include:

- The keeping of a reflexive journal of decisions made, reasons for doing so, and the impact that my position may have had upon the research trajectory (Silverman, 2005, in Henn et al, 2009).
- Withdrawal from my voluntary role in connection to the Birmingham case study.
- Allowing extra time (and effort) for building relationships and familiarity with potential participants in Bristol and Manchester. Whilst my 'insider' status greatly facilitated initial access and familiarity with the first few participants in Birmingham, the relationships built from that point have been on the basis of my position as an interested researcher rather than as a volunteer, which is important in terms of a consistent professional relationship with participants.

It was also partly a stroke of luck that the Manchester Carbon Co-op initiative emerged in Manchester at the same time as the Energy Saving Co-operative, because in line with the body of work to be produced by the Retrofit 2050 project, which focuses on Greater Manchester and Cardiff, this PhD research needed to include at least one of those places. Had the Manchester Carbon Co-op and not existed, a different initiative in Manchester may have been selected and the research design may have taken a different path, perhaps looking at very different cases in different cities and having a strategy that was less contingent on the similarities listed above. Nonetheless, the research design settled on a comparison between community-based, domestic energy efficiency retrofit initiatives in different cities, and a focus upon the effects of the different city contexts upon the organisation and orientation of those initiatives.

Furthermore, the development of these criteria has happened alongside a number of problems with selecting a comparable case in Bristol, which was the third and final city added to the comparison.

At the time of initial case selection, there was no community-scale, specifically Green Deal-based retrofit initiative emerging in Bristol at the time of case selection. After a visit to Bristol and a period of familiarisation with the range of energy efficiency initiatives in action

in Bristol, a more similar, domestic-based retrofit initiative was targeted. However, this first initiative was difficult to access for a number of reasons:

1) The staff at the lead organisation were very resistant to face-to-face visits and to taking part in interviews or discussions about the project and showed little interest in the research process. It was doubtful that a fair representation of perspectives of those involved would be gained, and after difficult initial contact, it might be hard to build the required level of rapport with participants.

2) The particular funding stream for this project ended soon after discovering the scheme and the project was in its final stages when I discovered it, making consistent access to those involved a little more difficult.

In terms of the Bristol case study, The Bristol Home Energy Upgrade scheme was city-wide and council-led, which was not originally envisaged to be the scale of initiative that the comparison would entail. It was also time limited and had ended by the time data collection started which creates some differences in terms of the kind of reflections and experiences that will be gained from interviews, but it encompasses a number of the same themes and foci that the other two case studies do, and its organisation is a reflection of the existing networks and arrangements in Bristol, which is interesting in itself as an element for comparison. The section criteria listed above were moulded along with the research, in order to create a comparison that would best tackle the research aims and objectives.

Much like the experience Shurmer-Smith (1998) describes in her account of researching elites in the Indian Administration Service, the reflexive, autobiographical process of doing the research from my perspective shows a constant juggling of competing pressures: academic rigor, fleeting opportunities, personal values and practical issues, all whilst trying to define and redefine the actual focus of the project as it progresses, without losing its core identity altogether.

4.2.2 Data collection methods and analysis.

Broadly, data collection and analysis methods followed the recommendations of Yeung (1997) in his attempt to methodologically connect critical realism and human geography, and Yin (2013) who advocates the use of the case study method – so long as it is rigorously

done - for explanatory research as well as exploratory, descriptive research. It will employ some of the network analysis elements of the MLP approach outlined in the previous chapter in order to depict and connect the multiplicity of actors and factors involved in each case, but as MLP case studies (such as Geels, 2002) tend to be historical desk studies, much of this approach is inappropriate for a comparative case-study based heavily on primary data. Hence, the majority of data collection will follow the 'thick description' approach of assemblage-based research (McFarlane, 2011). This will involve collecting rich primary data in order to illuminate the contextual nuances of each city context along with its interweaving with factors and actors outside of its representational space, and bring the lived realities of those working within those contexts on the particular problem of domestic retrofit to life.

Yeung highlights three key components to a methodology that reflects the critical realist philosophy. The first is the concept-refinement process of iterative abstraction, which goes hand-in-hand with the second: the grounded theory approach to data analysis. This involves an oscillation between fieldwork and adaptation to the conceptual framework according to what is found, thus adding clarity and guiding subsequent data collection. This builds a range of robust descriptive and explanatory concepts closely linked to the primary data but which are abstracted enough to enable their wider application (May, 2011 and Grbich, 2007). This holistic, back-and-forth interaction between concepts, method, data and analysis results in what is known as retroductive theory building (Yeung, 1997).

The last component of Yeung's ideal realist methodology is methodological triangulation, in terms of collecting data from multiple sources, or using parallel methods (Yin, 2013 and Grbich, 2007). Different sources and methods illuminate experiences or representations of the same event by different stakeholders or in different social spheres, uncovering the discrepancies and harmonies between those representations. Additionally, using multiple data sources can confirm and corroborate strong or common themes that may emerge, adding external construct validity to the concepts and theories drawn from the data (Yin, 2013). Using multiple sources also provides a fuller and more textured picture of the initiatives and the issues surrounding them, and therefore a better chance of understanding the dynamics of their construction and operation over time, both visible and hidden (Bourdieu and Wacquant, 1992). Using only one data source, such as semi-structured

interviews, gives individual representations in particular scenarios, with particular pressures and influences upon the kind of accounts given by participants, such as the topics covered by the researcher in the interview schedule, time pressures, perceptions about what it is or isn't acceptable to say about the organisation you work for or with, and so on. By utilising different sources, particularly in the form of participant observations of meetings and content analysis of public communications, the possibilities for uncovering unexpected and less censored issues, themes and dynamics, and therefore a greater depth of understanding, is increased.

In addition to this, a number of scholars advocate the use of mixed qualitative data sources in relation to case studies with an eye on the intended data analysis techniques, such as equipping the researcher with the necessary tools for qualitative narrative analysis and network analysis, (Henn et al, 2009, Sayer, 2000, May, 2011) which shall be explored in greater detail in the next section. When viewing the methodology holistically in this way, with the underlying epistemology, ontology, overall research design, data collection process and intended forms of data analysis all being interdependent, rather than a linear process (Bourdieu and Wacquant, 1992), a logic begins to emerge that fits both the brief given by the broad aims of the research (for a reminder, please see above), and compliments the explicit commitment to reflexivity.

Data sources

The data sources that were used in both the case studies and the exploration of the macro-level include:

1) Interview data (predominantly one-to-one), with a range of individuals involved in both national policy and in each case.
2) Participant observations of internal project or organisational meetings, and external promotional or informative events, including those at the macro-level.
3) Policy, organisational and promotional documents such as websites, meeting minutes, project reports and promotional material from both national national government and each case.

The data sources for each case and for the macro-level research are listed in the tables below, followed by an explanation for the selection of these sources and their importance to the comparative case study method. Eight interviews were completed for each case, along with a range of organisational documents analysed. For the Carbon Co-op and Energy Saving Co-operative cases, a series of observations at internal and external meetings were made, but as the timing of the Bristol Home Energy Upgrade was that it had ended by the time fieldwork started in earnest, there is a lesser reliance on observations in this case, and a greater reliance on project documents. At the national level, four one-to-one interviews were conducted, and experiences and opinions of the national policy context were also taken from the case study data as well, where relevant. These perspectives were designed to add detail and perspective to the range of policy documents and academic analyses of the policy climate.

Interviews ranged in length from 40 minutes to two hours, both within cases and between participants at the macro-level. However, because of the positive rapport developed with participants, further questions were often asked by email or by phone to clarify certain elements of the interview or issues that arose after the event.

Carbon Co-op, Manchester		
Organisational documents	**Observations**	**Interviews**
Carbon Co-op website and blog	Cities @ Manchester June 2012	Board Member 1/ URBED 11th July 2012
Carbon Co-op 2012 AGM meeting minutes.	Carbon Co-op and Go Early Green Deal Pilot launch September 2012 Manchester Town Hall	Board Member 2/Project Manager 24th October 2012
Carbon Co-op in Stockport project plan Carbon Co-op whole house retrofit report	18th March 2013 Carbon Co-op AGM	Board Member 4/SLiH 10th May 2013
Carbon Co-op Strategy day 2013 meeting minutes and report.	26th June 2013 Carbon Co-op Strategy Day	Board Member 3/Stockport 24th May 2013
	4th November 2013 Carbon Co-op Board Meeting	GM Partner (MoD) 26th June 2013

		Salford University Partner (WS) 8th November 2013
		Board Member 5/Householder 12th December 2013
		Project Manager Follow up/progress interview. 6th Feb 2014.
		Generating Success partner 22nd November 2013

Table 3 - Carbon Co-op data sources

Energy Saving Co-op, Birmingham		
Organisational Documents	**Observations**	**Interviews**
Meeting Minutes of AGM 2012	Board Meeting and Management Team Meeting 22nd May 2013	Community Partner/Board Member 25th May 2012
Financial reports and projections April- November 2013	Board Meeting and Management Team Meeting 11th July 2013	ESC Sales Manager 23rd August 2012
Board of Management Meeting Minutes April – December 2013	Board Meeting/Site visit June 12th 2013	ESC CEO 4th October 2012
ESC Website	AGM 6th April 2013	BSeen/Community Partner 2 17th January 2013
		ESC CEO follow up interview 18th July 2013
		ESC Installer member 1 24th September 2013
		ESC Installer member 2 18th October 2013
		Birmingham Energy Savers Representative 14th November 2013

Table 4 - Energy Saving Co-operative data sources

Bristol Home Energy Upgrade		
Organisational Documents	**Observations**	**Interviews**
CSE Final Report to Bristol City Council 2013	Retro Expo November 2012	Bristol City Council Project Co-ordinator 21st May 2013
CSE project website https://www.cse.org.uk/projects/view/1203	Bristol Energy Network Meeting December 2013	CSE Project Co-ordinator 21st May 2013
CSE Case Studies – 3 experiences of solid wall insulation, 1 experience of boiler installation.		Bristol Energy Network Representative 17th July 2013
Maintaining Momentum in Bristol Community Energy Project Report		CSE Project Co-ordinator follow up interview 17th July 2013
		CSE Project Officer 17th July 2013
		Bristol City Council Technical Advisor? 29th October 2013
		Bristol City Council Project Officer 12th March 2014
		Bristol Green Doors Representative 12th March 2014

Table 5 - Bristol Home Energy Upgrade data sources

Observations	**Interviews**
Retro Expo November 2012	Third Sector Policy Perspective – Sustainable Housing Action Project (SHAP) representative 23rd September 2013
Green Deal Supply Chain Briefing Event, Birmingham, September 2012	Energy Policy Perspective – Ex-Energy Saving Trust Policy Advisor 25th November 2013
Making Transitions Happen Event, Brussels, November 2014	Cities Policy Perspective – Cities Policy Unit Officer 1st January 2014
	DECC Perspective – Senior DECC Officer 3rd February 2014

Table 6 - Macro-level data sources

Interview data

The first purpose of conducting interviews is to tell a story or biography (Crang 2002), from both individual and collective perspectives, of how the initiatives came to be: e.g. what were the processes of identifying a problem or need, connecting with other stakeholders, and what were the personal motives and values that led certain people or configurations of people and organisations to come together around the issue of domestic retrofit. This connects in some senses to Sayer's (2000) geohistorical approach, which pays particular attention not just to the specifics of place, but also to the temporal context in which decisions were made and actions taken. This data was gathered largely through interviews with participants working in or with those responsible for creating and enacting the retrofit experiments. The intended result is a descriptive presentation of the initiatives, concerning who is involved, in what capacity and why, enabling the depiction of the retrofit experimental assemblage's formation in a diagram as explained in chapter 3 above.

The second use for the interview data, which includes all perspectives, internal and external, is to identify the key issues connected with domestic retrofit at different scales and in different roles, and to capture the range of social interests, power dynamics and processes attached to it. These include the personal values and motives identified in the biographies, but also context-specific issues from the micro (household) level to the community and city-regional 'meso' levels. Through gathering data from a range of perspectives from household level, to community groups, funders and policymakers, we can identify primarily what retrofit *means* to the people and organisations involved. The cases' connection to landscape, local and personal issues, such as whether the actors in the cases are more concerned by excessive global carbon emissions or by unemployment in the local area, helps us identify which issues and factors were the greatest priorities in each case, and explore the dynamics of how they are constructed and perceived at different scales (Brenner, 2001).

Style and format of interviews

Interviews were broadly semi-structured, with loose topics to cover, and open-ended questions, with prompts to extract greater detail where necessary. For example, one open-ended question such as 'tell me about how you came to be involved in this project' actually

incorporated issues around motivation, networking, skills and the like, (especially with appropriate prompting) without having to ask those separately.

Interview topics varied slightly according to the participants, because, as mentioned, they were selected specifically for the purposes of illuminating different perspectives, therefore some questions for one perspective would be entirely inappropriate for another. For example, there is naturally going to be a greater exploration of household-specific issues when asking why a householder may have become involved with the case and probably a lesser focus on professional skills than when interviewing a project manager. These common-sense variations, help to explain the suitability of the very loosely semi-structured interview as opposed to a more structured approach, primarily for the purpose of allowing the participant to give their own account of the experience rather than to categorise aspects of that experience according to my predefined ideas about it (May, 2011).

A list is shown below of topics discussed with different participants, depending on their relevance to the participant, over the course of a semi-structured interview.

- How you got involved with the initiative;
- Why you got involved with the initiative;
- What your professional background is;
- What the key challenges have been and why they are important;
- Whether these issues are particular to this place;
- What the project's goals are in relation to domestic retrofit, and;
- What has enabled or constrained the progress of this case or project
- What are your opinions on the current policy context for domestic retrofit?

Along with seeking a range of participants with different perspectives, such as installers, designers, project managers, householders and community partners, it is important to note that a number of participants had multiple roles and views, such as Carbon Co-op participants who were both householders and board members or held active positions in the organisation, or a community partner in Birmingham who went on to become directly employed by the case study organisation. Once again, this does not necessarily present an obstacle, but shows another interesting facet to the dynamics of the urban retrofit arena.

Furthermore, the positioning and perspective of participants in relation to the initiatives was not always clearly defined in terms of whether the participant was representing themselves as an individual or an organisation. There were variations both within and between accounts, with a multiplicity of positions, as Mullings (1999) found in a thought-provoking discussion of positioning in interviewing workers in Jamaican information processing companies. These nuanced differences are not only important to note for staying true to a reflexive and honest research approach, but also form part of the character of the initiatives themselves, providing even more interesting comparative elements to the data analysis process.

Participant selection

The objectives of this research are to describe and explore the experiences and manifestations of domestic retrofit activity in different contexts and to investigate how the relationships between actors in different places produce retrofit experiments with different intentions, effects and outcomes. As explained through the concept of experimental assemblages in chapter 3, these experiments are not just the sum of these varied actors, but the sum of these actors AND the processes that connect them to each other and to wider social structures. As such, selecting participants who work on, or perceive the issue at different levels such as the household, the neighbourhood, the city or regional level and the national level is imperative. Not only do representatives of different types of organisations working on different aspects of retrofit, such as community organisations, contractors and suppliers and local authorities provide different accounts of the domestic retrofit experience at different scales, they also represent incumbent place-specific features and embedded capacities in themselves, so the range of perspectives is also vital for the explanatory element of the research concerning the varying importance of context and conditions upon the nature of the initiatives.

Access and snowball sampling

The initial points of contact in each city were through a few key informants from within what are/were perceived to be the lead organisations in the case study initiatives – namely project managers and directors. In the Manchester case these were selected both from names and contact details that were made visible on the initiatives' websites and from

people who had been mentioned or recommended by other research colleagues. In the Birmingham case this came through introductions from the staff at the community organisation that I used to volunteer with, and in Bristol this came from connections with Bristol City Council representatives made at an open third sector meeting. From this point a snowball sampling method (Henn et al, 2009) was used. Each participant was asked how they became involved in the initiative and by what means. This naturally created connections and relationships to be noted and incorporated into the assemblage, and presented possible further contact and interview opportunities. It is acknowledged that the resultant representation of the initiative does, then, depend largely upon the connections of the initial participants (May, 2011), but, when reflecting on the process if it appeared that a particularly valuable viewpoint or detail was excluded, further effort was made to remedy this and to seek out other participants or revisit previous participants to provide the necessary insight. Furthermore, snowball sampling resulted in selecting participants viewed as valuable informants from within the world of domestic retrofit by their peers, rather than attaching my own, less-informed judgements to that selection. Another advantage of snowball sampling was that it avoided undue pressure on one gatekeeper, which is a common phenomenon in organisational research (Henn et al, 2009). With snowball sampling, each person acts a gatekeeper to the next rather than one person being constantly required to provide access to others.

The macro-level interview participants in different positions and roles in relation to the retrofit agenda at national level were selected to gain insightful perspectives on the creation and orientation of the particular policy context for retrofit in the UK and the conditions, both enabling and limiting, that it creates for the case studies. These interviews can also be used to look at whether the landscape and local issues are shared and perceived similarly or differently between the macro-level and the meso- and micro-levels.

Again, positioning and relationships in the interview process is something that should be constantly borne in mind. In relation to Mullings' (1999) findings that her own, and her participants' positions in relation to each other, was both fluid and dynamic and often out of her own control, it has been interesting to note that many participants viewed me as an information resource, just as I viewed them. I have been asked for contact details for potential business partnerships, asked what the other cases are doing and how. This is both

flattering, and enables easy and rich discussions about the issues at hand, but it also poses interesting questions for me about confidentiality, which is not as clear cut as it may have seemed at the outset. What, for example, is to stop me from speaking about another person or initiative when the same information is already in the public domain? Is it helpful in the process to remain 'unbiased' and answer questions blandly and neutrally in pursuit of objectivity? Well, perhaps nothing, and probably not, but my responses to such questions may be based upon interviews that are as yet, unanalysed and should not refer to specific people, so there is constantly a judgement to be made about the sensitivity and the validity of my response. Other issues of this nature shall be explored further in the chapter covering ethical issues and reflections.

Participant observations:

The purpose of observations is to understand the practices of reasoning and decision making in relation to the case study initiatives' progress, identity, goals and form, by key actors in a given time and space. This allows a further look at how the initiatives are shaped both by the people involved, and by the key issues of the moment, which could relate to pursuing funding sources, or to marketing the scheme, or to building community contacts, for example. As McCann and Ward (2012) describe, this adds the dimension of studying 'through' the subject under question rather than looking at it from outside, and brings the detail of investigating what people actually do, as well as what they say in an interview setting (Crang, 2002). Despite efforts to create relaxed and informal interview settings, there is still an unnatural element to being quizzed at length about one's work and personal history and the like, so even with the possible 'censorship' effects of having an observer at a board meeting, there is extra value in seeing some of the narratives 'in action'. The limited timescale of the data collection phase of the PhD and the practical issues with my location and family commitments prevents participant observations from being a more substantial element to data collection. This is a general issue with long term ethnographic immersion research illuminated by Crang (2002) who points out that very few research papers in human geography are based upon this kind of research due to the time demands of the method. Nonetheless, it may still be able to illustrate which values, knowledge and issues are considered and prioritised *from within* the initiative and why.

Settings and positioning in observations

Observations took place within meetings that concern the direction of the initiative as a whole, such as board meetings and the annual AGMs of the Manchester Carbon Co-op and Energy Saving Co-op. Observations concerned the language, gestures, feelings and relationships involved in these decision-making processes, and also the types of knowledge and discourses that dominated in the settings. To an extent, the analysis of observations took place at the time of making the observations, in terms of immediate decisions to note an event or a conversation, to attach meaning to it in this way implies that it is perceived as important in that moment (Henn et al, 2009), but the detailed thematic analysis of observations in terms of categorising events and instances will take place alongside the analysis of interview data as described below.

It is important, in the interests of a reflexive research design, to be aware of my own position during the process of observing in order to give the proper context for the data and the findings that are taken from them (McCurdy and Uldam, 2013 and May, 2011). There are a range of positions in participant observations that relate to various continuums or axes in terms of relationships with participants, such as the covert/overt and insider/outsider nature of my role. These positions also range in level of activity from being an observer who does not participate at all, and an active participant. My positioning was fully overt – all attendees at internal meetings were aware of my presence and in external or public events I explained to anyone who was interested why I was there and what I was researching. But whilst my level of activity and my level of familiarity at the start pitched me somewhere between what May (2011) describes as 'participant as observer' and 'observer as participant': something like becoming 'a fan' of the initiative, my position changed as the research progressed, with increased familiarity and with views being formed about the value of my emergent findings. I moved from being not familiar or insider enough to be fully participating, to being invited to participate in events and meetings. On the other hand, as the Bristol Home Energy Upgrade was finished by the time I began intensive fieldwork, no observations at internal meetings were possible, so external meetings were used alongside a greater focus on project reports and interview data.

Documents

For the case studies, organisational documents such as websites, meeting minutes, financial reports, project evaluation reports and promotional material were used to triangulate information such as components of the biographies of the retrofit experiments and their goals and priorities, to strengthen construct validity (Yin, 2013). These were also used as part of the narrative and thematic analysis detailed below, to identify key points in the process of constructing each retrofit experiment and priorities.

For the macro-level analysis, policy documents and academic analyses, combined with interview data, were thematically analysed to identify whether and if so, how, the themes and issues identified in the literature review were manifest in domestic retrofit policy. These themes included the landscape issues of climate change, economic crisis and energy security, along with the marketization of policy, shifts from central state government to localised governance of policy, the role of technology and the positioning of cities as localities for experimentation.

4.2.3 Thematic Data Analysis

The combination of interview data, observations and documentary data was subjected to an in depth analysis involving both a form of network analysis intended to assist in the depiction of the experimental assemblages in terms of the actors and factors involved, and thematic analysis to explore, refine and discuss the themes emerging from the literature review. Combined with the thematic analysis of the macro-level, this analysis created an explanation of why the cases took the form they did, as a product of the actors identified and the relationships between them.

This involved taking a Straussian, rather than Glaserian approach to grounded theory thematic analysis (Henn et al, 2009 and Grbich, 2007) in which there are a set of flexible, predefined ideas and concepts, predominantly rooted in existing literature and personal experiences and observations, For example, originally, the research aims and objectives were all about local contexts, but have now broadened to incorporate contexts and conditions at different scales, which upon analysis of the data was considered a better way of understanding and representing the experiences and issues around retrofit. Taking

periodical breaks from fieldwork to report on data collection process, analyse the section of data collected, and refine concepts and focus, was very important in this process.

The guiding concepts at the start of the thematic analysis were a product of the literature review:

- landscape issues (economic crisis, climate change, energy security)
- Experimentation, knowledge and learning (different forms e.g. technical, procedural, legal, social and psychological)
- Visions and goals (problem definitions, targets and ambitions, different interests)
- Scale and space
- Governance and organisation (networks, organisational form, relationship with policy, funding, local authority involvement)
- Dealing with technical risks
- Engaging with people, behaviour and motives

These concepts are not independent of each other, but interdependent and overlapping. There are scalar aspects, for example, to the landscape issues and these in turn could be influenced by the interests present in the network which influence the experimental elements of each case. The purpose of using these concepts to guide the thematic analysis is to start to thread them together and form an idea of how they influence each other over time and in particular places. These concepts are under constant review and refinement as data analysis proceeds, otherwise known as 'fuzzy' (Ragin, in May, 2011), enabling the descriptions and explanations that emerge to be as close to the data as possible. For example, ideas around visions and priorities were modified to become the aims and priorities of the cases, because visions and goals did not capture the accounts of how the projects and organisations were orientated as hoped.

The intended result of the thematic analysis of the macro-level is both a narrative account of how the policy context has been constructed over time, incorporating landscape issues and UK-specific trends and policy and regulatory tools, as well as a thematic account of that policy context in terms of the issues and conditions it creates for those working within it.

The intended result of the thematic analysis for the case studies is a both descriptive and explanatory.

The descriptive element includes establishing, through the combination of data sources, a biographical narrative of how each experimental assemblage came to be, identifying landscape factors and actors that were particularly important, place-specific actors and factors that are involved in the case, and individual/micro level factors including personal interests and motives, all of which contributed to the formation of the initiative. These were then combined into a diagram that shows how those actors and factors involved in the initiative are distributed through the three levels of the assemblage, thus producing a particular approach to retrofit, such as top-down, middle-out or bottom-up.

The explanatory element applies the second multi-level framework developed in chapter 3 above to explain why each initiative ended up the way it did. This part of the analysis identifies and investigates the key interests and internal dynamics of the case, in terms of the ways in which the relationships in the assemblage, and processes of negotiation that occurred within and around the initiative, affected its approach to the key themes listed above, such as its approach to technical risks, its knowledge focus and the scale at which it operates.

This process involved identifying how the actors and factors in the assemblage bring a range of interests to the experiment, which affect its priorities, especially in terms of what it is testing and therefore the knowledge it is producing, from trying out specific policy tools, to testing ways of 'scaling up' or engaging with householders, looking for specific technical solutions and learning about processes for delivering services. These relationships, interests and negotiations around knowledge also affect the construction of a space or 'territory' of activity, and contribute to strategic decisions.

The data analysis process also sought to critically assess the initiatives in terms of the changes they hoped to and did or did not effect, using the conceptual tools from the socio-technical transitions literature to delineate between different forms of change (or non-change): transformation, transition and reproduction, to identify and discuss the outcomes and effects generated by the initiatives. It looks for evidence of whether the experiment changed aspects of the micro-contexts, the local contexts or national context, or different

elements of the retrofit problem or 'system', both in terms of physical, built environment elements and in terms of relationships around, governance of or approaches to the problem of retrofit, local policy or any other effects and outcomes both locally and at the micro and macro-context levels. This part of the analysis also identified whether the assemblage or elements of it enabled or constrained different forms of change.

The final part of the analysis produced a framework 2 diagram depicting and recapping on the key interests and inputs to each case at each level, summarising the key areas of negotiation and influence in the assemblage and how these have contributed to the place-specific nature of the experiment and its outcomes. This methodology therefore links back to the theoretical framework in the following ways:

- Its focus on networks of people, organisations and influences - and the use of snowball sampling and mixed methods to investigate these – was designed to capture the messiness and complexity of the domestic retrofit cases in the spirit of employing an assemblage-based theoretical approach;
- The use of interviews in the emerging local networks around each case, especially interview questions that the particular motives, values and views of the people involved, exposed the range of interests and influence of the different actors and factors involved. This populated the bottom level of the experimental assemblages framework concerning the influence of the individuals involved, as well as contributing to a context-sensitive appreciation of how each case came to be and how it was governed;
- The use of interview questions, observations and thematic analysis pertaining to visions, goals, targets and learning are designed to illuminate the experimental nature of the responses and what various forms this might take as highlighted chapter 3;
- Interviews, observations and documents that produced data on the specific nature of how each case approached the specific technical and social aspects of domestic retrofit were used as the basis for comparison and also to illuminate the challenges of addressing these in urban contexts, and;

- The inclusion of perspectives from policy and national-scale organisationswas designed to explore the landscape aspect of the experimental assemblages framework and its influence on place-specific urban activities.

4.3 Reflections on the methodology

4.3.1 Access, rapport and relationships

Access to policy documents for the macro-level data was not at all difficult, with these documents publicly available and having been analysed and scrutinised by academics already. However, access to interview participants at national level was far more difficult. The policy and third sector contacts were gained either through contacts within the case studies or through persistent emailing of Whitehall departments, being referred to various different people and eventually managing to arrange interviews. It was also intended that there would be additional interviews with an energy company representative and a national level installer or contractor, but after repeated emails with representatives from two energy companies (Eon and Npower) no interview materialised due to both clashing schedules and a plain lack of response.

For various reasons, accessing documents, meetings for observations and interview participants varied in difficulty between cases and between groups. An excerpt from my reflexive fieldwork journal details a slightly exasperating process of trying to establish contact with a Bristol-based installer, but being refused once the person I had made initial contact with realised that I was not going to be advertising the company or promoting its work. This process was repeated until unfortunately I was not able to gain an installer's perspective in this context. However, employees at Bristol City Council, CSE and members of Bristol Energy Network were extremely welcoming and willing to discuss the Big Home Energy Upgrade and provide me with project reports and evaluations that they were working on in lieu of opportunities to observe at meetings.

In the Manchester context, everyone at Carbon Co-op welcomed me with open arms, viewing my presence as inherently positive and being interested in my opinion and input right from the start. However, in the Energy Saving Co-operative the relationship between me and the organisation was explicitly conditional – they allowed me to research them on the agreement that I gave something back such as producing meeting minutes and writing a

guest blog post. In terms of board members of the ESC, many of them were only willing to participate in an interview once they had already met me at meetings where I was observing and was able to explain the research to them and build a relationship with them. For example, one installer member told me:

"It's a good job I'd met you, we get so many requests for research that I would probably have ignored your email if I didn't know who you were"

Furthermore, the range of participants and key informants in each case was different, so for example, because the Carbon Co-op was a householder co-op, I gained valuable householder perspectives, whereas for the BHEU which was local authority led, I gained perspectives of different parts of the local authority as well as from their partner organisation, CSE, but far fewer community perspectives and no installer perspectives. From the Energy Saving Co-op, because some of the board members were installers, I was able to gain this perspective, but was not able to gain a householder perspective other than secondary data from the Northfield Ecocentre website.

This does not mean that the data from any case is more or less valid than the other, but is important to bear in mind when taking in the case studies as they are presented differently according to the data that was available.

4.3.2 Triangulation, validity and reliability in practice

The idea of triangulation mooted above is to get multiple sources of data to corroborate the same theme or category, but in reality this was very difficult to achieve and data sources varied wildly between cases. Some information such as targets and funding that I obtained from interviews in Bristol, I got from documents in Manchester or observations in Birmingham. In reality it was very difficult to get the same information from multiple sources, so instead I had to make judgements about what things to include and exclude as important parts of the cases.

The potential implications of this for the validity and reliability of the data are significant. My approach to this was to try to keep analysis and themes as close as possible to the data so that it accurately reflected the accounts given, and to take care in reporting so that if a theme was not shared by other sources it was either carefully illustrated as an individual perspective not a shared perspective or was not reported as a significant theme at all. Also,

themes and concepts were modified as the fieldwork went along, so that important issues such as ECO troubles or different forms of knowledge (survey data) were included in the list of topics later in the fieldwork process, reflecting the emerging issues rather than just the predefined ones from the literature review.

4.4 Summary

This methodology chapter has outlined, explained and justified the empirical approach and research design that has been used, as well as reflecting on some elements of the process and what these meant for the reporting of data in the empirical chapters to come. It has explored the benefits of the comparative case study approach and thematic analysis, as well as explaining the process of conceptual refinement and negotiation.

The methodology employed - particularly its focus on networks and multiple perspectives and factors - incorporated actors, concepts and issues operating at multiple scales, from individual people, to local and national organisations, along with national and international policy. Its focus on city-based actors also incorporated the context sensitivity required for examining the specifically urban elements of the issue. Despite the challenges of negotiating access, and inconsistencies in the data from different contexts, this methodology did successfully allow the theoretical framework to be operationalized in a way that met the requirements set out at the beginning of chapter 3. It produced rich data that represented a holistic approach to the problem of domestic retrofit, covering the specific social and technical issues with that problem, the personal experiences of the people and organisations involved, the broader 'landscape' issues around domestic retrofit, and the messiness of the place-specific, contingent elements of each of the urban responses to domestic retrofit under question.

The following chapters are the product of this methodology, marking the beginning of the empirical part of the thesis.

Chapter 5 - Macro-level context and conditions for domestic retrofit in English cities

5.1 Introduction

As detailed in chapter 1, one of the most prominent roles of improving the energy efficiency of existing housing through domestic retrofit in English cities, is that of contributing to carbon emissions reduction targets both nationally and globally. However, energy security and economic concerns are also entwined with those of climate change, which creates a nexus of sometimes competing and sometimes harmonious macro-scale – or 'landscape' - pressures acting on this issue (Bradshaw, 2010, Pearson and Watson, 2012 and Mallaburn and Eyre, 2014). Moreover, the growing dominance of neo-liberal, market ideologies globally has resulted in shifts in governance and policy at multiple scales, creating a complicated interplay between policy, government, markets and publics in relation to energy efficiency (Mallaburn and Eyre, 2014). This chapter will use an overview and analysis of the key international, EU and UK policies and regulations relevant to domestic retrofit to show how these issues above are manifest in the UK policy context. It will firstly describe the most relevant policy tools of the Green Deal and the Energy Companies Obligation and explore how these were produced over time as a result of landscape pressures, and outline the Localism Act 2010 to show how the localism agenda has over time interacted with the domestic retrofit agenda producing experimental retrofit activity at various different scales. Finally it will outline some of the most significant tensions and issues with this policy context, supported by empirical material from interviews and observations with actors working in and around retrofit-related policy at the macro-scale, and some extracted from the case study data (see methodology for details of participants and observations).

This exploration is necessary to define and populate the macro-context within which the three city-based case studies operate – i.e. the top level of each experimental assemblage, identifying the common actors and factors that are present for all cases. Each case may, though, have different connections with macro-scale actors and interact with landscape factors and pressures differently, or include or exclude some from the assemblage.

5.2 What was the policy context for responding to domestic retrofit in English cities?

The policy context for the three domestic retrofit case studies was dominated by two key policies: the Green Deal and the Energy Company Obligation, both of which were defined and their legal elements made explicit in the Energy Act 2011. These entwined policies were also heavily affected by elements of the building localism agenda and some elements of the Localism Act 2010 which has influenced the range of different spaces in which retrofit activity might be governed. This section overviews these three components of the policy climate.

5.2.1 Green Deal – the Coalition Government's 'flagship' policy.

The Green Deal began operation between October 1st 2012 and January 2013. It has two elements: it is both a financial mechanism which enables householders to access loan finance to pay for qualifying retrofit measures and pay back the cost through energy savings (previously known as Pay As You Save), and a framework for creating, supporting and upskilling a supply chain for retrofit, through defining a retrofit process and an industry recognised process of Green Deal Accreditation retrofit professionals. The 'vision' of Green Deal was:

"To regenerate whole areas and see them having a real facelift and looking nicer, for people to be warmer and paying less for their bills but for that to be integrated with other systems like district heating: it needs to be holistic and integrated so not just a retrofit market on its own, but insulation is crucial to this because it has to be fabric first." DECC official

Green Deal Finance

Green Deal finance was created as a way of overcoming what was perceived by EU and UK policymakers as the most significant barrier to deep housing retrofits: the upfront cost. With solid wall insulation installations costing upwards of £5000 alone, not including any of the other measures required for whole house retrofits such as heating upgrades, floor or loft insulation, and associated costs such as planning permission applications, domestic retrofit represents a significant initial outlay. Green Deal finance is based on the principles of Pay As You Save, which is designed on the following principles:

1. That the cost of the retrofit can be paid back using the savings made on fuel bills.
2. That the cost of paying back the retrofit over time must not exceed the fuel bill savings and render the householder paying more for their fuel bills than they did before the retrofit – this represents the 'Golden Rule' of Green Deal finance.

The element of the Green Deal finance arrangement that was particularly unique to the UK was that the loan finance was designed to be attached to the house through repayments attached to their electricity bills through the meter, rather than a loan attached to the individual, which it was intended would open up Green Deal finance to a wider number of householders who may not wish to take on personal debts, or may be limited in their ability to do so due to poor credit ratings (Eichammer et al, 2013).

Green Deal industry framework

The Green Deal industry framework was set up to establish a process by which householders could enter into the retrofit process, provided by professionals who were accredited to an industry standard in order to create trust and confidence in them and avoid the inclusion of 'cowboys' in the industry. The process was defined as follows:

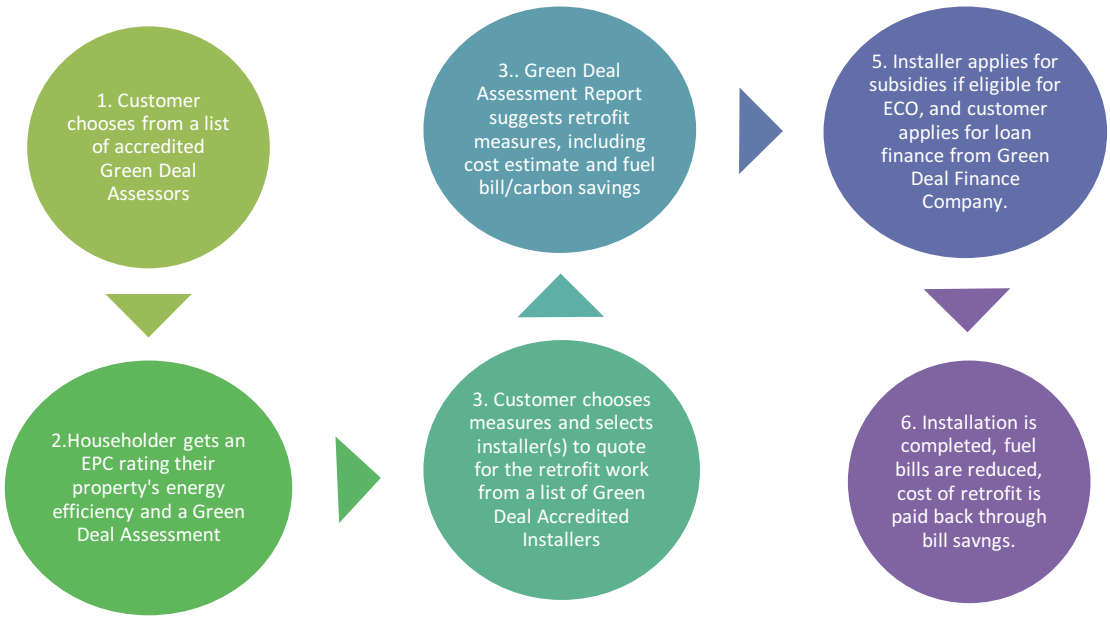


Figure 12 Green Deal Process

As part of this, new roles in the industry were created. Green Deal Assessors (previously known as domestic energy assessors) were those responsible for visiting the homes

interested in retrofit, surveying the property, completing an EPC if required, and using a survey method created by the Buildings Research Establishment (BRE), recommending a range of retrofit measures to the householder to improve the property's energy efficiency. Green Deal installers were installation companies who provided measures such as wall, loft and floor insulation, windows, doors, boilers and solar PV, but had gained Green Deal Accreditation through adhering to a newly created industry standard called PAS 2030 which is not a technical standard but a quality assurance system of reporting to the BRE who would then provide the installer with an accreditation certificate. Green Deal Providers were intermediary organisations that provided a combination of retrofit services including advice, assessments and installations. The Green Deal framework also involved a variety of temporary financial incentives such as the creation of funding streams for local 'Green Deal' projects such as Green Deal 'Go Early' which provided subsidies for the Core Cities to fund Green Deal measures, and schemes which paid householders back for undertaking domestic retrofit work, such as the Green Deal Home Improvement Fund, running between June and July 2014, then in March 2015.

A DECC official speaking in 2014 described the process of developing the Green Deal/ECO policy framework:

"We've put a whole new structure in place. I think people underestimate that when they talk about the Green Deal framework sometimes. We've set up a whole new standard in terms of PAS 2030 for everyone to operate to, set up a registration and oversight body to see that through, put in place all the IT structures that underpin all of that… Without that, Green Deal wouldn't have happened – it's the same with Green Deal Finance really, it's an intrinsic part of the offer. So all of that had to be set up and in place already - you know - the networking and relationships and infrastructure with the energy companies to make the money transfer, I mean all of that is huge: massive, massive chunks of work and legislation lie behind all of that and that was the early years really. We've put that infrastructure in place. That's been done".

5.2.2 The Energy Company Obligation (ECO)

Introduced as part of the Energy Act 2011 and legalised through The Electricity and Gas (Energy Companies Obligation) Order 2012, the Energy Companies Obligation (ECO) obliges large producers of electricity and gas - i.e. those who have more than 250,000 customers and supply either 400GWh of electricity or 2000GWh of gas to their customers in a year (OFGEM, 2014) - to provide funds to help improve the energy efficiency of domestic

properties in the UK. The amount that each energy company must pay is cumulative over the period of a year, and is dependent upon both a base level of carbon emissions reductions required (set by the government), and the market share of the energy company in relation to the other obligated energy companies. The Office of Gas and Electricity Markets (OFGEM) is responsible for administering, monitoring and enforcing the ECO in the UK.

The ECO is made up of three components, each of which contributes a different percentage of the overall obligation:

1. The Carbon Emissions Reduction Obligation (CERO), which includes insulation of 'hard to treat' properties – particularly solid walled properties which are difficult and costly to insulate because of disruption, the need for scaffolding, and the high labour costs, as well as 'hard to treat' cavity walls that are problematic for various reasons, incurring a higher than usual cost to insulate. The majority of the CERO is directed towards external wall insulation.
2. The Carbon Saving Community Obligation (CSCO), which directs funding towards carbon saving measures (mostly cavity and solid wall insulation) and connections to district heating systems in low-income or deprived areas, with 15% of this obligation being to low-income rural areas.
3. The Home Heating Cost Reduction Obligation (HHCRO), which involves the installation of heating systems (mostly boilers) and controls in low income households that receive certain qualifying income-related state benefits. (OFGEM, 2014)

The ECO provides a specification of which domestic retrofit measures energy companies can use to meet their obligation, under which part of the ECO they qualify, and whether they are to be the primary measure, i.e. they count towards the ECO on their own, or a secondary measure i.e. they count towards the ECO only when installed along with a listed primary measure. The overwhelming focus in ECO is upon solid wall insulation and hard to treat cavity wall insulation, which are measures that qualify under all three parts of the obligation. For CERO, other measures, such as loft and floor insulation, draught proofing, and district heating connections can qualify, but only as part of an installation that has

included an aspect of solid wall insulation or hard to treat cavity wall insulation. For CSCO district heating connections qualify with or without solid wall/hard to treat cavity wall insulation, and for HHCRO a much wider range of other energy efficiency measures such as draught proofing, heating controls, boilers and the installation of microgeneration technologies like air source heat pumps, CHP, solar photovoltaics also qualify as primary measures. The CSCO and HHCRO are the tools which relate closely to fuel poverty agendas, being targeted at vulnerable or low income households and communities. CERO, on the other hand is related to the particular circumstances of solid wall insulation and is not related to income or economic characteristics, and for privately owned and occupied properties is the component of the ECO that should be most applicable.

In December 2013, however, a series of changes were announced to the ECO: firstly the CERO component of the obligation was reduced by 33%, secondly the obligation period – the time allowed for the suppliers to spend their obligation – was extended from two years to four years, and thirdly loft insulation, cavity wall insulation and district heating systems were deemed eligible measures for CERO. The effect of these three changes was that the amount of ECO money suppliers were offering for solid wall insulation was drastically reduced across the industry (DECC, 2014c).

5.2.3 The Localism Agenda

Alongside the energy-efficiency specific issues and regulations there has been an ongoing debate in UK politics about localism, which has infused energy and sustainability debates in various ways.

The Localism Act 2011 intended to devolve power, responsibility and the structures of authority and decision making about various aspects of local development and regeneration and the provision of public services and infrastructure away from central government and towards local governments and communities. It intends to do this by promoting:

"• *new freedoms and flexibilities for local government*

• *new rights and powers for communities and individuals*

• *reform to make the planning system more democratic and more effective*

• *reform to ensure that decisions about housing are taken locally*" (DCLG, 2011).

In December 2011 the Core Cities Amendment was added to the Localism Bill which enabled the ten largest UK cities outside of London (Birmingham, Bristol, Cardiff, Glasgow, Leeds, Liverpool, Manchester, Newcastle, Nottingham and Sheffield) to be awarded funding from central government with which came greater power and control over their economic development and management of resources and infrastructures. In return they had to demonstrate the effective capacity and capability of the cities' or city regions' 'leadership' and the particular intentions and strengths of the city in terms of its potential for 'unlocking growth'. This involved what are termed 'Local Economic Partnerships' or LEPs, which include not only local authorities but also other public sector actors and private and community sector organisations as well – intending to create a 'new architecture' that defined cities as more than just their local authorities, particularly embracing the involvement of the private sector.

The overwhelming focus of these city deals is on encouraging city regions to bring in external investment to boost their economic growth prospects, both through corporate investment and from investment from supranational bodies such as the European Bank (DCLG, 2011), due to a gap between the economic performance of London and the other cities especially compared with other European countries. However, the intention of this is not to equalise economic performance and productivity to London, but to encourage variation and difference in economic approaches and development:

"It's not an effort to equalise economic performance with London or with each other, it's more about supporting local areas to empower them to accelerate growth locally – in theory if you equalise that would bring down the top performing cities and that would hinder economic progress, so that is not government policy…

….What the government wanted was for city deals to be bespoke and based on what the cities had identified as their own key economic challenges." Cities policy unit representative

What this actually means for domestic retrofit is that local decisions around economic planning, budgeting, responsibility for managing social housing standards and provision etc. and the prioritisation of retrofit as a local issue among these varying local demands and

pressures, is intentionally more dependent on the local governance network and local capacities and relationships than it may have been in the past (Hildreth, 2010). These locally context-specific actors and networks vary from place to place, which means that although much of the attention on the Localism Act is placed upon local authorities' changing roles and responsibilities, the influence of non-government actors is both more prominent and less prescribed. Demonstrating who government considered the key actors to be in relation to energy, it was in fact the private sector team who oversaw the energy-related areas of the City Deals, with some involvement from the infrastructure team.

The Localism Act and the Core Cities Amendment sit apart from The Energy Act and the Green Deal and ECO policies but over time – both before and after its publication - aspects of the localism agenda have become increasingly interwoven with energy issues. More locally-focussed components of broader energy and climate change related policy emerged such as the Low Carbon Communities Challenge in 2008-9, which had particular spatial foci and employed socio-technical approaches combining capital measures such as solar PV, insulation and energy efficient lighting, with behaviour change and advice services:

As DECC (2011) described them:

- *"The projects are geographically targeted, area-based initiatives*
- *They involve integrated packages that provide a more joined up offering to householders*
- *They are testing different models of community-scale delivery, from projects which are led by community groups through to other projects which involve existing agencies (e.g. local authorities, energy utilities) delivering their services in a geographically-targeted way.*
- *The approaches draw upon sociological models of behaviour that emphasis the potential for social norms to nudge and trigger widespread, community-wide behaviour change."*

In a similar vein there was the London based Low Carbon Zones programme in 2009, and the competitive Local Energy Action Funds (LEAF) in 2011 for community projects addressing energy efficiency at the neighbourhood or sub-urban scale.

In specific relation to the Green Deal, though, the £10m Green Deal Pioneer Places fund aimed at smaller local authorities (or consortia or local authorities) and the £12m Green Deal 'Go Early' programmes specifically for Core Cities were introduced in 2012, which were specifically designed to 'kick-start' Green Deal activity in their areas, prioritising the number

of Green Deal plans, the street by street approach and the ability to stimulate further green deals using demonstration projects and open homes, testing marketing approaches and tackling issues with planning (DECC, 2012)

As the Cities Policy Unit representative described, these programmes were the product of a 'deal' between DECC and DCLG, and were not expected to produce uniform results but a variety, depending on decision-making and capacity within the cities' governance networks:

"DECC identified that it wanted to work with the cities on testing certain areas and negotiated with the DCLG and the Cities Policy Unit on that and then the cities were approached with that proposition. From then on it was between the cities and DECC. What we would expect to see is that some cities will have particular strengths or interests when it comes to energy efficiency, and others will have less, and it's up to them how much they commit to this."

The latest iteration, the Green Deal Communities programme announced in 2013 for any local authority or consortium, running between 2014 and 2015 was an 'upscaled' version of these pilot programmes, coming after the official start of Green Deal in January 2013. They were still experimental: 'testing' ways of delivering Green Deal and ECO, but at larger scales in terms of the targeted numbers of properties, with a total funding pot of £88m. The Green Deal Communities projects across the country have been delivered through various partnerships between local authorities and third sector organisations, some in partnership with energy companies such as North London with Eon and main contractor Instagroup, some with one large delivery partner such as in Bristol with Climate Energy or with a framework of three retrofit contractors such as in Manchester. Some used social housing schemes to deliver additional retrofits to privately owner occupied households such as in Nottingham and others like Telford worked with existing regeneration schemes. Most have utilised local community groups as 'lead-generators' – finding interested households in return for a referral fee. Whatever the partnerships, the Green Deal Communities scheme prioritised the street by street approach again, but also focussed heavily on the blending of multiple sources of finance such as Green Deal, ECO and DECC grants, continuing to target the privately owned and occupied market:

"The street-by street approach is really important and we really wanted the projects to test that. We wanted it to be that you could walk down a street and have a universal offer of some description depending on what the households need and with different ways of funding that depending on their ability to pay. It was trying to bring the ECO market and the

private market together to unlock it and to be able to do more. ECO is still only really scratching the surface – somehow you've got to unlock the private market" DECC official

This series of locally-focussed retrofit programmes demonstrate a vision that DECC had about engaging private homeowners and bringing together retrofit for different types of tenure on a street-by-street or area based basis. They also show how place-specific consortia – usually involving local authorities – have been made responsible for creating local retrofit markets and working out how to make the DECC vision of retrofit become realised. This shifting of responsibility to sub-national coalitions of local state institutions, non-government organisations and the private sector reflects quite clearly the trend highlighted in the literature review, of the emergence of new state spaces, or territories of activity at the sub-national, or urban regional scale (Brenner, 2004 and 2009 and Swyngedouw, 2004 and 2009).

5.3 Where did this policy regime come from?

The intention of Green Deal and ECO was that effectively the UK government was shifting the responsibility for funding domestic energy efficiency improvements away from taxation, levies on fuel bills and government subsidies, and towards individual homeowners (Guertler et al, 2013 and Mallaburn and Eyre, 2014). Green Deal finance was intended to remove what was thought to be the most significant barrier to retrofit for private homeowners – the upfront capital cost – with the Golden Rule protecting people against overly high loan repayments. The CERO component of the ECO was meant to supplement Green Deal finance to cover the particularly high capital cost of insulating 'hard to treat' properties using solid wall insulation (particularly expensive external wall insulation) and technically tricky lofts or cavity walls, thus addressing the issues with the large proportion of ageing and solid walled housing stock in the UK.

However, many aspects of the Green Deal, ECO and the Localism agenda combined are not novel or standalone: they are the product of a long and complex set of policy shifts and trends around climate change, energy security and economic crisis. They represent a particular set of priorities configured in a particular way because of the political and economic circumstances in which they have emerged and from which they have been produced, which heavily dictates how they are interpreted and responded to in urban contexts such as those of the case studies. It is important to explore the nature of some of

these shifts through some key policies and tools, in order to understand their impact and influence on place-based activity and the context that they have created for the case studies to work within.

5.3.1 Peculiarly British policy obsessions: insulation, boilers and supplier obligations.

It is important to note that there has also been a particular journey of peculiarly British energy efficiency policy approaches relating to insulation and heating systems as the technological 'fixes' for any of the triad of energy related issues (but particularly in relation to fuel poverty-related risks) and a constantly evolving agenda around obligations on energy suppliers to provide funding for these things (Mallaburn and Eyre, 2014).

The journey of these two intertwined agendas gives a background to how the Green Deal and ECO policy tools in particular have been produced over time. As far back as the 1970s the 'Save it!' and Home Insulation Schemes focussed on both collective commitment to using less energy in the fact of a national crisis of blackouts and energy supplies and on protecting vulnerable households from cold and damp risks through insulation. The Home Energy Efficiency Scheme in 1991 continued this provision to poor and vulnerable households, alongside an early acknowledgement of the potential risks of climate change and another behaviour change campaign around reducing energy use. This trend was continued with the Home Energy Efficiency Scheme and Warm Front through the 2000's, which consisted of state subsidised cavity wall and loft insulation and upgrades to gas central heating for households on certain benefits and at risk of health and financial vulnerabilities, such as the elderly. Alongside this, the Decent Homes programme was introduced from 2000 onwards which set standards of living for social housing and the UK government committed to upgrading social housing nationwide to this standard for the next fifteen years. Part of this included addressing issues of damp and cold, which had a natural crossover with energy efficiency and retrofit activity. More recently, the UK's boiler scrappage scheme in 2010 encouraged people to trade in their old boilers for a £400 replacement, instead of the usual £2000 to replace a boiler, but this did not apply only to the vulnerable – it was qualified for by the age of the boiler.

Energy Supplier Obligations (ESO's), such as the ECO, developed independently of EU policy, and have now become the single biggest way of funding energy efficiency improvements in the UK , growing from approximately £25m per year in 1994 to around £1.2bn per year in 2012, combining with government insulation schemes along the way. ESO's were first introduced in 1994 to incentivise reduced energy use and the delivery of energy services at the least possible cost, as part of a process of liberalising electricity markets in the Thatcher era, according to Rosenow (2013). The predecessors to ECO were the Carbon Emissions Reduction Target and Community Energy Saving Programme (CERT and CESP) which ran from 2008-2012, and before that the Energy Efficiency Commitment and Energy Efficiency Standards of Performance (EEC and EESoP) which ran from 2002-2008 and 1994-2002 respectively.

The growth in supplier obligations was the result of a number of gradual changes rather than specific crisis events, with influences ranging from concerns over increasing energy bills, increasing incidences of fuel poverty, changes in government personnel and institutions dealing with the ESOs, and increasing confidence in suppliers to meet higher and higher obligations (Rosenow, 2013). Over time, despite neither being the original purpose of ESO's, fuel poverty and climate change wrestled for position as being the main objective. Particularly in the early 2000s under the Labour government, fuel poverty became an explicit responsibility of the supplier obligations, introducing the provision of energy efficiency measures for both households in receipt of certain benefits and certain geographical communities (particularly under CESP), and reflecting the foci of the previous government insulation schemes listed above (Mallaburn and Eyre, 2014 and Rosenow, 2013). However, with the ratification of the Kyoto Protocol in 2005, although these installations continued, carbon emissions reductions once again became the explicit primary purpose of the EEC in its second period, and as an ex-policy advisor describes it:

"There had always been two strands to energy efficiency schemes: firstly issues around the quality and liveability of buildings, which had always been more linked to housing standards and more linked with housing policy and then climate change. Setting that target of 80% [by 2050] was what really drove the need for 'deep' retrofit" Former EST Advisor

Furthermore, the ESOs over their life have created a huge market for the energy efficiency industry: installations of cavity wall insulation are thought to have increased from under 50,000 per year without the SOs to around 550,000 per year under CERT (Rosenow, 2013).

This increased especially as the technical specificity of the obligations changed – initially suppliers could choose what measures they provided to households, but from 2008 there was a requirement for at least two thirds of the obligation to be met by providing insulation measures, largely consisting of providing heavily reduced or free loft and cavity wall insulation to householders across the UK.

Where Green Deal and ECO differ from previous programmes is that they have shifted the technological focus from cavity wall and loft insulation to the more complicated and costly solid wall insulation. Equally significant are the changes in the financial elements of Green Deal and ECO: Gone are all remnants of state subsidised insulation programmes – this setup presents loan finance as the 'solution' to a lack of retrofit, and the suppliers obligation (ECO) as a supplement to this, which is also charged with tackling fuel poverty through the HHCRO and CSCO components. There has also been, rhetorically, a shift away from insulation being something primarily for vulnerable households and towards a focus on the larger, owner occupied market, as well as positioning retrofit as an economic fix for the effects of the financial crisis in 2008 through creating the Green Deal industry.

"There's the view that markets are definitely being made increasingly responsible for energy efficiency, and with that looming second period [of carbon emissions reductions] it pushed the focus on that 'middle' sector of society who weren't poor enough to get the subsidies but weren't wealthy energy efficiency enthusiasts either. There was an acknowledgement of the need for some element of external financing to access that sector." Former EST policy advisor

The current policy climate for energy efficiency demonstrates a hybrid of elements that have been both long established in UK policy, such as the energy efficiency programmes discussed above, technological specificity and an obsession with insulation, and simultaneously 'newer' elements such focussing on markets and private-sector rooted responses rather than service provision, and a particular manifestation of localism - policy outlined at national level but 'delivered' by local consortia. The specific changes in approaching insulation schemes and supplier obligations demonstrate how oscillations between landscape issues have become embedded in the policy in different ways over time: in the same way as the previous programmes reflected shifting agendas in terms of fuel poverty, energy security and climate change, the current programmes very clearly reflect the acuteness of the austerity agenda post-2010.

However, the Green Deal, ECO and Localism Act combined not only reflect the specific context of post-2008 economic crisis, but a long shift towards marketization of energy efficiency policy, and also the shift towards localised implementation of national policy, as shall be explored below. The following section explores the roots of many of the elements of the Green Deal and ECO through International, European and UK policy and governance.

5.3.2 International commitments to climate change

Over a period of time between the first Earth Summit in Stockholm in 1972, and the present day, climate change and the importance of reducing greenhouse gas emissions in order to mitigate it has become increasingly important as an international political issue, marked by particular events such as the publication of the Brundtland report "Our Common Future" for the UN World Commission on Environment and Development in 1987, the establishment of the International Panel for Climate Change in 1988, and the Earth Summit in Rio de Janeiro in 1992 which produced the United Nations Framework Convention on Climate Change (UNFCCC). However, the most significant of these occurred in 1997, when the Kyoto Protocol was developed for the UNFCCC as an internationally legally binding commitment from participating nation states to cut their carbon emissions as an effort to stem the progress of, and mitigate against the effects of, climate change. The Kyoto Protocol entered into force in February 2005.

The implications of signing up to the Kyoto protocol for the UK were many, but can be summarised into three broad themes: firstly, that the commitment to reducing greenhouse gas emissions was legislated by the Climate Change Act in 2008, secondly, that the UK entered into this commitment as part of a 'bubble', sharing the commitment with other EU countries and binding itself to EU climate change policy and strategy, and thirdly, that the commitment to reduce greenhouse gas emissions was organised by the Kyoto protocol in certain ways, such as the definition of different commitments for different periods of time, and the promotion of carbon 'trading' as a key tool (amongst others) for reducing emissions (Gupta, 2010). The first period of commitment ran from 2008-2012, and involved reducing greenhouse gas emissions by 5% from 1990 levels. The second commitment period runs from 2013-2020 and involves reducing GHG emissions by at least 18% of 1990 levels.

5.3.3 European Union (EU) Policy

Being a member of the European Union impacted heavily the methods, tools, organisation and financing options available for those involved in practices relating to energy efficiency in the UK, partly because of being part of the EU 'bubble' of climate change and emissions reductions relating to Kyoto as described above, but also in terms of an ideological approach. The overarching principles of market liberalisation and economic competitiveness in energy industries and networks are embodied in some key elements of EU legislation and policy such as firstly, a focus on carbon pricing and finance options, and secondly, regulating the application of State Aid – i.e. state funding - for energy efficiency projects (Pearson and Watson, 2012) by adopting the principle of open competition for public funds in providing any public service. This is intended to stimulate innovative activity in the private sector without stifling 'competition'.

The specific aspects of EU policy contributing to and emerging alongside the Green Deal and ECO, though, are the Energy Efficiency Plan 2011, the Energy Efficiency Directive 2012 and the Energy Performance in Buildings Directive 2010. The Energy Efficiency Plan highlights the broad priorities and objectives around energy efficiency including a deliberate primary focus on improving energy efficiency in buildings – particularly space heating. It also proposes a set of particular measures through which to approach this, including encouraging Energy Services Companies (ESCos) to act as intermediaries for finance and co-ordination of energy efficiency works, changing energy and carbon taxation and carbon pricing to make energy efficiency more feasible as an investment, making more sources of loan finance and EU grant funding available for energy efficiency projects and using improved energy efficiency to improve the economic competitiveness and energy independence of EU member states. In this plan the entwinement of economic concerns, energy security and the focus of responses on finance and pricing are quite clear.

The Energy Efficiency Directive 2012 and the Energy Performance of Buildings Directive 2010 are more prescriptive and make certain aspects of policy and practice in EU member states mandatory although there is some national and regional variation in their interpretation. The Energy Efficiency Directive 2012 in particular was the legislative product

of the Energy Efficiency Plan, and includes the following stipulations in relation to domestic retrofit, that member states must address (From ECEEE, 2013):

- A long term strategy for the renovation of domestic properties, including 'deep' renovations (i.e. whole house retrofits).
- Setting up and providing a system of 'high quality, cost effective' energy audits, and the associated training and accreditation for the auditing system.
- Removing barriers to energy efficiency, including financial ones, and establishing effective financing facilities for energy efficiency improvements.

The Energy Performance in Buildings Directive contains more specific targets and prescriptions in relation to buildings in particular that add technical detail. It sets out an objective of having all new buildings be 'nearly zero' by 2020 and requires specific components and systems to be considered in energy performance calculations of buildings, including:

- Minimum energy performance standards for appliances, systems (e.g. heating) and certain components of buildings (e.g. walls or glazing) when they are new or retrofitted.
- Member states to set and publish minimum energy performance standards for existing buildings when they are renovated or a significant part of them is renovated in line with the standards for components as mentioned above.
- Energy performance calculations and inspections of these systems and components to be carried out by accredited people and lists of accredited people provided to the public.
- It sets out the conditions upon which Energy Performance Certificates are to be issued for buildings, e.g. upon sale or transfer of the property.

It is important to note that there are other directives and elements of these directives that are extraneous to domestic retrofit, but that may influence aspects of it, such as those relating to air quality or renewable energy, but - whilst the potential interplay is acknowledged - for the purposes of bounding this chapter, these are not examined in detail.

In summary, EU policy and regulation has directly shaped certain key aspects of the domestic energy efficiency policy context in the UK such as the use of carbon pricing in

addressing energy efficiency, the prioritisation of existing domestic buildings for energy efficiency improvements, and defining the kinds of tools and instruments that are recommended to meet these commitments. There is a clear request for an accreditation system and particular attention on the auditing and inspection – or survey – process as underpinning retrofit – as we see in the Green Deal process. There is a particular focus on financing retrofit, as well as the specific standards and conditions of using EPCs being applied to new or significantly renovated buildings. What this context does, though, is leave a significant regulatory gap where existing, not heavily renovated buildings are concerned, i.e. the kinds of retrofit promoted by Green Deal/ECO are not supported by regulation, only by financial incentive and industry accreditation (Mallaburn and Eyre, 2014). The key themes and priorities of the above policy and strategy instruments from the EU are shown in the diagram below.

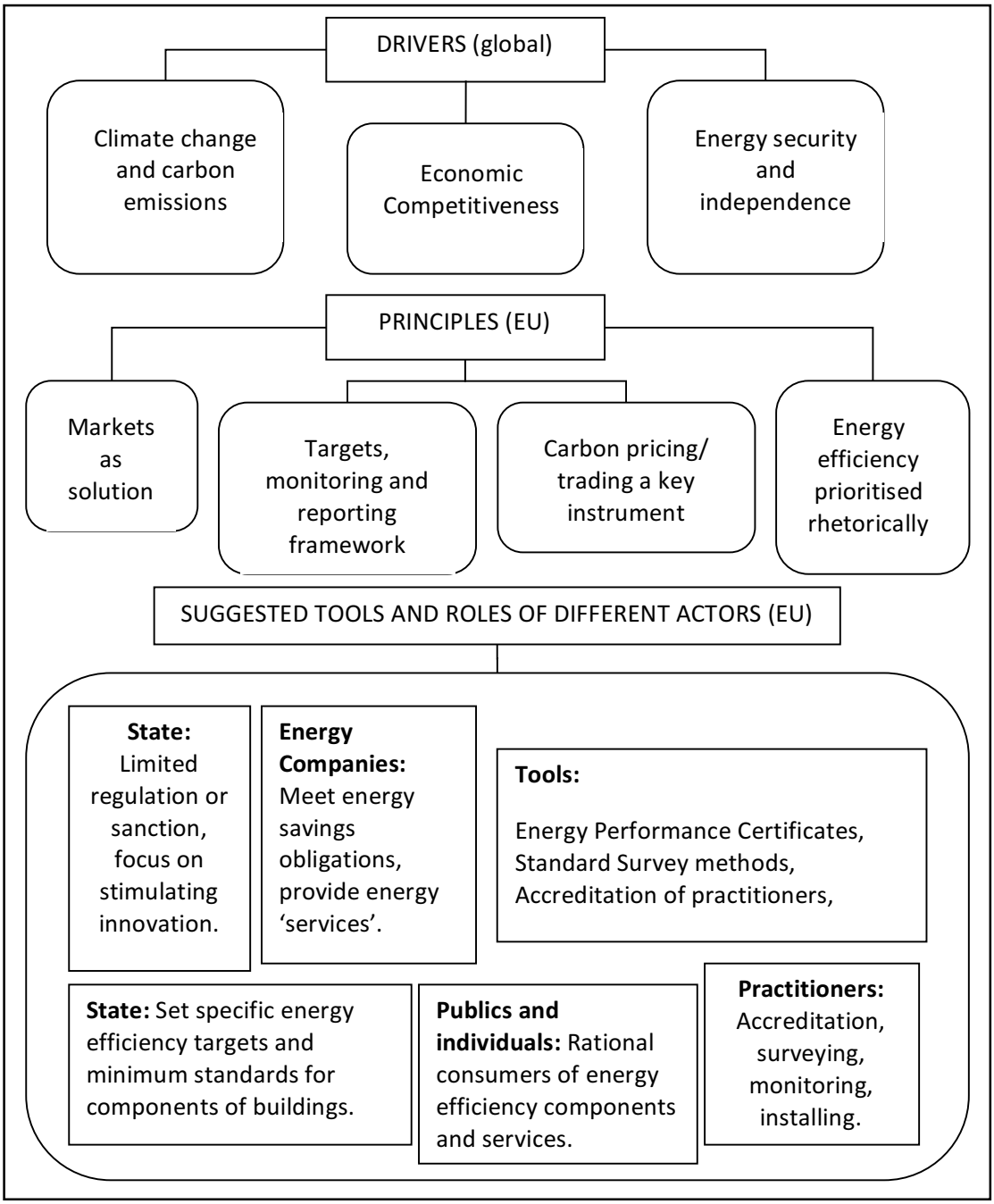


Figure 13 EU Policy influencing domestic retrofit in the UK

5.3.4 UK Policy and governance of energy efficiency and retrofit

Despite clearly adopting in Green Deal and ECO many of the principles and tools featured in the EU policy context, there is a noticeable difference between EU and UK priorities: UK priorities include a much stronger focus on fuel poverty in the wake of increasing energy prices and an increase in the number of households in fuel poverty. This is alongside a broader, ongoing national debate on energy supply security in the UK whereas EU policy is almost exclusively driven by climate change concerns and targets (Boardman, 2007). The

tensions and shifts between agendas shall be outlined below through an exploration of general energy policy changes in the UK in the last twelve years.

National energy policy strategies – shifting political agendas.

National Energy Policy strategies began with the UK's 2003 Energy White Paper entitled 'Our Energy Future – Creating a Low Carbon Economy', which was the first clear energy policy document in twenty years, and it set out a series of principles and key challenges that were based around two clear drivers of climate change and energy security. It identified four goals:

- *" to put ourselves on a path to cut the UK's carbon dioxide emissions - the main contributor to global warming - by some 60% by about 2050, as recommended by the RCEP, with real progress by 2020;*
- *to maintain the reliability of energy supplies;*
- *to promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve our productivity; and*
- *to ensure that every home is adequately and affordably heated."*

DTI (2003, p11)

What this strategy did for UK energy policy was to make climate change a very serious political priority, and define the principles underlying energy policy as a unique policy area as opposed to amalgamated into other departments (Bradshaw, 2010, Mallaburn and Eyre, 2014 and Boardman, 2007). In 2006, an Energy Review was consulted on and in it a clearer set of proposals were made, in the three broad themes of saving energy, cleaner energy, and the energy security challenge due to the new and – to some - worrying position of being a net energy importer. Domestic energy efficiency emerged as a prominent component of the proposals, with attention on energy pricing markets to solve issues of fuel poverty, and all other consumers viewed as rational actors who could be expected to invest their own capital in energy efficiency measures in order to achieve lower running costs and meet the objective of reducing household energy consumption (Boardman, 2007).

Subsequently, a further energy White Paper entitled "Meeting the Energy Challenge" was published in 2007, which built upon progressions in European Policy (those issues

contributing to the Energy Efficiency Directive outlined above), results of the Energy Review in 2006, and added some specificity to the principles outlined in the 2003 version. This white paper is thought to have been published in response to the highly contentious public and political debate around the potential for nuclear power to meet energy efficiency challenges (Boardman, 2007 and Mallaburn and Eyre, 2014). Whilst not directly impacting domestic retrofit per se, the nuclear debate did boost the visibility of energy as a political issue.

Around the same time, in July 2007, a draft Climate Change Bill was published which detailed how the UK would go about setting statutory, mandatory climate change targets. It included the concept of five-year carbon budgets in line with Kyoto and EU policy with interim targets for those periods. In terms of principles, it continued to discuss energy efficiency as a requirement for meeting carbon emissions, to promote market liberalisation in line with the EC's approach, emissions trading schemes for both small and large businesses, and continued to prioritise existing households as a focus area for improving energy efficiency. However, in the detail of the White Paper, there were more specific proposals for improving household energy efficiency, such as:

- Improving energy efficiency of components e.g. lightbulbs and appliances.
- Incorporating and increasing energy suppliers' obligations in a Carbon Emissions Reduction Target (CERT) – which later became the ECO, targeting assistance towards those in fuel poverty and encouraging suppliers to becoming broader energy services providers rather than just selling units of energy.
- Rollout of smart meters and clearer billing to consumers to give information on energy use/carbon emissions (so they can switch suppliers, change behaviour and so on)
- Introducing EPCs for assessing household energy
- Making new homes carbon zero (or nearly) from 2016

These proposals show that despite attention on appliances, billing and metering in existing homes, there is a lack of attention on existing homes' energy efficiency performance overall, as opposed to new homes, which have strict standards and targets. Also, despite the imminent arrival of the Climate Change Bill, there was an increase in attention on

energy security and fuel poverty in the UK specific context: By this point, the number of households spending more than 10% of their income was calculated to have increased considerably, up from 7% in 2003 to over 15% in 2007 (DECC, 2012) and fuel poverty was becoming a serious political problem.

By the time the UK Low Carbon Transition Plan (LCTP) was published in 2009, the Climate Change Bill had been consulted on and brought into force through the Climate Change Act in 2008 and the UK was committed to a legally binding target of reducing its carbon emissions reductions by 80% of 1990 baseline levels by 2050. The LCTP marked a progression from previous strategies because it attached specific targets to homes and committed a large sum of funding specifically towards energy efficiency improvements. It made a priority of the pay as you save (PAYS) method of retrofitting houses – what became the Green Deal - in order to overcome upfront cost barriers for households (where the upfront cost of energy efficiency improvements – i.e. retrofitting measures are paid for through the savings made on energy bills), introduced the Feed in Tariff – a payment for people who used low carbon sources to generate heat and/or electricity, and, crucially, began to acknowledge the role of energy efficiency related efforts at different spatial scales. Communities, cities and towns became the locus of 'green innovation' and sustainability strategies. This was a departure from the attitude of previous policy styles, which largely viewed energy efficiency primarily as a relationship between individual households and national-scale regulation, intervention or provision (Kern et al, 2014). It was at this time that the localism agenda in the UK was building momentum prior to the Localism Act 2010 and ideas around decentralisation and devolution of power to localities in the wider political sense as well as in relation to energy and energy efficiency, were taking hold.

Furthermore, there was a clear prioritisation of 'demand-pull' policies, i.e. market mechanisms that 'tweak' relationships between suppliers and consumers rather than 'supply-push' policies that directly regulate, or support technological development, research and learning, reflecting the increasingly neoliberal nature of policy. Nonetheless, the LCTP marked an explicit effort, in the light of the recent Climate Change Act, to meet the national commitment to reducing carbon emissions and ensuring better energy security. The creation of the dedicated Department for Energy and Climate Change (DECC) brought these concerns together into a coherent department that recognised the entwinement between

supply and demand side policies, and the general commitment to energy efficiency was strong (Mallaburn and Eyre, 2014).

The Low Carbon Plan and Economic Crisis

The Carbon Plan (HM Government, 2011) was the next, and is the most recent overall energy and climate change policy document. In many ways it continued the aims of the LCTP, covering electricity generation including a reinstatement of nuclear power, plans to stimulate and encourage the use of low carbon heat, reducing emissions from industry and transport, and a whole chapter dedicated to 'Homes and Communities'. In the Carbon Plan, buildings and retrofit are even more prominent, with specific emphasis on cavity wall insulation, solid wall insulation, and smart meters. This plan, along with the legal tool of the Energy Act 2011 also made explicit the Green Deal and the Energy Companies Obligation. The Carbon Plan also has a particular focus on technological and design innovation and on financial support for such initiatives provided by the Green Investment Bank. There is, though, a new and strong focus on the role of domestic retrofit in generating jobs and developing the 'green' industry and on the role of local, 'community' embedded activity in stimulating demand for energy efficiency services, which reflects a far more economically driven agenda than the largely climate change driven LCTP, which was largely climate change driven, and previous strategies which concerned energy security.

One of the major differences between the Carbon Plan and the LCTP is the political context in which it was produced: of post-economic crisis austerity measures and severe budget cuts. Austerity resulted in the disbanding of key NGO's such as the Sustainable Development Commission and removed central government funding from the Energy Saving Trust and the Carbon Trust, who were key actors in the provision of energy efficiency advice in previous energy efficiency programmes. It is also manifest in the specifics of the Green Deal and ECO in a drastic reduction in central government funding for energy efficiency, instead promoting private loan finance in Green Deal, and in the explicit expectation of 'industry' and 'market led' organisation and 'delivery' of the Green Deal/ECO.

This results in a conundrum for the local actors working on retrofit, as described by the GM retrofit partner:

> *"This government is not really about true localism and empowering cities but is more about pushing pressures and issues back onto localities and not really bringing the funding with it which is what we have with Green Deal. GM is supportive of a shift in resource and governance to a sub-regional city focus… but it's happened at the same time as a huge retrenchment in public expenditure. So it's been part of a local government reduction plan at the same time which puts us in a really difficult position."*

It is under this context that the aforementioned competitive place-based funding schemes such as the LEAF funds for community projects, and the Green Deal Pioneer Places, Go Early, and Green Deal Communities schemes were created. Bearing in mind the acknowledgement from those involved in the City Deals and localism agenda that there would be local variation in responses, and that this was to be expected and even desired, this creates a context for uneven responses and progress around domestic retrofit. This scenario reflects the landscape trend towards the positioning cities and regions in competition with one another, encouraged by neoliberalised policy and competitive funding (Brenner, 2004 and 2009, Jonas et al, 2011, Gossop, 2011 Swyngedouw, 2004, Massey, 2007 and Marcuse and Van Kempen, 2000).

The product: varied policy experimentation

These shifting national energy strategies and devolved power to cities and places, as well as the emergence of the PAYS financial mechanism, increasing focus on surveying or 'auditing' tools such as the EPC and other forms of home energy assessment from EU policy, and the anticipation of the Green Deal framework, created a spate of activity between 2010 and 2014 in the form of projects testing various aspects of this emerging policy regime at varied spatial scales. DECC's Pioneer Places and 'Go Early' schemes mentioned above are one example, but other activities at various spatial scales have been attempting to 'try out' elements of the emerging policy context. The LEAF projects launched in 2011 supported sub-urban scale projects such as delivering EPCs, energy advice, and installing solar PV panels on community buildings to generate electricity. At a national scale the Superhomes network was established to demonstrate and share experiences of successfully retrofitted individual homes, and Forum for the Future, a project supported by the Technology Strategy Board (TSB) and Innovate UK was developed between 2011 and 2013 to 'test' the possibilities of whole house retrofit, providing funding to retrofit 100 test homes nationwide

to 80% carbon emissions savings. A PAYS pilot was undertaken in Sutton, North London, which tested the takeup and practicalities of the finance mechanism for retrofits.

These projects, along with many others, display a trend of experimentation with various aspects of the policy from the financial to the technical, to the assessment process or the management of networks, at various scales. They often employ multi-actor, cross –sector collaborations, involving a range of actors from grassroots environmental organisations, local authorities and housing associations to energy companies. This policy approach, which views places as 'test beds' for low carbon or energy-related activities is akin to the theoretical concept of 'strategic niche management' (Kemp et al, 1998): encouraging experimentation and innovation in hyperlocal, specific contexts in the explicit hope that 'models' or 'lessons' can be used from these experimental activities to transfer or replicate to other contexts and generate regime.

5.4 Policy analysis – regulatory gap, expensive finance, lack of clarity and consistency.

In reality, the Green Deal and ECO combination has struggled to deliver the widespread commitment to energy efficiency in the British public that it was intended to, with only 1612 Green Deal Plans (loan finance repayment plans) in place at the end of December 2013, a far cry from the government's predicted 10,000 in the first year of the scheme (Construction Index, 2014). The Green Deal/ECO has suffered from a lack of political confidence and consensus from within the government and the energy efficiency industry, and changes in personnel dealing with it – most notably the resignation of Chris Huhne in 2012, who designed the scheme (Guertler et al, 2013). It also suffered from a lack of clarity: about who was going to provide finance beyond a vague combination of private financiers, about exactly how and by whom ECO would be blended with Green Deal finance to meet the high costs of external wall insulation, and about what kinds of organisations would become 'Green Deal Providers' and from the start, sign ups to become Green Deal Providers were well behind what was expected (Guertler et al, 2013). There were delays and confusion around when Green Deal Finance would become available – the date changed from Autumn 2012 to early 2013, and what was meant to be a public launch in October 2012 became a 'soft launch' and then a 'gradual rollout' of the scheme. All of this, combined with poor

media representation of the scheme, with numerous 'horror stories' of Green Deal retrofits emerging (see 'British Gas botched our insulation' in the Telegraph, 2104) and continuous question marks about whether the Green Deal would tackle fuel poverty (Independent, 2013) meant that the Green Deal framework has struggled continuously. Very recently in July 2015 funding for the Green Deal Finance Company has been cut by the newly elected Conservative government, with no replacement energy efficiency scheme on the horizon.

Some of the most commonly raised issues with working with Green Deal and ECO are explored in further detail below.

5.4.1 Complexity, inconsistency and lack of clarity around policy.

Despite the technical specificity and the shifting of responsibility from state to local networks and markets, there was still an expectation from actors on the ground that there would be more guidance and advice from DECC about how the green deal process would work in practice. Observations at a Green Deal briefing day in October 2012 at the point at which Green Deal should have been launched, showed an Eon representative speaking publicly about his struggle to comprehend exactly how ECO money would interact with Green Deal Finance, what the role of the Green Investment Bank was, and whether their ECO money should be awarded directly to partners or brokered. This was in response to suggestions from DECC that a certain proportion of ECO money should be put into a 'blind brokerage' system, which never materialised. This view was supported by members of the audience, and also emerged in an interview with a key third sector organisation:

> *"The trouble is none of us know how much ECO is going into brokerage. We've always known that not all of it would, but for companies and projects trying to access it it's impossible – especially when you see British Gas doing a lot of the work themselves."* –SHAP representative

Some industry actors also struggled to make sense of the Green Deal offer and process, unclear who was responsible for which parts and what it was offering in terms of a financial product or an installation service:

"We are used to working with people either who know what they want or if they don't we tell them what they want and they listen to us. We have that relationship directly with them. With this, it's something else entirely. Am I supposed to know how their finance arrangement works? I'm a building contractor! Who's dealing with the customer? I'm in the industry every day and I don't understand it so how is a homeowner with no expertise meant to understand it?" Energy Saving Co-op installer member 2.

In terms of the ECO there were also ongoing issues and inconsistencies with accessing and spending the ECO money which emerged as the cases progressed, exposing the lack of clarity at national level:

> *"ECO is, as you know, ridiculously complicated. We had thought it would all be available in a pot to dip in and out of – but that turned out not to be the case."* – BCC project co-ordinator

Furthermore, the accreditation framework set up for the industry (PAS 2030 accreditation), which installers were required to have if they wanted to access ECO or Green Deal related work, as well as the reporting and auditing process required for installations to qualify for ECO subsidies – presented some significant administrative challenges:

> *"For every boiler we install we have to upload 30 documents to get the ECO. We've done 20 boiler installs this week – that's 600 documents!! I do realise the need to stop cowboys but this is ridiculous." Energy Saving Co-op installer member 1.*

Compounding these issues with a lack of clarity around ECO and Green Deal, there was a persistent lack of trust in the energy policy climate, which was seen as being sporadic and unstable. The Feed-in-tariff introduced in 2009 had contributed to the rapid growth of the solar PV industry, but was abruptly slashed in 2011, from 46p per kWh to 21p per kWh. This created significant problems for community schemes and installers alike, whose incomes depended on the FiT's attractiveness as an investment, which left a feeling of uncertainty throughout the emerging energy efficiency industry. Alongside the inconsistent media and government support and endorsement of Green Deal, and followed by the changes to ECO in late 2013, this created a very uncertain atmosphere for retrofit installers, advisors and intermediaries alike:

> *"Our turnover went from £3.1m to £800k in 2012. The work just fell through the floor when they cut it, and you know as that agenda moved away from PV it became about the whole house, and we needed to be prepared for that like we always try to be but we're worried that something similar will happen."*

The quote above is from an ESC installer member, who demonstrates this issue as he describes the effect of the FiTs cut on his small business.

5.4.2 Difficulties transitioning from social housing to privately owned and occupied market:

Other difficulties with the Green Deal/ECO policy regime focussed on the shift from social housing to privately owned and occupied housing. Previous schemes such as CERT and CESP had created existing relationships and infrastructure between social housing providers energy companies and contractors, and much of the ECO was far easier for energy companies to deliver at scale in social housing or deprived communities, which also often offered measures with 100% funding so there was no upfront cost to the homeowner, landlord or provider. One-by-one arrangements with privately owner-occupied housing in which every homeowner represents an asset holder with complex life circumstances, preferences and motives, and in which they must usually contribute a significant sum of their own capital and/or be willing to take on a significant level of disruption, which makes engagement a greater challenge:

> *"The trouble with the private properties is that you've got to draw people in. You can't just say we're going to do this to your house, they've got to volunteer to have it done and [SWI is] a fairly unknown technology - people aren't that familiar with it so it's not an easy sell."* BHEU project co-ordinator

This view was supported by an ESC community partner's experience of trying to engage householders with retrofit through the ESC's pilot project:

> *"The whole process with the householder is a nightmare – this is not a lean process! There's a ridiculous amount of work that needs to be done for each household before anything gets installed, and the installation itself is ridiculously expensive as it is."* ESC Community Partner

These perspectives suggest that engaging the owner occupied housing sector requires a much more intensive level of engagement, handholding and reporting than the social housing sector to achieve any increase in the prevalence of retrofit.

5.4.3 Lack of regulatory mechanisms

A significant feature of the policy climate is that despite promoting particular technologies and creating incentives and tools such as PAYS, and an industry standard around domestic retrofit to be able to provide the works, there is very little regulation of retrofit in the privately owned and occupied housing - the sector that incorporates the vast majority of

people in the UK (Swan, Wetherill and Abbott, 2013). At the time of the study, the only regulations for existing homes were the requirement to make available the EPC for the property upon it being built, sold or being let, and Part L1B of the building regulations, which set minimum standards for different parts of a home, including 'thermal elements' – i.e. walls, windows and doors – that are being renovated, or their fabric altered over 25%, or a significant heating system change is made. This means that there are performance standards, such as particular u-values (calculations of heat loss through a material) which retrofitted elements must meet, as well as when an extension over a certain size is built, or when the building's use changes. However, there is no regulatory imperative for retrofit for the majority of existing homes that are not being renovated or significantly altered. This policy and regulation gap means that the rhetoric of prioritising energy efficiency in climate change strategies is not matched by a regulatory structure, thus lacking the 'push' factors required for a functioning socio-technical transition to improved energy efficiency, relying only on the market 'pull' factors (Vergragt and Brown, 2012).

5.4.4 Lack of alignment with planning

The technological focus of the policy climate – external wall insulation - is not automatically supported by the National Planning Framework which is often interpreted differently by individual authorities and even by individual planning officers (Friedman et al, 2013). This issue is illustrated by the following perspective from a previous energy efficiency policy advisor:

> *"It's getting less and less joined up with planning – DCLG are not on the same agenda and they've been backtracking on building regs, on the energy efficiency obligation as part of major renovations in planning permission – it's clearly not a priority for them."* – Ex-EST policy advisor.

Approaches to planning consider multiple factors including preserving buildings with heritage status and the appearance of conservation areas, and the aesthetic qualities of a neighbourhood, street or building. This means that deciding firstly whether does require planning permission, or secondly if planning permission should be granted when it is deemed that a full application must be made, is not a simple decision. Some local authorities have defined external wall insulation as a 'permitted development', and some have defined partial installations (external wall insulation on the back of the property and

internal wall insulation on the front, to preserve the appearance of the property). Many other external wall installations do require full planning permission which adds considerable cost and time to an installation, and even then, applications of planning guidelines vary (Friedman et al, 2013). This results in a clear picture of the policy areas of planning and energy efficiency being poorly aligned.

5.4.5 Neglecting householders: finance and technical fixes.

Another issue concerns the interest rates offered by the Green Deal Finance Company for retrofit-based loans. Although being accessible to a wide range of people including those who may not be able to access traditional personal loans (Guertler, 2013), rates are high compared to mortgages, at around 7% interest, appearing as an expensive investment over time, and presenting difficulties with making solid wall insulation - which can cost between £5000 and £20000 per property fit into the 'golden rule':

> *"We know from the research that we've done that Green Deal and ECO don't actually cover the cost of the work if there's external wall insulation involved, so there still has to be a contribution or a top up from somewhere. Either the householder puts in their own cash or they get another loan or something, which is a real challenge. So the finance provision hasn't actually solved the issue it was meant to solve."* SHAP Representative

Combined with the uncertainty and inconsistency around how ECO combines with Green Deal Finance which is very complex for private owner occupiers, and the changes to ECO in December 2013 which reduced the amount of subsidy available to householders, this has created a very unclear situation in terms of predicting costs for householders.

What we also see in both the previous government programmes and the ESOs is that there is a long history of technological specificity around insulation and boilers manifest in a measures-based, 'technology first' approach:

> "*The issue is that policy is directed at 'things' not people, and it fails to acknowledge that finance isn't always the barrier – there are social differences and different values between places and households even for the same property and tenure type, so the idea that you just provide loan finance and people will come flocking is very shortsighted. Energy policy has always struggled with people."* Ex EST policy advisor

This approach assumes that solving the problems associated with poor energy efficiency can be achieved through marketing these particular products (in Green Deal and ECO this

relates specifically to external wall insulation) available to the public, rather than embedding behaviour change or understanding of energy usage and practices into retrofit schemes alongside or even instead of technical measures.

> *"The Green Deal is the mechanism we have to work within. But it seems to have been set up by financiers to support large businesses, sell products, and put financial mechanisms in place. Now if you really want to help people, make their homes more energy efficient and reduce their bills, your best bet is to go around and do behaviour change with them… how to use their boilers, how putting all their clothes to dry on the radiators is contributing to black mould growth. Help them understand the difference between ventilation and air leakage. That will save people more money than putting external wall insulation on when they've got massive holes in their wall that aren't dealt with, or when they've still got single glazing."* BHEU retrofit officer.

This quotation both questions the underlying motives of the Green Deal and rues the missed opportunity to combine an understanding of householders behaviour with the technological and financial elements of Green Deal and ECO.

5.4.7 Ideological gaps between policy and practice

Overall, there seems to be a considerable gap in perception of what the retrofit industry and people working within it and around it think that national policy should be trying to do, and the context that it has actually created. The tensions caused by tackling fuel poverty and climate change as joint objectives generates significant frustrations for those enacting policy, as demonstrated by this quotation from a representative of a national sustainable housing charity:

> *"There is a moral issue here with ECO. A lot of people have been approaching this from a fuel poverty perspective and there is a huge target group for that, who should be first in line for ECO because they're the most vulnerable. But if you really want to get a supply chain going and tackle carbon you really need to look at the Green Deal side of things too and many of those people will be eligible for ECO too, and there isn't enough ECO to go round. So what's more important? That's something I find very difficult to reconcile."* SHAP representative

An installer also laments a feeling of injustice about how the policy context directs funding:

> *"People are making life decisions about whether to turn on the electricity or feed their children. That's disgusting in the year 2013. The government thinks ECO will sort that out, but it's not. It's as if they've deliberately made it unnecessarily hard to get the money to the people who need it the most."* ESC installer member 1

And finally, a council officer questions the ideological premise of the Green Deal as a market mechanism and its ultimate effectiveness:

> *"The fundamental flaw in this is that Green Deal is a market mechanism. There's a very good argument for why a national scheme of just fully funding it would pay for itself and more in social benefits, employment and so on, but there's no room for that in the conversation."* BHEU retrofit officer.

Together, these perspectives demonstrate a significant scepticism of and challenge to the ideological foundations of the Green Deal and ECO policy context, by those charged with delivering and implementing these policy tools at the local level, indicating an ideological divide between the problem definitions at national and EU policy level and at the local level.

5.5 Summary

This chapter has presented an overview of the three key policies affecting domestic retrofit of privately owned and occupied homes in UK cities. It has outlined Green Deal, ECO and the Localism Act and has demonstrated how the agendas behind these policies have been produced and entwined over time, reflecting competing landscape issues from economic crisis, climate change and energy security, to shifting forms of urban governance. This suite of policies reflect the political priorities and context of the specific temporal zone in which they were produced, reflecting particular contemporary ideological and technological priorities in their focus on local economic growth, market-making and finance provision, solid wall insulation and boilers and a degree of devolution of decision making away from central government and both upwards towards EU policy and downwards to local governance coalitions.

The function of this exercise was to populate some of the key issues and actors that may be common across the macro-level of the three case study experimental assemblages. This chapter has ascertained that this particular policy context created space and possibility for localised experimentation, and an expectation of variation between places. It also necessitated the involvement of networks of actors crossing multiple scales and with various areas of expertise in responding to the different parts of the domestic retrofit problem. Furthermore, it fixed certain aspects of supranational, i.e. EU policy in the architecture of the retrofit process, thus setting significant rules and boundaries around retrofit practices, such as the mandatory Green Deal Assessment which starts the retrofit process for the householder, the Pay As You Save mechanism, creating industry

accreditation for practitioners and prioritising solid wall insulation and boilers as technological fixes – with other measures often conditional on these.

What it also created, though, is a set of particular challenges for retrofit stakeholders ranging from complex financial issues with aligning Green Deal Finance and ECO to moral and ideological issues with what policy priorities should be, as well as an uncertain context for practitioners to work within due to previous experiences of abrupt policy changes. There were also challenges in the retrofit supply chain around overly onerous accreditation and reporting for ECO, as well as inconsistency in accessing it, and a persistent lack of confidence in the Green Deal policy rhetoric from both government and the media. In system terms, the Green Deal/ECO framework represents an effort to create a new system for retrofit similar to that depicted by Swan (2013). But the focus on the financial and technological aspects of the socio-technical system for domestic energy use and the lack of attention to the social, cultural and people-focussed elements - along with a lack of regulation - produces an imbalanced or incomplete system. This significantly limits the possibilities for change that localised experiments can effect because in transitions thinking, change can only be effected if all the levels and parts of the system work in harmony to do so (REF again).

The entwinement of places and spaces within this as loci for experimentation and the positioning of localised urban networks as becoming responsible for acting on retrofit through the city deals and DECC-combined funding, adds another critical factor to the possibilities for change: the place-specific nature of those networks and the particular capacities and skills that they encompass. This makes highly relevant the observations of Brenner (2004 and 2009) and Swyngedouw (2010) of the varying, place-specific and often temporary configurations that coalesce around such issues in urban spaces, with networks often engaging directly from local level with global circuits of capital and governance structures, and the differential levels of influence of different interest groups that are created by these coalitions of actors under the conditions of economic competition.

Having populated the landscape area of the assemblage the thesis will now examine three different experimental urban responses to the issue of domestic retrofit, and how they each connect with and navigate that landscape.

Chapter 6 - Case study #1: Carbon Co-op, Manchester

Carbon Co-op in itself was a grassroots movement consisting of householders who were committed to fighting climate change through the particular vehicle of domestic retrofit, but its projects embedded it into a broader suite of local and city-regional government retrofit efforts. For Carbon Co-op, this meant balancing the expectations of multiple local organisations as well as individuals, and navigating new working relationships whilst retaining its grassroots identity, through the high-end, whole house retrofit of eight homes in Greater Manchester. The table below shows some of its key features and the rest of the case study explores the factors and actors, issues and pressures that contributed to the story of Carbon Co-op.

Tagline	An experiment in co-operation between a grassroots movement and local government.
Defining features	Grassroots householder co-operative providing whole house surveys, technical support and practical, experiential support for householders wishing to make their homes more energy efficient.
Key Activities	Greater Manchester 'Go Early' Green Deal pilot, Stockport community engagement projects, Developing survey method Developing energy monitors
Key priorities	Tackling climate change, technical excellence, survey methods, peer to peer support.
Key relationships	GM local authorities – at city-regional and individual council level, URBED architectural solutions, Personal relationships and shared history of environmental activism.
Outcomes and effects	8 whole house retrofits completed, self-assessment survey method developed, 60 whole house surveys completed and community advice and support networks developed.

Table 7 - Key features of Carbon Co-op.

6.1 What is Carbon Co-op?

Carbon Co-op is a householder co-operative characterised by its provision of very detailed whole house surveys, its peer-to-peer retrofit support approach and its engagement with multiple projects at once. It runs community engagement workshops and events relating to various aspects of retrofit and improving domestic energy efficiency across Greater Manchester, such as bus tours of retrofitted houses in the region, sharing advice and information both online and between neighbours, and developing open source energy monitors. It covers an area ranging right across the 493 square miles of Greater Manchester, from Bury and Rochdale in the NorthEast to Wigan in the West and Stockport in the SouthEast of the region. Its primary activity through 2012-2014 was conducting whole house surveys and project managing whole-house retrofits, working with the Greater Manchester Combined Authority (GMCA) as part of one of the core cities' 'Go Early' pilot projects for the government's Green Deal, delivering twelve whole house retrofits aiming for high carbon reductions (80% in each house) across the Manchester region, including a suite of measures in each house such as loft and solid wall insulation – both internal and external, new boilers, heating controls, passive stack ventilation systems, microgeneration technologies, underfloor insulation, triple glazed windows and doors, and others.

6.1.1 Organisational form and governance

The organisation's membership is comprised by likeminded and professionally or socially connected individuals in the Manchester area, many of whom worked at some stage for URBED, or had been involved in environmental activism or the city-regional network of environmental organisations at some stage, including many who had been involved in other co-operatives. Members were able to vote on matters concerning what projects and activities Carbon Co-op took on, who it worked with (e.g. which accountants it chose) and who sat on its board of directors. Much of the running of Carbon Co-op was done by members on a voluntary or at least partly voluntary basis, such as website upkeep, promotional events, administration, newsletters and so on. The decision to be a co-op was based both on market research around retrofitting showing that co-ops were one of the most trusted kinds of organisations, and a shared belief the co-operative form as an emblem of independence and social justice, with a particular focus on the lack of external shareholders and interests as shown by the quotations below:

> *"One of the biggest barriers is disruption, and if you're going to venture into that level of disruption, you really want to have absolute confidence in the people who are knocking down your walls and so on. And the ethical and mutual underpinning [of carbon co-op] has got to increase your confidence."* Board member 4/Sustainable Living in the Heatons (SLiH)

> *There is an element of trust that people have towards something that is independent and impartial…. So instead of being visited by the council by someone you'll never see again, it's your neighbour."* Board member 3/Stockport

The other significant element of being a householder co-operative, as opposed to a worker co-operative or a supplier co-operative, was the principle of being better able to take action on climate change or social justice collectively rather than as individuals.

6.2 Carbon Co-op's goals and priorities: ambitious vision, modest targets

When asked about what might constitute a success for Carbon Co-op, interview participants consistently stated that their aims were modest, and that their visions of success were based more on principles than numerical targets. The following quote illustrates this approach:

> *"We don't' really have targets… We have a trajectory that we'd like to be on…"* Project Manager

Where 'numbers' did come into the goals and targets of Carbon Co-op, this was in relation to growing the membership base, and even then were flexible:

> *"We don't know what we can say about scale, but our targets are informed by what we can see in front of us – in the first year we would like, say, 40 or 50 members, in the second year maybe 200. And maybe 10% of those will be retrofitting".* Board Member 3/Stockport

There was a shared, long term vision of the Co-op as facilitating the growth of retrofit locally, with lots of households communicating the retrofit 'message' to each other, a series of retrofit showhomes demonstrating the possibilities of retrofit, and the involvement of local colleges and other organisations in progressing the agenda. This vision included encouraging a change in frame of mind to more people becoming motivated to retrofit by protecting the environment instead of by saving money.

But there were also goals that related to products and the local economy, such as the hope to boost local employment and generate a local retrofit economy instead of, for example, sourcing timber window frames from Scandinavia. There were long term goals of incorporating ethical conditions in contracts when selecting suppliers, and an even broader goal of replicability - creating an organisational model – in terms of Carbon Co-op's approach to community engagement and membership - that can be replicated and self-sustaining in other communities than just Manchester:

> [When asked if the issues Carbon Co-op are working on are Manchester specific] *"Oh no, definitely not. Part of its attractiveness is that you can do this anywhere…. If it's not replicable, it's failed."* Board member 4/SLiH

However, the individual projects that Carbon Co-op was involved in did have specific targets, such as the Go Early project targets of twelve whole house retrofits, and the Carbon Co-op in Stockport project targets of holding ten community champions workshops in local residents houses and getting ten people signed up to have whole house assessments. These targets were negotiated, such as the original twelve Go Early homes being increased to fourteen with the addition of extra funding, (but reduced to 8 as practical, financial and motivational issues prevented some of the houses from proceeding), and the ten whole house assessments being conditional on the households being prepared to have some of the recommended retrofit measures installed within a year.

6.2.1 Experimental orientation – what is it testing and why?

Carbon Co-op does not have one priority area that it is testing through its retrofit work, focussing on technical, social/motivational, practical and processual and experiential, tacit knowledge all at once, as shown in the table below, and with different knowledge interests for different partners. The knowledge focus for URBED was heavily technical – with one respondent describing the Go Early scheme as a *"technical playground for URBED"* . It provided valuable technical data to URBED in terms of assessing techniques of applying external wall insulation and their relationship to condensation, or testing the actual in-situ thermal performance of different insulant materials. A perceived shortage of specialist knowledge about the after effects of retrofit drove a collaboration with University of Salford and the Greater Manchester Low Carbon Hub on monitoring, sharing data from the Go Early pilot houses which showed energy use before, during and after the retrofit process. For

Stockport and Manchester Councils, Carbon Co-op's value was in its socially-focussed knowledge – its approach to community engagement and sharing information between householders, and in the eyes of the GMCA the function of Carbon Co-op was in producing demonstrations of successful retrofit, playing a role in kickstarting a market. Recognition within the Carbon Co-op of the need for multiple forms of knowledge to approach this is also shared by its partners:

> *"What we are going to have is a lot of technical problems that have social fallout, if we don't do it properly. You get damp, you get mould growth, you get systems not working properly and people living in cold houses, you get illnesses. It's quite fashionable intellectually to say oh but it's not just a technical problem it's a social problem, but it isn't just a social problem either, it's both."* Salford university partner

Knowledge focus	**Example and source**
Testing technical elements of retrofit as part of a city-regional approach.	*"This is basically a technical playground for URBED."* Salford University partner *"This is a learning period… It'll change how we engage with residents, both before, during and after, how we evaluate, how do we make those savings, what works and what doesn't, who is best to communicate that message, how we bring in innovation, so we can understand technologies that aren't mainstream now they're too expensive – and this is something that Carbon Co-op might be able to do because their people are sometimes prepared to pay a bit more for these technologies."* GMCA partner
Demonstrating the retrofit process	*"We want to rehearse the whole Carbon Co-op process from recruitment, assessment, recommending measures, going through the whole process with the householder, modelling, how much money it's going to cost them, what kind of loan repayments they can afford, during the works, arranging the finance, project managing the works…err, and then evaluation."* Project manager *"Part of it is proof of concept – households who have done it and are happy with the product, hasn't created any problems with the home, happy with the quality of work, and who feel as though they have played their part."* GMCA Partner

Testing open source, collaborative approach to knowledge generation	*"..this idea about the energy monitors is a key thing – we needed that tool so rather than try and buy it, we've invented and developed it, a new technology. Not only that but it's open source, so lots of people can participate in it. It's a big problem this, we need lots of minds on it, not a closed approach."* Project manager
Generating and sharing technical and experiential knowledge of retrofit	*"One of the best things about having your own home is experimenting in your home, you know testing things out. And as we were all doing different things we were all understanding the difficulties. Whether it was choosing what thing to do to the house, how to do it, is it insulation? How do you apply it to the wall? What product – you know out of a hundred products out there – so it was about thinking blimey – and feeling like you were doing it a little bit blindly… So it made sense to get together and share this knowledge so that whoever is doing it next doesn't have to go through the same mistakes and can do it right straight away."* Board member 3/Stockport

Table 8 - Carbon Co-op perspectives on knowledge and experimentation

Many of Carbon Co-ops activities were connected to a clear idea of what Carbon co-op wished to do with the learning afterwards. For example, Carbon Co-op has a clear stance on the need to make technical information about retrofit accessible to non-experts, both in terms of communicating complicated information clearly to householders through the Carbon Co-op whole house survey report, and in terms of 'demystifying' technical language:

> *" Language is used to create a hierarchy and give different positions. So say a representative of an energy company comes along and … they are all about using the technical language to try and get you to trust them … well we don't think that's the right way to go about it. It's actually by explaining the complexity of technical problem in an accessible way that people can understand what those things mean."* Board member 3/Stockport

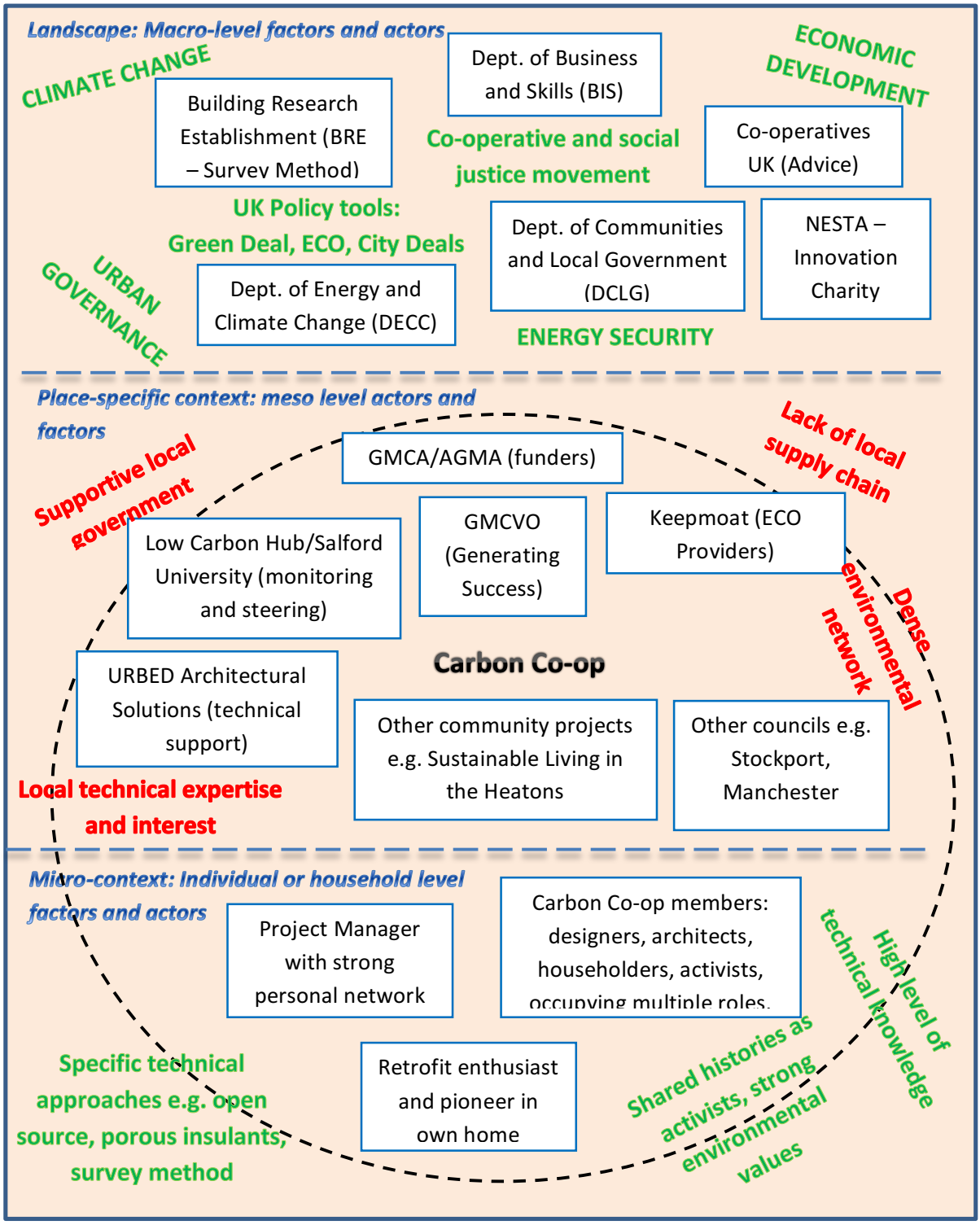
Similarly, developing the energy monitors did not only perform an instrumental function but an ideological one too: the value of the technology and the knowledge it generated being 'open source' rather than exclusive –open for development by anyone - chimed with the Carbon Co-op's organisational values of co-operation.

6.3 What contextual factors influenced Carbon Co-op's priorities?

As identified in the literature review and theoretical exploration of chapter three, multiple factors and actors operating at various different scales can influence experimental assemblages at the local level, from macro-level landscape issues to meso-level issues in the

broader urban context and factors at the micro-level – shown in red and green in figure 14 below. The following sections seek to identify the factors and issues at these three levels that were significant for Carbon Co-op, and conditioned and shaped its approach and priorities.

Figure 14 Carbon Co-op Assemblage as description



6.3.1 Macro-level factors

The single biggest factor driving Carbon Co-op was concern for climate change. When one founder member was asked why he felt retrofit was important, he answered, in relation to the issue of climate change:

> *"Because I want to be able to sleep at night knowing I've done something to help my kids and their kids have an inhabitable world to live in"* Board member 1/URBED

This was an explicit and shared motivation for the organisation and its members, and its strong commitment was seen as a particular characteristic of the organisation:

> *"What's unique about Carbon Co-op is that it's committed people [to climate change] who do things differently"* Board member 5/householder.

There were also some concerns around social justice linked to energy security, with a fundamental desire to empower communities and reduce dependency upon energy companies both by the instrumental effects of retrofit on reducing bills, and through the principle of using the co-operative model, but there was no mention of the economic crisis.

6.3.2 Meso level factors - supportive governance context and lack of supply chain.

The GMCA city-regional governance structure, with ten local authorities of roughly similar sizes, who, according to the Salford University partner *"all play together quite well"*, and are interested in and committed to retrofit, created a supportive context in which experimenting with retrofitting whole houses became acceptable:

> *[when asked about the role of Carbon Co-op in relation to the planned mass market green deal programme in Greater Manchester] – "The GM view is that it is supportive of those co-operative approaches, recognising that they won't all work, that that is a part of a normal market. But these social, environmental issues are too important to wait around for the bottom up approach to work, so we need to help it get going really quickly, so we can get competitive advantage and make sure that we are on trajectory with our carbon emissions. In 3-5 years time, if we're sat here and I can say we've done what we wanted to do, we've created a viable market in GM, it could be that GM can back out. But we want to drive it early."* GM low carbon buildings director

Furthermore, this supportive environment enabled continuous discussions with planners in all the different authorities which resulted in a GM- wide guidance note advising which installations of solid wall insulation would come under permitted development and which

would require planning permission (external wall on the rear and side of properties, with internal wall insulation on the front was generally agreed to be permitted development). This knowledge enabled greater awareness in design and projecting timescales for works for the pilot houses, and in exploring other options beyond external wall insulation:

> *"With planning the more you communicate right from the start the better the chances are. But then there are conservation areas – there's no point asking for external wall insulation. So with the whole house approach that's a battle you won't win, so we look together at other solutions for reducing energy use that will still help the household but won't give them problems with planning approval"* Board member 1/URBED

However, a feature of the GM context that was discovered as the project progressed was that there was a distinct lack of specific retrofit installers in the city region. This meant that finding accredited, capable and experienced contractors to carry out the works was very difficult for Carbon Co-op, and they ended up working with a standard building contractor instead.

6.3.3 Micro-level factors

The original ideas for Carbon Co-op were centred on community empowerment and ownership, and a transition in energy use and generation as a way of achieving that empowerment. Through the personal networks and open conversations between the founder members these concepts connected to other ideas around the concept of mutual support in living sustainably and a consumer co-operative providing a vehicle for engaging more people at once. One of the founder members had also retrofitted his own house to the highest possible carbon savings as an experiment, which brought a particular domestic retrofit focus to these general ideas:

> *"One person - one family bought this Victorian house and did a lot of work to it and I think that was a starting point, you know, for realising this is not straightforward! So he was a big driver for that."* Board member 3/Stockport

The presence of other specific individual expertise and capacities, though, had a significant effect on the initial form and focus of Carbon Co-op and its strategies, such as the particular approaches of the Project Manager, whose particular attributes were a huge factor in its approach to attracting funding. His skills in bid writing and and his ability to mobilise and

engage people was mentioned numerous times throughout the fieldwork process, one example being:

> *"Everyone knows [Project Manager]. He's got about 8 million fans on his facebook and about 4000 connections on LinkedIn..." – Generating Success Partner*

Furthermore, the involvement of open source energy monitors in the process was built on a particular interest of one of the board members in open source technology, showing how individual interests shaped and interacted with the Co-op's other activities.

6.4 How did Carbon Co-op go about meeting its goals and objectives?

6.4.1 Funding

Carbon Co-op received funding from various sources over its development, each step piecing together to create the organisation and its activities as it is now. In 2009 the co-op won £3000 from NorthWest Climate Foundation to run development workshops and later in 2009 NESTA invited the co-operative to bid for Big Green Challenge funding on the basis of a previous failed bid. They were awarded £10,000 plus some additional funding from Manchester City Council to run a pilot in Moss-side over 2009-2010 which focussed on community engagement. In 2010 they received further funding from NESTA and the GM Innovation Fund to do a feasibility study for the co-operative, and in 2011 the co-operative received £10k of funding from Manchester City Council on behalf of GMCA to develop the rules for, officially set up and register the Carbon Co-op. At this time they also wrote a share issue to attract investment to fund the works. However, this share issue was based on revenue generated from Feed-in –tariffs paid for electricity generated from installing solar PV panels on community buildings. In 2011 the UK government halved the feed-in tariff for small renewables from 43.3p to 21p per kWh, which rendered the share offer and business plan unfeasible due to the comparatively poor return on investment. The co-operative then started to seek other sources of funding including community projects from Manchester City Council and investigating the possibilities of Green Deal. The Green Deal Go Early programme – a pilot of large scale citywide retrofitting that the Greater Manchester Combined Authority (GMCA) had at this precise time been awarded £2m of funding from DECC for - emerged in early 2012, and, in the words of Board member 2/Project manager:

> *"it just fitted with everything we were trying to do really"*.

It was at this point that Carbon Co-op became primarily involved with whole house retrofits: GMCA awarded Carbon Co-op £200,000 of the £2m to carry out the private sector element of this project.

6.4.2 Carbon Co-op's activities and projects:

Green Deal Go Early

The twelve houses Carbon Co-op was responsible for were the only part of the GM pilot project that was focussed on owner occupied housing, with the high-cost works funded by zero-interest loans from the DECC money. Their task was to recruit participants, perform household surveys and assessments and design packages, and project manage the whole house retrofits at the installation stage. It did this by first conducting a launch event in September 2012 that combined the first round of promotion for Green Deal Go Early with the public launch of the Carbon Co-op and a drive to recruit new members – both as potential candidates for the Go Early retrofits themselves and for their support, both financially through membership fees and in terms of voluntary capacity and contribution to running the organisation.

Through the course of 2013 Carbon Co-op narrowed down around forty possible applicants to the twelve homes it was intending to use for the Go Early pilot project. This selection was based on a number of factors: firstly, the twelve pilot homes were partly selected in geographically diverse locations to represent the whole of Greater Manchester region, and to encourage engagement in communities and spaces that were not currently engaged with retrofitting. Secondly, the houses were selected to represent different types of housing:

> *"we've tried to select them so we've got a semi-detached, a victorian terrace, different types of house like this, so there is an understanding that if someone comes and says I've got a 1930's semi-detached, they can go to a manual which has tested it and has a proven solution that works."* Board member 2/Project manager

A third factor in selecting the pilot houses was the commitment of the householder. Producing successful demonstration projects required that the householders receiving the whole house assessments or the 0% grant from DECC via GMCA were very motivated to carry on and do the works that were recommended and unlikely to pull out. This meant that they needed to meet certain socio-economic criteria as well, such as owning their own house rather than being a tenant, and being able to make the loan repayments comfortably.

Over the course of 2013 Carbon Co-op conducted the whole house surveys, made the recommendations and calculated packages of works and costs, procured a single contractor (Jackson and Jacksons) through the GM Procure Plus resource, utilised URBED for architectural specifications for works and negotiated a series of obstacles to the works being completed. There were significant issues with acquiring an ECO contribution – specifically for the solid wall insulation - to reduce the overall costs of the works because of the changes to the ECO in 2013 which reduced the amount available from energy companies and created inconsistent pricing in the industry. There were issues with some of the homes requiring planning permission and significant contractual problems between URBED, Jackson and Jackson and Carbon Co-op, which resulted in inconsistent costings for some of the householders, and although Carbon Co-op received extra funding from GMCA, a number of householders withdrew from the scheme and only eight houses remained.

The eight houses that remained had their measures installed throughout January 2014, with works each costing £40,500 on average and including the full range of technical measures listed above. Figures 15 and 16 below show some of the works in progress:

Figure 15 Completed External Wall Insulation on Carbon Co-op house

Figure 16 Internal wall insulation being applied to Carbon Co-op house

Whilst the whole house retrofits became the Carbon Co-op's main activity in 2012 it was also engaged in a number of other energy-efficiency related activities, in order to avoid dependency on single funding sources and protect against policy vulnerabilities.

Generating Success

In Generating Success, Carbon Co-op provided technical and project management support through workshops and feasibility studies for a series of four renewable energy retrofit installations in community buildings in the rural areas around Greater Manchester, including one biomass boiler and three solar PV arrays. This was done in partnership with the Greater Manchester Centre for Voluntary Organisations (GMCVO). The projects were intended to produce lessons and build extra capacity in the Greater Manchester voluntary sector about how to manage and complete community renewable projects.

Energy Monitors

In 2012 Carbon Co-op also became involved with developing, and testing open source energy monitors, running a series of workshops building the monitors with members and interested parties, and installing them in the GM Green Deal pilot houses. This monitoring data is being used and interpreted not only by Carbon Co-op but also by Salford University,

to support other retrofit projects in Greater Manchester through its involvement in the retrofit advisory group to the Low Carbon Hub.

Community Champions and Carbon Co-op in Stockport

In 2012 and 2013 Carbon Co-op ran community engagement programmes funded by Manchester City Council and then Stockport Council, along with Network for Social Change, to recruit ten 'community champions' for retrofit and energy efficiency, promoting the idea, the service and increasing membership. The intention was to *"get people to network"* (Carbon Co-op board member). This was based around a strategy of residents hosting advice sessions in their homes, with their neighbours. This included sharing experiences of retrofit, providing technical advice – or access to it through Carbon Co-op – about retrofit measures and potential issues such as preserving heritage features, and practical information about costs, suppliers and installers and planning permission. The Carbon Co-op in Stockport programme also offered a competition for ten free whole house assessments, on the condition that within a year the households receiving those assessments would start some of the works recommended.

6.4.3 Strategy and identity

Technical approach – survey method, monitoring and knowledge sharing.

Carbon Co-op's unique whole house assessment method is one of its defining features:

> "*Green Deal Assessments are so generic, this is why we need a tailored approach – on this street the houses are exactly the same, but our energy use is completely different. But the RdSAP assessment doesn't even take into account behaviour. Whereas when you come into peoples' houses and really understand how people use their homes you can really make a difference to their energy use."* (Board member 1/URBED)

Set against the Green Deal Assessment, which costs approximately £150 and takes approximately two hours, and is based on the BRE's reduced data Standard Assessment Procedure (RdSAP), the Carbon Co-op survey costs around £450 and takes an entire day to complete. It incorporates a much higher level of individual property-specific detail than the Green Deal approved RdSAP method which bases a lot of its recommendations on assumptions and standard details. The whole house assessment method has been under continuous review as the Carbon Co-op's actual retrofits and monitoring proceeded, and

has been further developed using funding from Innovate UK into a self-assessment online home energy planner' tool that householders can use themselves, bringing down the cost and time required for the whole house assessment.

The Carbon Co-op's approach to the technical risks and issues around retrofit concerning mould, damp and build quality were approached in a number of strategic ways. Firstly, by incorporating such a high level of detail and thoroughness into the whole house survey, these issues are intended to be designed out from the start. URBED technical advisors also make specifications for particular products such as porous insulators that are better at preventing mould and damp than non-porous ones, and including a ventilation strategy as part of the assessment. Concerns over the moisture performance of brick slips (placed over external wall insulation to create the illusion of a brick house) precluded URBED and Carbon Co-op from recommending these measures, even when they may assist with planning approval, and they have lobbied GM partners on this issue.

Carbon Co-op also deliberately took a small number of houses and a range of house types, as a way of slowly continuing to test and monitor the design and installation issues involved in a whole suite of measures, rather than rushing into 'scaling up' straight away:

"We're doing a small number of houses, but really, really well" Board Member 2/Project Manager

Incorporating a strong focus on monitoring into the whole process is how Carbon Co-op approached the risk of the 'performance gap'. This is teamed with incorporating behaviour and occupancy into the survey method, thus allowing a far more accurate picture of what has changed in each house as a result of the retrofit.

Finally, the presentation of survey reports (see Fig 17 below), which includes a glossary and detailed commentary about the specific characteristics of that house and its occupants, and along with support from the Carbon Co-op community regarding the processes and experiences of retrofit of other householders (peer-to-peer), makes it easier for households to access and understand:

> *"The thing is that retrofit works – it's great for reducing energy use. But some of the things you do might create other problems such as how you apply internal wall insulation, there are certain ways that cause condensation to get trapped and can cause damage to the house. There are other ways which might be more complicated*

and expensive but are more foolproof. So it's also doing things that we can monitor and understand whether it was the right thing to do. There's a commitment that we don't just do it and leave. And because it's us, we are all doing it on our own houses, you can go back and check over a period of years, and the idea is it's somebody you know." Board member 5/householder

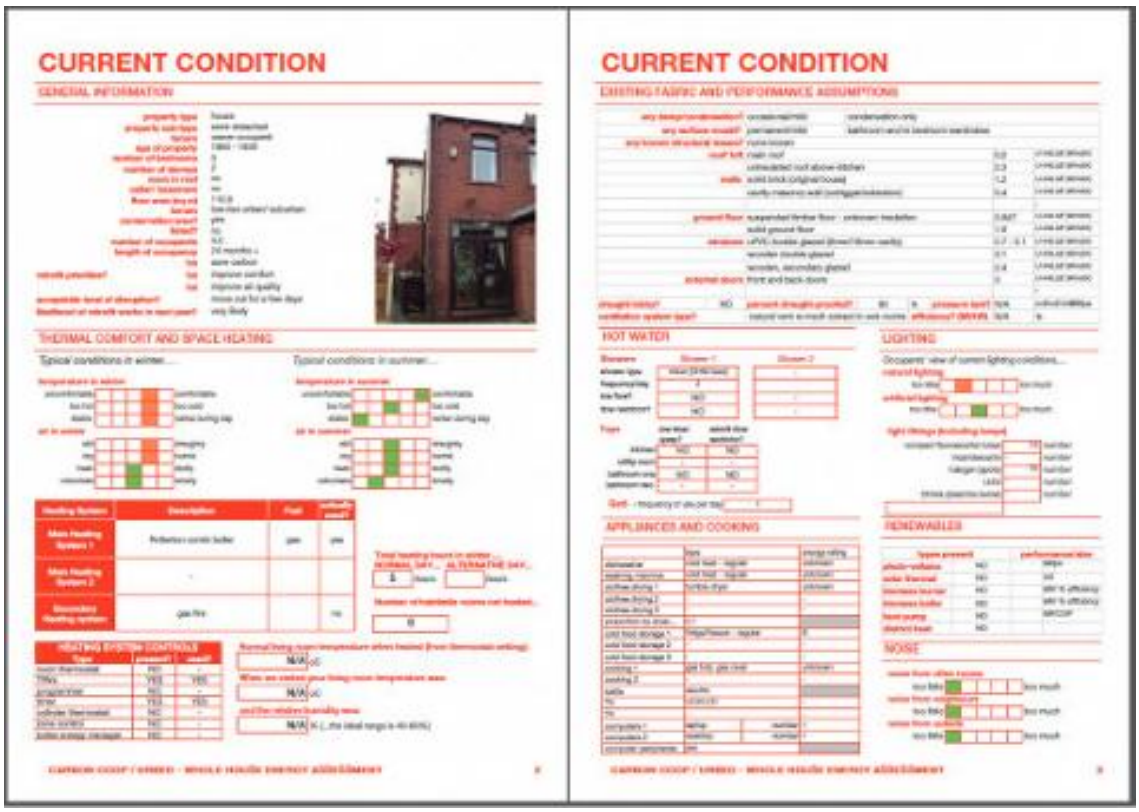


Figure 17 Carbon Co-op whole house assessment report

Carbon Co-op also alleviates some of the financial and technical decision making elements by sharing technologies such as light fittings (mostly LEDs) and energy monitors, through their community champion household workshops. The LED library gives householders the opportunity to test different light fittings to see if they work with the connection in their homes, rather than purchasing them and risking them being incompatible or impractical. Borrowing LEDs helped two householders to make a decision to replace all their light fittings with LED lights, and combined their purchases to get a 15% discount. Loaning energy monitors allowed people to identify particular patterns in their household energy use, and select appropriate retrofit measures e.g. discovering that heating costs were higher than the average house of their type, so investing in draughtproofing and later, insulation.

Addressing householder motivation and engagement

What emerges from the Carbon Co-op's website and promotional literature, interview and observation data is a strong, consistent vision of the Carbon Co-op's "peer-to-peer" method of engagement and support in the technical decisions around domestic retrofit, and a shared vision of action on climate change at the household and local level:

> *There are Green Deal providers who have just been created because people think there is a gap in the market and employment can be created out of it which is no bad thing, but the motivation for that is very different for that is very different to our motivation, which is our homes, and how they can contribute to tackling this massive problem."* Board member 3/Stockport

As previously mentioned, Carbon Co-op's approach to the varied and complex motives and feelings around retrofit, both positive and negative, is dealt with by focussing on those who are already committed to environmental values and carbon reductions, rather than trying to persuade people to adopt these values, or sell something to those who are not motivated by this.

> *"Our whole marketing strategy is based on community advocates really. We identify people who are really pro-environmental and want to do the stuff, and get them to spread the word in their local area."* Board member 2/Project manager.

A good example of how this works is shown below:

> *So because our houses are all identical on our street, and we had an assessment, our next door neighbours wanted to do a bit more, so they had an assessment too, and then a new neighbour two doors down the road also became interested. Then we had a community champion workshop in our house and four neighbours came along, and we realised that because we have to re-felt our roof every seven years and it's an expense and a hassle, we are looking at possibly doing a street approach. And Carbon Co-op because of the community gives us better buying power, so we can go to a contractor and say we are not doing one roof we are doing four roofs, so as a street this is working as a really good example of that"* Board member 3/Stockport

This is not just an avoidance of those who are not already motivated by environmental values or those who are sceptical about retrofit. Engaging already enthusiastic people has a deliberate function in terms of providing demonstrations of retrofit for the wider 'market':

> *"We have always been very clear that we are starting with pioneers – people who already want to do it for reasons that are more connected to the environment. But to go to people who are motivated by money, we have needed these pioneers to test this process – at financial risk – because that is not their primary motive. But they*

can show the savings like I used to spend £600 on gas and now I spend £300." Board member 4/SliH

6.5 What relationships affected Carbon Co-op's activities and progress?

Not only do multiple factors and issues affect the goals, priorities, strategy, funding and organisation of experimental assemblages, but as discussed in the literature review and theoretical chapters, so do the actors and organisations that are involved. The following sections explore the significant and influential actors and relationships operating at the macro, meso and micro-levels of Carbon Co-op's assemblage, and the particular interests, approaches and priorities they bring to the case.

6.5.1 Macro-level relationships – mediation and selectiveness

Carbon Co-op's relationships with the state at a national level have been turbulent. Between 2008 and 2011, Carbon Co-op experimented with different elements of energy efficiency but policy changes helped steer them towards whole house retrofit. The connections between Carbon Co-op and GMCA provided access to larger national funding sources connected to Green Deal, offering increased stability, enabling the Co-op to continue its work, and raising its profile regionally. However, there are mixed views about working under this policy climate. These range from:

> *"I'm really chuffed about the green deal [go early] project, because it shows that DECC is listening and interested in community innovation. We don't know what effect green deal will have – it might kick start it or it might put people off, we don't know. I'm just glad we're part of it." Board member 2/Project Manager*

To:

> *"We have big reservations about how Green Deal is being designed and delivered in the UK. Especially the finances. Simply put, you're looking at an interest rate of around 7%. When a householder sees a direct impact on their energy bills, and a direct improvement in their comfort, it's a much better understanding of 'when I do this it has an impact on that'. Whereas when the loan is attached to your bill, you are still seeing an energy bill that is exactly the same. It becomes difficult to make that link."* Board member 3/Stockport

Among other issues with the policy climate that the Carbon Co-op identified were serious administrative problems with actually getting the technical measures on the pilot homes to

qualify for the ECO money according to OFGEM's criteria and clear issues around trust in the green deal assessment process:

> *"I went to Carbon Co-op because I didn't trust Green Deal basically. I don't think the Green Deal Assessment is much good and I'm not interested in 7% loans. I felt like they [Carbon Co-op] at least had a bit more technical know-how."* Board member 5/Householder

Carbon Co-op attempts to balance these issues and tensions by maintaining a certain degree of independence from national policy and regional strategies, for example using its own survey method, and rejecting the national policy suggestion of paying community groups for retrofit referrals. It also directly sourced funding from other national sources such as NESTA and TSB on the basis of its other activities outside of Green Deal, and continues to maintain and build links with other grassroots movements in order to retain its identity and function as an alternative:

> *"Because the way we're doing it is very thorough and we're not afraid of that, every time we've gone for funding - from DECC or anybody else, we've been very clear that this is not a quick, go out and do what you can and come back, it is a step by step approach until we've found a good tested strategy.* Board member 3/Stockport

Additionally, Carbon Co-op continued to directly provide retrofit services outside of the Green Deal, whilst maintaining contact and conversation with the GM local authorities, thus playing a key mediating role between the values and priorities of its members and the city region's priorities which are closely tied to policy.

6.5.2 Meso-level relationships – GMCA, local authorities, environmental networks and URBED.

A number of place-specific existing relationships and capacities significantly influenced the identity and approach of the Co-op, as well as enabling its activities. Previous URBED retrofit projects, for example, provided technical expertise, and their role as technical advisors to Carbon Co-op strongly embedded the focus of technical excellence into their activities.

Many participants separately acknowledged that Carbon Co-op's relationships at GM level prevented the Green Deal Go Early project from collapsing, for example, URBED and Carbon Co-op board members liaised with GMCA, resulting in being able to use their 'Procure Plus' framework to procure a contractor to undertake the retrofit installations. The framework of

contractors for the wider GM project also mobilised an ECO commitment from building contractor Keepmoat for Carbon Co-op's twelve Go Early installations.

Relationships at the meso-level also resulted in a concentration of membership and interest in whole house assessments in the South of Manchester and the 'Heatons' and Marple areas of Stockport. This is because these areas happen to house a particularly active movement of environmental groups and households such as Sustainable Living in the Heatons.

Furthermore, relationships between local authorities at the meso-level encouraged and supported Carbon Co-op's Community Champions programme in Stockport:

> *"They [Stockport council] had seen that in the Manchester postcode the uptake was a lot more successful and wanted to bring that interest and that dynamic to our end [Stockport] as well"* Board member 3/Stockport.

Even within the Stockport project, Carbon Co-op's relationships with planners and sustainability officers, as well as existing fuel poverty and energy efficiency outreach projects in Stockport Council facilitated its work. The Council officers' support at promotional events helped alleviate householders' concerns about the viability of the works in terms of planning permission, and making them feel that the service was supported by their council.

> *"people tend to create small groups like existing projects and events with Groundwork and Stockport council around sustainability… so when she [Groundwork employee] does her presentations, she also has a couple of slides about Carbon Co-op. Where there is already a good existing interest I go along as well and do ten minutes. It works so much better when you work together."* Board member 3/Stockport

6.5.3 Micro level relationships – personal reputations and circumstances

Many of the Carbon Co-op board members were either contract, self-employed or part time workers, often occupying multiple overlapping roles, such as the lecturer in architecture who was also a householder and ran the Carbon Co-op in Stockport project, the householder board member who also worked as a sustainability officer at Salford Council, and the board member who was involved with a local community group. This created both a

high level of personal commitment and voluntary capacity, as well as a number of personal connections that were mobilised as part of the Carbon Co-op's work:

> *"It's all about communication – there's a few of us who wear different hats – but it works well because we create those links and it all works better when it's joined up."* Board member 4/SLiH

> *"We knew about it through friends, and both myself and my husband at different times worked for URBED, so we were already part of that network of people already interested in buildings, and environmental issues, and from our studies – you know we both studied architecture – so it was something we were already interested in."* Board member 3/Stockport

The project manager's personal relationships were extremely significant in maintaining the momentum of the Go Early project. He himself commented on this at the Carbon Co-op strategy day, just prior to the installation phase, when there were multiple issues around accessing funding, timings of works and accurate pricing:

> *"A lot of people told me that, basically, they were doing it for me. It was such a nightmare that they would have pulled out if we hadn't had that connection. I don't think I realised how important that was."* – board member 2/Project manager

Similarly, the householder who undertook extensive retrofit works on his own house prior to the existence of Carbon Co-op, who is also an URBED employee, has a strong reputation based on his technical knowledge. His previous experiences of retrofit enabled the connections between Carbon Co-op and Salford University's involvement in monitoring, through mutual involvement in the GM Low Carbon Hub.

> *"I mean he's like this regional expert, it's just one guy in the whole of Greater Manchester, and people trust him to know what he's talking about."* Board member 2/Project Manager

The importance of these personal relationships, though is in the relationships they then generate at other levels. As the Salford University partner describes:

> *"Caring isn't enough - you need processes to deliver things. That relationship with AGMA and Carbon Co-op – over four years they have developed systems, built knowledge about the technical stuff, how to engage with people, how to tell a story, how to build networks. It's about having these partnerships and processes. Some of that is linking with external bodies. Engaging with planning, working with local authorities, building political capital. Connecting to New Economy. But it's a complex, personally driven series of relationships. People having pints with each other, and those people actually get on."*

6.5.4 Internal dynamics and negotiations

The combination of interests, factors and relationships at multiple scales results in a number of tensions and negotiations within the Carbon Co-op itself, from its ideological roots and strategies through to particular roles, responsibilities and processes.

Identity and priorities

Views varied regarding the extent to which Carbon Co-op should engage with broader sustainability and climate change activities as opposed to just concentrating on retrofit, which emerged in discussions in board meetings and the strategy day, especially when discussing the redefinition of the Carbon Co-op's official mission statement. This linked to negotiations in internal meetings concerning how closely Carbon Co-op should stick to its target of 80% on each house. Some argued that in the spirit of inclusivity a target of 60% would reach more people and prevent the biggest gains from energy efficiency being made by those who already have a lot of wealth. Others felt that if the commitment to climate change was serious, reducing this target would make it impossible to contribute to national and global emissions targets enough to prevent the serious effects of climate change. Further questions were raised about the future trajectory of Carbon Co-op, regarding how quickly it should seek to grow and progress. This debate was heavily influenced by the tension between a desire to have a greater impact on carbon emissions through retrofitting more houses, and caution about growing 'too quickly' and losing some of the technical rigorousness and professional reputation:

> *With the funding we have and the partners we have at the moment we can do about ten a year [retrofits], if we want to do say 30 or 40 a year we will need extra capacity and we will have to grow. But there's a big debate about whether or not we want to grow and do more, or should we just stick with the ten a year, then assess ourselves and monitor what we are doing first a little bit?* Board Member 3/Stockport

Roles and responsibilities

There were also internal debates around roles and responsibilities, especially relating to the risk of burnout of the core members of Carbon Co-op in terms of their capacity to continue to manage the organisation largely on a voluntary basis. The relationships and projects at GM level had widened Carbon Co-op's scope and scale from the grassroots to the city-regional, and placed heavy expectations on an organisation staffed by part-timers and

volunteers, creating something of a mismatch between capacity and scale, which was discussed at board meetings and at the AGM in March 2013. As a result key priority in recruiting members became to encourage existing and new members to take a more active role in promoting, in administration, and in dealing with governance issues such as writing or modifying policies, mission statements and rules, to share the load.

At the installation stage of the Go Early project, technical difficulties and conflicts over the roles and responsibilities of different members of the project team also produced serious divisions in the team. Approaches to the level of involvement on site and who was responsible for project management, advising the contractor and assisting the householder were not clear and were contested on site, leading to confusion and disruption for the householders. The installation phase also created significant problems for the relationship between Carbon Co-op and the main contractor, whose struggles on site resulted in them litigating Carbon Co-op for a significant sum of money and holding them responsible for loss of revenue.

Overt or covert experimentation

Another interesting tension emerging in both public and internal meetings was a negotiation around the experimental nature of Carbon Co-op's work, particularly at the installation stage. Some board members were very explicit about the nature of the works as being experimental, testing how to deal with certain details and negotiate certain parts of the process such as applying for the ECO funding. However, other board members and participants felt that being so explicit about the experimental elements and uncertainties in the process could put householders off, or compromise the Co-op's reputation for robustness, arguing that they did not want people to *"feel like guinea pigs".*

Territory

There was also negotiation around constructing the territories for Carbon Co-op's work: in the Community Champions project, even though an initial desire had been to move beyond the areas of Stockport that had plenty of interest, this process relied on existing projects and outreach as described above, and realistic expectations about what could be achieved in these areas:

> *"There are ten boroughs in Stockport and eight are not really engaged in any way. Originally they [Stockport Council] wanted ten workshops and ten assessments, one in each of the ten boroughs. But that was not possible - you have to generate interest first. To go into totally new areas is arrogant and a waste of energy. It's not about persuading people – telling them they really should do this, it's about them already wanting to do it and connecting them up."* Board member 3/Stockport

Thus, partly due to the ethical position that the Co-op took, much of the interest was still based primarily upon an existing desire to do the work rather than an element of persuasion from Carbon Co-op.

6.7 What were Carbon Co-ops achievements and outcomes?

To date, Carbon Co-op has completed 60 whole house surveys, which give long-term recommendations which are likely to lead to more households retrofitting. It developed a new energy monitor which could measure gas and moisture as well as electricity use, and through the Go Early project it completed eight full whole house retrofits resulting in considerable visual and material changes to the properties. These retrofits precipitated – yet to be confirmed through monitoring – high carbon emissions reductions from those homes as well as improved comfort and dramatically reduced energy use for the 8 householders, some of whom are now generating electricity as a result of solar PV panels.

The evaluation and monitoring process that Carbon Co-op is in the process of carrying out is intended to produce detailed information about the technical intricacies and effects of the installations which will add to previous projects such as the TSB Retrofit for the Future Homes and the national Superhomes network, building richer knowledge of retrofits over time. The evaluation also gives a clear voice to the householders involved, enabling them to describe in detail the disruption, difficulties and frustrations around the process, with many of the householders stating in evaluation interviews (results observed at Carbon Co-op AGM in June 2015) that they were surprised by how disruptive the process was, but pleased with the overall results and have noticed significant improvements in comfort post-retrofit. This contributes to Carbon Co-op's own goals of sharing knowledge and experience around retrofit processes.

Other successes include that the detailed whole house survey method has been developed into a new self-assessment tool which allows householders to produce some elements of the survey data themselves, reducing the cost of the full assessment and enabling people

who may not be able to have a whole survey at all, and that a few new community champions have been recruited and have held events, gradually engaging more people with retrofit as an issue. The guidance note produced regarding planning permission opened up a regional dialogue about retrofit measures and provided a basis upon which all the Greater Manchester local authorities could work.

However, observations from the AGM in 2015 show some less favourable outcomes. Firstly, the core group of people promoting, volunteering and networking is largely the same, and the load of responsibility on them is still heavy. Furthermore, issues with the installation phase resulted in relationships between Carbon Co-op and the contractor souring, and a litigation against Carbon Co-op which is ongoing. As a result of this, the local retrofit industry is no better established or expanded as a result of Carbon Co-op's activities. An unintended consequence of this is that considerable internal learning about legal processes and contract forms has been gained:

> *"They didn't really know what they were doing with domestic retrofit at all and we took bad advice about contracts. We never should have used that framework. Thankfully we've learned loads and are fully up on contract forms now and we have good support and advice so I'm confident it won't stick."* Project Manager

The same issues resulted in ructions within Carbon Co-op over how best to deal with the situation with one member wanting to attempt to resolve the issue informally and most others wanting to address it formally and factually. A number of board members resigned over this disagreement but were later reinstated, and the first individual – the founder member and URBED employee who had retrofitted his own house as an experiment – left Carbon Co-op and URBED to set up another retrofitting co-operative on his own. Due to the stress of the situation, both Carbon Co-op and URBED decided not to get involved with the next DECC-funded GM retrofit project - Green Deal Communities, thus being unable to maintain the new intermediary relationship between the 'alternative' environmental movement and regional authority that they had established. Carbon Co-op has since moved on from the Go Early Projects, pursuing new experimental activities involving smart networks as part of a comparative European project.

6.8 Theoretical reflections from Carbon Co-op

This case study has explored the multiple factors and actors that were involved in the Carbon Co-op at the three levels of its assemblage, finding that climate change was by far the most dominant macro-level factor in its development, and this was prioritised by the personal motives and values of actors at the micro-level, who had significant influence over Carbon Co-op's direction. It also found that Carbon Co-op had multiple priorities for experimentation and knowledge, with a particularly strong focus on technical excellence and peer-to-peer knowledge exchange as part of the organisation's identity. Actors specific to the local context of Manchester such as URBED and a supportive local governance context helped to embed these priorities into Carbon Co-op's operations, and enable them to experiment in a particular way with a small number of highly technical, 'deep' retrofits. However, other local factors such as a lack of an appropriate supply chain and national factors such as a complex and problematic policy context caused significant problems for Carbon Co-op's progress and its potential to stimulate systemic change in the prevalence of housing retrofit is questionable.

This raises questions for the next case study of the Energy Saving Co-operative in Birmingham about whether the landscape factor of climate change is also such a dominant force, or whether other factors at other levels have a significant influence. It also raises questions of how its knowledge and experimentation focus compare to Carbon Co-op, and whether these priorities and factors are embedded into the case by actors at the macro meso or micro levels.

Chapter 7 - Case Study #2: The Energy Saving Co-operative, Birmingham

A business experiment with bold intentions that failed.

The Energy Saving Co-op was launched in April 2012 and ceased trading in January 2014. It attempted to create a new co-operative business delivering domestic retrofit and build a new network of retrofit organisations in the Birmingham city region. It positioned itself as being 'better than' or 'different from' Green Deal, and operated in the Birmingham context in competition with a large Birmingham-wide Green Deal retrofit scheme. Unfortunately, despite its challenge to national policy, the forging of new relationships and its novel organisational approach to retrofit, it completed far fewer retrofits than it intended and was unable to survive as a business. The table below shows some of its key features and activities, and the rest of the case explains those features, how they came about and what happened to the Energy Saving Co-operative during its short life.

Key features	Multi-stakeholder co-operative providing surveying/assessments, retrofit project management and building supply chain networks.
Key Activities	Business development and marketing in Birmingham, recruiting staff and growing the organisation and its membership, building a local supply chain network and relationships with local authorities and community groups.
Key priorities	Building a profitable, ethical business, building local partnerships.
Key relationships	Birmingham City Council ('competitors'), Northfield Ecocentre (community partner), local suppliers and installers, other co-operatives (funders and board members).
Outcomes and effects	Approx. 100 retrofits completed nationally, 27 in or near Birmingham (including Lichfield). New organisational form and Birmingham-based network created. Severe financial losses and closing of the business.

Table 9 - Snapshot of The Energy Saving Co-operative.

7.1 What was the Energy Saving Co-operative? Retrofit networks and project management.

The Energy Saving Co-operative (ESC) was a multi-stakeholder co-operative launched in April 2012 providing retrofit co-ordination services in various English locations, but with a particular focus in Birmingham.

ESC offered two interdependent services. The first was for local authorities or community projects, involving a networking role that agglomerated retrofit installers and tradespeople in different locations in the UK, then managed and delivered whole house retrofit services to privately owned and occupied homes. Having recruited and vetted tradespeople against certain ethical and quality standards to become supplier members, local community groups were then responsible for finding interested householders (referrals) for which they were paid a fee. The Energy Saving Co-op then linked these householders to its network of installer members who would quote for and carry out the retrofit installation under a contract between the householder and the ESC. The second was a project management service for the householder, based on a house-by-house, approach, offering a bespoke package of retrofit measures from the installer network. Figure 18 shows a home visit in progress and the following quotation explains this service further

> *" The process for the ESC is that we get the referral, [an assessor] or whoever goes round and does the EPC if they want one, but really we start off doing the ESC survey when we sit with the homeowner and we have a look and a chat around their house. And the thing about retrofit is that every house is different. Trying to archetype the houses doesn't work… And when you start to look at demographics and different peoples finances, and aesthetics as well, you know, architectural features, trying to batch works is impossible. So it's room by room, element by element, so walls, floors, ceilings, roofs, renewables, heat and light, power, you go through it."* - ESC Sales manager.

Figure 18 Competition winner sits with ESC sales team, discussing possible retrofit measures for her home.

This project management service provides householders with a detailed household survey, information and advice on the measures, then connected them to the local suppliers who could do this, and managed the costing, quotation and on-site process of installation. The technical measures on offer were dependent on the measures that installer members in the different local areas were able to provide, but were generally a broad range, including:

- Cavity wall insulation
- Solid wall insulation (internal and external)
- Solar thermal (hot water)
- Solar PV
- Double or triple glazed windows and doors
- Boilers and heating controls, e.g. thermostatic radiator valves.

The Energy Saving Co-operative business model was based upon a profit of 20% of the total cost of the works for each household, with cash flow maintained by receiving a 30% deposit for the total costs upon the customer signing a contract for works with them, and then receiving the remaining 70% upon completion, at which point the ESC then paid its sub-contractors for the work.

7.1.1 Organisational form and governance

ESC was a 'multi-stakeholder' co-operative with three different kinds of members: it had installer members (tradespeople), individual homeowners or supporters (people who automatically became members upon contracting works, or people who invested in ESC shares individually) and community members which included other organisations connected with the ESC and its projects such as community group partners like Northfield Ecocentre, and funders like the Midlands Co-op and the Phone Co-op. Membership of the ESC allowed organisations and individuals alike to impact the running of the co-operative through voting on matters of strategy and finance such as sales strategies, what to do with investments, profits and dividends, and on matters relating to internal rules and governance such as who sat on the board of directors and what should their responsibilities be. Being a co-operative was a core part of the organisation's identity because of its perceived value in creating a trusted 'brand' in the retrofit industry:

> "*There is a trust issue about who do you trust to give advice – and you're more likely to accept an offer for solid wall insulation if it's a co-op than if it's Mark group or some other big business knocking on your door."* ESC Community partner 2.

The Energy Saving Co-operative was answerable to its board of directors, which in 2013 consisted of ten of its community and installer members, particularly those from the Birmingham and Midlands area. These included representatives from three of its funders: the Midlands Co-operative (the main funder), the Midcounties co-operative, and the Phone Co-op; a representative of Co-operatives UK who largely took an advisory role, representatives from its installer members such as Jericho Construction, REco and New World Home Energy, and representatives of community group members such as Northfield Ecocentre and South Staffordshire Community Energy.

7.2 The Energy Saving Co-op's priorities: profit, and 'being a co-op'.

Priorities and targets

The Energy Saving Co-op's key priorities were related to its organisational form. Its primary goal was to be a profitable business, but it was equally important to the ESC to do this in an ethical way, in line with its co-operative 'branding' and its perception of 'being a co-op' as its unique selling point. This priority was embedded in the ESC in the vetting of its installer members on ethical credentials, and its particular governance structure:

> *It creates a peer-to-peer relationship where everyone benefits and contributes to the running of the business, the future projects we take on, and what we do with our money".* - ESC CEO

However, in terms of the ESC's objectives in Birmingham specifically, its targets were initially to retrofit twenty properties in its first partial year (2012), and then to retrofit 200 properties in its first full year of operation (2013). This was based on a calculation of how many installations would be needed to keep the business running, which included an assumption that as a new business they would operate at a significant loss for the first year.

7.2.1 Experimental focus – what was it testing and why?

The view of the ESC's CEO was that the ESC was *"beyond technical experimentation"* (ESC CEO) and in terms of the knowledge being produced, was more concerned by learning about the 'how' of retrofit – mostly in terms of how to run a retrofit business and how best to deliver a product or service to householders. The CEO's vision was largely based upon the

awareness of upcoming Green Deal policy, and on previous commercial sector research projects he had been involved in which posited that the technology to achieve the transition to zero carbon housing stock was available but that the transition was not happening due to householders' lack of trust in suppliers and installers, and that the most trusted organisations included co-operatives alongside local councils. These convictions were based largely on commercial or business-based knowledge, rather than technical knowledge or experiential knowledge at the household level:

> *"Oh that project was mostly B to B. You know they asked businesses, specifiers, installers, architects that kind of thing. Not householders directly, no."* (CEO, ESC)

What this meant was that the ESC's experimental focus was on testing out a business proposition, a brand, and the governance or organisation of a process for retrofit, priorities which had significant implications for what ESC and its partners intended to learn from its projects and activities and how these learnings could be used. The table below shows some examples of perspectives from different members of the ESC network on the knowledge being produced and the experimental focus of the ESC's work, which generally leans towards learning about the process and organisation of retrofit.

Knowledge focus	Example and source
Testing a business model	*"We are testing a business design not a technology. We are operational, and doing a lot of learning-by-doing which makes us different from the projects that are still tinkering with external wall insulation on individual houses."* (CEO)
Testing and demonstrating the retrofit process	*"The problem is there's been a lot of money dished out to do exemplar retrofits that cost a hundred and fifty grand and the house is carbon neutral. Great. Who cares? No-one is going to do that apart from you because you've had funding. Give me an exemplar that cost ten grand for an average house and you can take that learning to the mass market - and we'll have that from this."* (Sales manager)
Testing roles and relationships in retrofit delivery.	*"There has to be a need for people [intermediaries] like ESC. We don't want to work with the likes of British Gas and Carillion, we'd much rather work with someone with some integrity, and I'm hoping that ESC shows us a way of doing that"* (Installer member 1)
	What we've always hoped is that we could take people right from coming to us with an idea about what to do with their house, all the way through to the installation. Until now we've not been able to do that, whereas people like Eon and Carillion are doing this for a living. But now with this we can. We've got a lot of learning to do in order to be able to compete with them." Community member

Table 10 – Energy Saving Co-op perspectives on knowledge and experimentation

These knowledge priorities were also evident observations at the ESC's AGM in July 2013, with the key 'learnings' communicated to members regarding business and operational strategy, such as slow sales being due to longer than expected time taken to develop supply chain capability in project areas. In recruitment strategies the focus was similar, with appointments of senior staff members largely being on the basis of their previous experience either in running co-operatives, other businesses deemed 'ethical' e.g. Cadburys, or from sales or general construction management backgrounds. Detailed knowledge about retrofit specifically was seen as less of an important feature than these.

7.3 What contextual factors conditioned and shaped The Energy Saving Co-op's priorities?

As identified in the literature review and theoretical exploration of chapter three, multiple factors and actors operating at various different scales influence experimental assemblages at the local level, from macro-level landscape issues to meso-level issues in the broader

urban context and factors at the micro-level. The following sections seek to identify the factors and issues at these three levels - shown as red and green text in figure 19 below - that were significant for The Energy Saving Co-operative, and how these conditioned and shaped its approach and priorities.

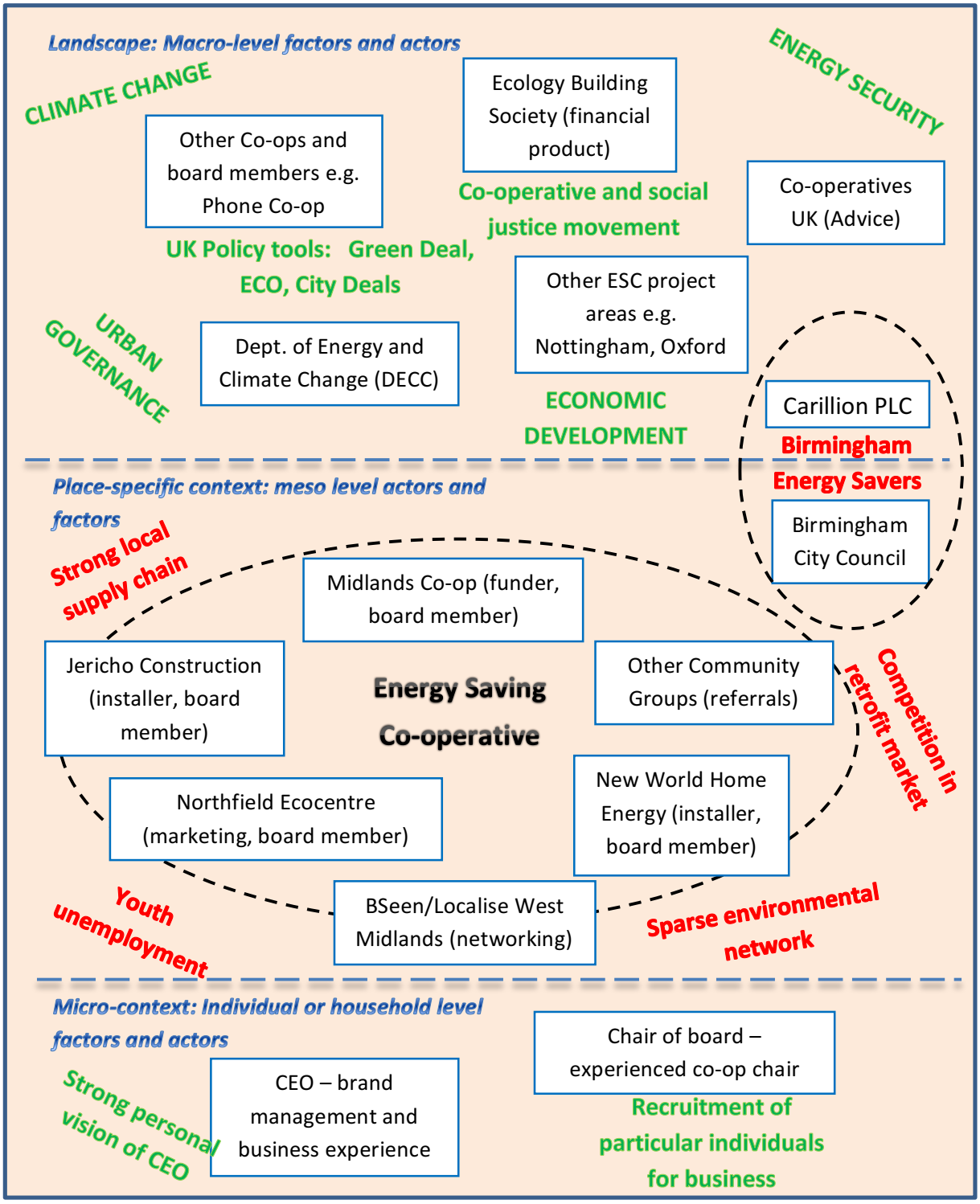


Figure 19 The Energy Saving Co-operative assemblage as description

7.3.1 Macro-level factors: finding 'solutions' to climate change and economic crisis.

ESC was heavily influenced by two key macro-priorities simultaneously: firstly of national climate change targets of reducing carbon emissions by 80% by 2050, and simultaneously by the prediction and expectation (shared among the stakeholders of the ESC) of a macro-societal change of attitude in relation to the financial crisis. This change in attitude was thought to be twofold: firstly that people would become more interested in energy efficiency as a means of securing themselves economically against exposure to fuel price hikes, and secondly that people would cease to trust banks and commercial entities for services, instead flocking to more ethical forms of business such as co-operatives:

> *"People like co-ops at the moment. You know with all the banking crisis I think the co-op bank membership has increased tremendously"* – ESC Sales Director

The ESC's particular area based approach to retrofit was also driven by a desire to boost local economies by creating jobs both in the construction industry and for energy efficiency specialists at the local level.

> *"The [construction] industry has been brought to its knees, and there are all these highly qualified energy people walking around basically doing work for free because they need the industry to need them. They just need someone to throw them a bone."* – Community partner 1

The quotation above shows that there was a shared awareness among its partners that both the construction industry and the environmental sector had been severely damaged by the economic crisis and that domestic retrofit, under the context of the upcoming Green Deal being launched, could provide an opportunity to replace some of the jobs lost in both sectors.

7.3.2 Meso-level factors and issues – funders' requests, supply chain, competition and unemployment.

Local carbon targets made very little difference to the strategy and activities of ESC. Instead, local factors leading the ESC to focus on Birmingham in the initial stages of its business were industry and interest-based. Firstly, the main funder, Midlands Co-operative, had its offices near Birmingham in Lichfield, and expressed a preference for the business to focus at least

some of its efforts on the area local to them in return for their funding contribution. Secondly, the CEO felt that there was a strong, well developed supply chain which had been operating in the energy retrofit field for some time in the Birmingham area, including PV installers, insulation installers and highly regarded small works contractors with energy retrofit capabilities. Thirdly, there were high numbers of ageing properties with solid walls that it was thought could benefit from external wall insulation (EWI) – the focal technical measure of the policy climate.

Furthermore, at the same time as the Energy Saving Co-op was being developed, so was a £100m scheme in Birmingham called Birmingham Energy Savers, a citywide domestic retrofit programme delivered for Birmingham City Council by multi-national energy services company Carillion addressing retrofit in council owned stock as well as privately owned and occupied housing. Whilst there were many other connotations of the presence of Birmingham Energy Savers (BES) in the Birmingham context at the same time as ESC, one of the key ones was that the presence of BES raised the general awareness of and interest in domestic retrofit in the city region, which was a benefit to ESC.

Suppliers and community partners in the Birmingham region also were keen to drive ESC's development because they foresaw domestic energy efficiency and retrofit as a growth industry and wanted to be involved in it, seeing the ESC as a way to do that, especially when situated against the model of BES which was perceived to be less supportive to local organisations.

The issue of unemployment in the Birmingham region also became a driver as the ESC developed, largely due to the input of local installer members. Observations from board meetings ranging from February 2013 to July 2013 show that this progressed from a fringe issue to the business to becoming a more prominent part of the ESC agenda resulting in a proposal to the board that upskilling and job creation in the supply chain be explicitly included in the ESC's mission statement.

7.3.3 Micro-level factors and issues: One man's co-operative vision.

One of the most significant things about the Energy Saving Co-operative was the fact that it was so strongly the brainchild of one person. The CEO's own personal interests, first in 'branding', second in the upcoming Green Deal policy, and third in a somewhat evangelical

view of the co-operative organisational form as a vehicle for social change and promoting sustainable development, defined the direction and vision of the ESC. For example, an important personal viewpoint was that being a co-op would strengthen the appeal of the initiative and its services:

> *"The change will come, we just haven't seen it yet… people will shop around – and the co-op is a powerful idea and brand."* (CEO).

It was also the CEO's personal experience in a commercial research project about the retrofit industry that led him to the conviction that the co-operative form would help to address issues around trust in the construction industry. In seeking funding, partners and support, the ESC's strategy was almost entirely defined by the CEO. He 'designed' the business around these personal beliefs and experiences, then set about looking for partners who shared his beliefs. Naturally, the strength of his belief in the co-operative form led him to seek funding and partnerships mainly from other co-operatives.

7.4 How did the Energy Saving Co-op approach its objectives?

7.4.1 Funding

In late 2011 the CEO felt that with the experience, knowledge and analysis he had, the idea was good enough to seek investment for. The CEO established contact with the then chair of The Co-operative Bank, who also shared his passion for sustainability and had recently completed his own 'superhome' whole house retrofit, who became the Chair of the Board of the Energy Saving Co-operative. Together they lobbied and pitched to various wings of The Co-operative UK's investment society, and eventually gained significant investment of £200,000 from the Midland Co-op, along with smaller investments from other co-operatives such as Midcounties Co-op (£50,000), the Phone Co-op (£70,000), and a U.S. based co-operative (£50,000) to start up and establish the business. It also issued a share offer in 2013 from which it gained approximately £180,000 of investment.

7.4.2 Projects and activities

The ESC's first active effort to establish its business took place in Birmingham, launched in 2012, involving a partnership with local environmental charity Northfield Ecocentre who undertook a marketing effort in order to generate leads for the ESC of interested households. This also involved a competition for two 'demonstration' homes to be

retrofitted for free, partly funded by the ESC and partly by funding from the UK government's Local Energy Action Fund (LEAF). (Figures 20 and 21 below show one of the competition winning houses in the process of being fitted with external wall insulation, and the completed installation.

Figure 20 ESC Competition winner's external wall insulation in progress (Northfield Ecocentre, 2015a)

Figure 21 ESC Competition winner's completed EWI installation – front and rear facades (Northfield Ecocentre, 2015)

The first competition winning householder received external wall insulation to the whole of her semi-detached property, a damp-proofing membrane, two new radiators, thermostatic radiator valves and room thermostats. She also self-funded a new boiler. The total cost of the installation was approximately £13,800.

The second competition winning household received external wall insulation to the rear of their terraced property, insulated boarding in their loft, and internal wall insulation on the ceiling of their extension. The total cost of works was approximately £7500.

ESC also attempted to establish community energy projects in different locations in the UK including one in Barton, near Oxford, with a project involving a neighbourhood of approximately 100 steel framed homes which it was intended would be retrofitted with solid wall insulation using ECO funding and the ESC would provide project management and access to local suppliers and installers. Other project areas included Nottingham, South Staffordshire, in partnership with South Staffordshire Community Trust, and Brighton.

The ESC's staffing structure, with approximately thirty people, some part and some full-time, some on temporary consultancy contracts, was divided into two teams: 'sales' and 'delivery' and supported by a partnerships officer who worked with the CEO in connecting with community organisations and local authorities, and an administrator who worked on 'back of house' issues such as data management. Each of these teams had representatives who were working in the different project areas in the UK.

Its main activities consisted of:

- Recruiting and vetting local suppliers and installers as members of the co-operative (delivery)
- Market and acquire leads for the Co-op's services through local community groups (sales)
- Follow up leads gained from community groups (sales)
- Develop internal processes such as CRM systems for keeping track of leads, customers and costings, and home visit survey tools (admin and delivery).
- Recruit staff to increase capacity and grow the business (CEO and chair of board)

7.4.3 Strategy and identity

In terms of delivering its services, the ESC's vision was that it would be:

> *"combining the best of 'Big' with the best of 'Local' – i.e. the strengths of a lean national organisation with the adaptability of our local co-operative and community partners."* (Energy Saving Co-operative website, 2013).

What this meant is that ESC provided a structure that it believed allowed place-specific, localised relationships to flourish in different places on the basis of existing capacity in those places.

> *"There are things that local groups do really well. Like understanding how buildings are different, like knowing where local tradespeople are because you don't want people travelling miles to do the work you want it to stay in the local economy. But there are things we can do above that like bring an efficient model that can be varied and integrated through the local groups. So it's about a balance between the two. Northfield are different to the [Oxford] Low Carbon Hub who are different to Nottingham and so on. They're all different but we can make use of that and work with them."* CEO

As a result of this, the ESC prioritised partnership building strongly, with particular standards and stipulations about who they would work with and why. Generally, the ESC prioritised working in areas with supportive local authorities and well-established community groups:

> *"I very deliberately selected established community groups - they have to employ people, they can't be all voluntary because you can't rely on voluntary groups to deliver"* CEO

The ESC also recruited installer members with both ethical and quality credentials, to match its strong identity in being pro-social, but also with a strong local reputation of being established and experienced in the industry, and of delivering high quality installations – in order to avoid using 'cowboys' and try to increase trust in the retrofit part of the construction industry.

The ESC's 'branding' not only as a co-op but also as something distinct from policy-related 'Green Deal' was a key part of its identity, and this connected to how it promoted its services to householders, choosing to focus not on technical exemplars or the mass market, but on those who were already motivated and engaged in the retrofit agenda, hence using environmental or energy-focussed community groups to find leads:

> *"The market we're looking at is what I call real people, real homes. Instead of being about PassivHaus which is the top end, or Green Deal cookie cutter which is basically the stuff you can get for free plus boilers, this is about what do you want to do to your property? Is it an extension? Is it insulation? And coming up with a package for that that deals with what people want but with energy efficiency as a priority. So this is for people with particular values – not the mass market yet – that's the wrong approach, but the first movers who are already interested and committed."*

7.5 What relationships affected Energy Saving Co-operative 's activities and progress?

Not only do multiple factors and issues affect the goals, priorities, strategy, funding and organisation of experimental assemblages, but as discussed in the literature review and theoretical chapters, so do the actors and organisations that are involved. The following sections explore the significant and influential actors and relationships operating at the macro, meso and micro-levels of Energy Saving Co-op's assemblage, and the particular interests, approaches and priorities they bring to the case.

7.5.1 Macro-level actors and relationships

National policy and the Department of Energy and Climate Change

The Energy Saving Co-op's push-pull relationship with national policy and related tools created a variety of issues. On the one hand ESC was both inspired by, and emerged in anticipation of the upcoming Green Deal policy being launched: A national policy shift towards PAYS (now the 'Green Deal' finance mechanism) was beginning to address one of the most commonly perceived barriers to retrofit – the high upfront cost. All the stakeholders in ESC were aware of the developing policy around this mechanism and believed that whether Green Deal was effective or not, the policy climate created a context into which a retrofitting business could step:.

> *"The Co-op came along as a precursor to Green Deal. The original concept came out of Green Deal and how it was going to work. We've known about it for two years now, we knew it was coming, but at the beginning of 2012 it started to get some structure".*- ESC Sales director

However, the relationship was in tension – there were multiple problems and issues with the financial elements of Green Deal nationally, yet being Green Deal accredited remained the only mark of quality assurance or reputability for retrofit professionals, which was important for leveraging funding and building partnerships. Consequently, the ESC attempted to tread a fine line between working with policy – making contact with the then Energy and Climate Change minister, and gaining media representation in the Guardian's

Green Deal section (citation) - and remaining independent of it, being acutely aware that a lot of media attention on Green Deal was very negative.

> *"We are more driven by the broader energy transition than the Green Deal specifically. Green deal is not a good proposition for customers – so we will become a GDP but we will be working on offering other financial incentives and products." - ESC CEO*

Certain key differences between the ESC's services and the 'Green Deal proposition' included offering reduced mortgage rates linked to improved energy efficiency from The Ecology Bank instead of loan finance, and not limiting technological measures to those prioritised at national level (EWI, boilers and heating controls), allowing householders greater choice and better incorporation of energy efficiency with broader home improvement plans. This attempted independence from Green Deal was enabled by the substantial initial funding sources ESC gained which allowed it to build a stable workforce and business plan rather than relying on conditional central government grant funding.

ESC also had a turbulent relationship with the ECO. Ongoing attempts to negotiate a price for ECO from the energy companies fell flat, especially after changes published by DECC in guidance to suppliers in March 2013 significantly reduced the level of obligation on suppliers. This caused significant problems for ESC and resulted in them having to end one of their key projects in Oxfordshire:

> *"British Gas gave us an offer of £7000 a home which gave us enough confidence that we could fully fund it. Then when the ECO changed in March they brought it down to £5400 which wasn't really enough. And the question from the council was: is it fully funded or not? And we couldn't give them that, so over the course of a month, we had to pull out and we lost the ECO offer and the opportunity to use the money."* ESC CEO

Co-operatives UK and the wider co-operative movement

The ESC's relationship with the wider co-operative movement provided force and motivation behind this fundamental aspect of ESC's branding and identity, which was designed with the goal of appealing to consumers who appreciated the values embodied in

the co-operative organisational form. Internally, building connections with other co-operatives such as gaining funding from a U.S. based co-op, having ESC partners nominated for awards at the UK co-operatives awards, and having the global president of the International Co-operative Alliance give a speech at the ESC's own AGM were all part of both building a visible reputation and providing motivation to the staff and the members that they were 'part of a good thing'. These relationships were also useful in terms of funding, advice and organisational and administrative resources such as templates for co-operative rules, defining roles and responsibilities of board members and structuring the ESC's share offer and reward structure.

However, this reliance on co-operatives as the primary source of support exposed the ESC to issues in the wider co-operative group: at the same time as the ESC began to lose the faith of its board, the co-operative group ran into a number of public scandals and funding for struggling startups such as the ESC became much harder to justify. With poor sales, no other source of financial support or funding in place and withdrawal of the Midland co-operatives funding, the ESC was no longer able to continue as a business.

7.5.2 Meso-level actors and relationships – Birmingham's organisations and influences

Through representation on ESC's board of executives, funders, community partners and suppliers from the Birmingham area (as well as other areas) were able to actively negotiate their own particular interests into the organisation's characteristics. Observations at board meetings and management team meetings show how different influences and interests described below were discussed and then translated into organisational changes such as increased attention to the skills and training provision of suppliers they work with, recruitment of (perceived) 'better' sales staff and improved financial reporting tools, and simplifying surveying methods for better communication with householders. Some examples of these relationships are given below.

Northfield Ecocentre

> *"We give them customers, that's the deal. And later on we might help them with other bits of the customer process as well."* – Commmunity member 1

Northfield Ecocentre is an environmental community organisation promoting and encouraging sustainable living in and around the South Birmingham. It employs two domestic energy assessors and prior to working with the ESC it was already engaged in outreach to households providing home energy assessments and linking households to previous government retrofit schemes Warm Front, CERT and CESP. ESC contracted Northfield Ecocentre to promote and market its services during a pilot phase between January and April 2012, in which its targets were to generate leads leading to twenty retrofits.

Working through community organisation Northfield Ecocentre defined the scale and space in which ESC was working, simply because of the capacity that Northfield had and the location it was in, where it was already doing energy efficiency work with householders:

> *"Where we work depends on who our partners are. So with Northfield it's generally South Birmingham, or a large part of South Birmingham"* CEO

For example, this resulted in the two competition winners, who were found through the Ecocentre's outreach, being located in Northfield.

The ESC's relationship with community groups also changed as a result of working with Northfield as its first community partner. After the pilot period ESC created a simpler 'deal' for community groups and also realised that it could not rely on one organisation in an area. Furthermore, Northfield Ecocentre's close links to householders brought feedback to the board about the frustrations of householders who had been contacted as part of the marketing strategy but left waiting for further information, or who had been given a quote but were confused about the rest of the process, such as who was going to do the works for them. Their presence on the board brought particular attention to the 'customer experience' and influenced changes to the ESC's strategy which were intended to make the link between the sales and delivery parts of retrofit much smoother for the householder.

Other local networks

A local business network connecting social enterprises involved in energy related work (BSEEN), and the Localise West Midlands (LWM) network of community organisations, businesses and local authority representatives, were also helpful for ESC, making the

connection between the CEO and Northfield Ecocentre, as well as the local installer members described below, and with local environmental community groups Kings Heath Transition and Balsall Heath is my Planet, who signed up to provide the ESC with householder referrals.

Local installers

Birmingham based installer members Jericho Construction and New World Solar both became involved with the ESC because they felt that their organisations and the ESC shared a value position in terms of a commitment to developing local supply chains and avoiding working with large commercial entities such as Carillion and some of the big six energy companies:

> *"We hold a strong belief in integrated local supply chains instead of these big companies screwing the little guy all the time and energy saving co-op really get that. We also believe that jobs are really a way of strengthening communities and preventing anti-social behaviour and we're really committed to helping disadvantaged jobseekers – you know, it's a bit like 'get a job, or go on the rob', and I like to think this industry might be able to help stop people going on the rob!"*
> Installer member 1

These members also brought particular issues to the table and represented the interests and perspectives of installers with practical experience.

"We tell them how it is from the supply chain point of view – this process really needs to be installer led as the advisors just don't have the technical expertise that we have." – Installer member 1

However, they also got involved to represent training and unemployment as an issue and make sure this was at the forefront of any strategy that is being developed in the construction industry.

> *"One of the main reasons that I'm there is to wave the banner for trade and employment in industry. Jericho's core mission is about employment and training and providing opportunities to people who have been disadvantaged in the labour*

market. So I'm there to make sure there's a strong focus on employment and training in the business as it develops." Installer member 2

However, one of the key tensions in the relationship between ESC and its installer members is that these installers became members on the expectation that they would get installation work, but this expectation was not realised and both installer members grew increasingly frustrated at the slow progress ESC was making in terms of converting leads to installations, ending up feeling like they were doing the ESC a favour by being on the board of directors and providing advice, without receiving much in return.

"I'm disappointed really… I don't like to use that word because I've been involved since the start but it's just been much slower than I expected. We trained ourselves up on the technology, got ourselves into the supply chain and then… Where did it all go wrong? I haven't done a single solid wall [insulation] job since last year when we did the demonstrations, none from Birmingham Energy Savers and none from Energy Saving Co-op either." – Installer member 2

Midlands Co-op

As the ESC's main funders, Midlands Co-op had a significant impact. Their presence and contribution contributed to the focus of the business initially being in Birmingham and its surrounds, and also meant that internally in board meetings as the main funder with the biggest stake, the Midlands Co-op board member largely took the lead in holding the management team to account, quizzing the ESC CEO and Chair about progress and persistently focussing discussions on profit and sales targets. This prompted a strategic shift within the ESC in prioritising sales activity and recruiting staff to support this. However, as the ESC continued to struggle to meet its financial projections and reduce its losses during the latter half of 2013, the Midlands Co-op board member was losing faith in the ESC as an investment. This meant that the decision to continue to fund a struggling business was under pressure in and of itself, and because of additional scrutiny from the broader co-operative group under the conditions of a reputational crisis and group restructuring. The Midlands Co-op's decision to withdraw funding from the ESC and additionally not to buy the business when it became insolvent ultimately resulted in its demise and the ceasing of trading.

Birmingham Energy Savers

The relationship with the large Green Deal scheme Birmingham Energy Savers (BES), led by Carillion in partnership with Birmingham City Council was somewhat conflicted. There was a certain dependency on the presence of BES in terms of the awareness of retrofit that it raised in the city-region, but there were some customers, local installers and community groups that were uncomfortable with BES because of concerns over power and representation. This tension is represented perfectly in this perspective from one of ESC's community members, who also worked with BES:

> *"The better situation is definitely the co-op because we are an equal partner and we have a say in the rules. But we wouldn't be involved in Green Deal at all if it wasn't for BES. The overall picture in Birmingham would look very different"* – community member 1

Generally speaking, both the leaders of BES from Birmingham City Council, and the ESC shared a viewpoint that they supported each other's goals and aims, but that they were not interested in working together due to fundamental differences in their approaches. Indeed, both parties alluded to 'healthy' competition being a positive thing for progressing in retrofit in Birmingham.

> *"Birmingham is big enough for both models as long as they're both looking after the customer"* – Birmingham Energy Savers manager, Birmingham City Council

> *"On BES my position on Birmingham Energy Savers has always been very clear – we are trying to achieve the same thing. We will work alongside them but not get subsumed by them. Our structure and our process is better, we just need to prove it." – ESC CEO*

However, this situation resulted in a compromise in ESC's strategy in terms of how it wanted to work, having identified a supportive council as one of its important strategic priorities in areas it worked in. In Birmingham this was compromised in favour of other factors such as core funders the Midlands Co-op's preference for working in Birmingham, the strong supply chain presence, and the particular strengths of Northfield Ecocentre. As time progressed, it became evident that there were serious problems in the BES scheme,

with rumours of poor surveying and assessments, technically suspect recommendations and poor communication with householders. This resulted in not quite the relative knock on that ESC might have hoped, with the reputational risk not only of BES being damaged, but potentially of retrofit as a whole:

> *"To be honest, BES is a nightmare, it's a disaster… And people are getting really fed up. I do think you know that if people are looking around and they're after quality and something a bit more personal, they'll go for the Energy Saving Co-op, but the damage might have been too great for people to even consider going somewhere else."* – Community Member 2

7.5.3 Micro-level relationships

The importance of individual personal connections were very important to the ESC in its initial stages. Networking at local events and personal introductions between one particularly active individual in the Birmingham region who managed both BSEEN and LWM, and the CEO, were the primary source of initial partnerships and members such as the Northfield Ecocentre, Jericho Construction and New World Home Energy.

7.5.4 Internal dynamics and negotiations

Financial concerns and forecasting

Whilst the ESC's vision, strategies and identity were externally well defined around its organisational form and structure, observations from internal management team and board meetings showed a gap between these intentions and the realities of the business.

Over the period between February and July 2013, questions from the board to the CEO repeatedly involved concerns over how far behind financial forecasts the ESC was, largely due to difficulties converting 'pipeline' works and leads to actual sales and installations. Despite a temporary reprieve after financial reforecasting in April and an overhaul of the ESC's business plan based on more modest targets and fewer sales, the ESC had done very few or no installations in many of the ESC's project areas, and in comparison with its targets of 200 in Birmingham in the first year (which had long passed by this point), progress was slow. This bred further concerns over the nature of financial reporting to the board and explicit requests for sales figures to be clearer.

Fears were also raised in board meetings repeatedly about waning support from the wider co-operative group, with some divisions about how to approach this: some board members preferred informal verbal conversations with senior members of the co-op bank and others suggested formal communications requesting support. These discussions ignited additional questions about whether business risks were being effectively identified and communicated to the board, with subsequent requests for a risk register to be presented to the board.

Staffing and organisational structure.

The CEO and Chair's response to the concerns raised about poor sales figures was to enact a recruitment drive and restructure the business. A greater drive on building external partnerships was made, and an existing member of staff was promoted to a role of 'head of customer experience' – and a previous construction manager was promoted to manage the 'delivery' team nationally. A temporary Chief Operations Officer was recruited to remove some management strain from the CEO and allow him to concentrate on sourcing extra funding. These were all based on the CEO's perspective that:

> *"The big challenge is about people. Early on we had lots of customers and not enough supply chain – so our stress was in the community groups having fed up people. Now the stress in the business is that we have a great supply chain and we're not giving them enough work so we really need to get our sales and our operations team working much better together and we need the right people for that."*

However, these staff changes caused internal disquiet, with some staff resigning over the changes and numerous members of the board airing concern over the high earnings packages being offered to new members of staff in the context of poor financial performance, without consultation with the board. Consequently, the board requested that the CEO and Chair provide them with CVs of senior management.

Further internal disharmonies as a result of fears of poor financial performance also resulted in a withdrawal of the share offer funds from being used for business development, which, along with the Midlands Co-op's withdrawal of funding, contributed to the ESC being unable to continue trading.

7.6 What were Energy Saving Co-op's achievements and outcomes?

During the 18 months of its life, ESC managed to gain over £500,000 of funding, create a new business and pioneer a new, multi-stakeholder organisational form for delivering domestic retrofit. It attracted 100 individual members and 13 organisational members, was tweeted by the then Secretary for Energy and Climate Change, and was featured in a national newspaper. It also created new connections and a network between community organisations and retrofit installers in the Birmingham area.

The number of homes retrofitted in the West Midlands over the whole of 2013 was 18. The majority of these were in what the ESC's project team called 'Greater Birmingham', which included West Bromwich, Walsall and as far as Lichfield. Two competition winning showhomes were also completed in Birmingham with Jericho construction in 2012 and the total of 20 homes in the region is clearly significantly less than the target of 200 in the first year. However, one of the showhomes was revisited by Northfield Ecocentre a year later, and the householder was able to demonstrate a rise in her EPC rating from D to C, and report great improvements in comfort and significantly reduced damp.

However, despite predicting a significant financial loss in its first year of operation, accounts showed a much greater than expected loss from the West Midlands region, alongside greater than expected losses in all regions of the business.

The pipeline of sales shown on management accounts had increased in the latter half of 2013, and a number of deposits for work had been paid across the region, but there was a persistent lack of installations and the ESC was receiving complaints about delays in the process. The organisation was struggling to keep up with the promotions and increased sales efforts that it had made. Changes at macro-level to the ECO dramatically reduced the levels of subsidy available, and alongside internal conflicts and inaccurate financial predictions this made it very difficult for ESC to present an attractive package in terms of combinations of services and subsidies to local partners and householders alike as well as to funders in reassurance. With the withdrawal of the Barton project, and much slower sales elsewhere including in Birmingham, cash flow became an enormous issue and the organisation relied entirely on direct funding rather than its own revenue to pay salaries and cover its operational costs.

Between October 2013 and November 2013 the board had become increasingly concerned about the lack of sales and the ESC falling further and further behind its projections. In late December 2013, an emergency board meeting was called in which insolvency practitioners were present, and the decision was made to dissolve the ESC and pay back the shareholders investments.

There were a number of effects of this: Many of the ESC's staff were not paid over the Christmas period. One of the ESC's board members who had been promoted to the Chair of the Board of UK Co-operatives on the basis of a recommendation from the ESC, was forced to step down as a result of the insolvency. In an unexpected connection between cases, another effect was that members of the Carbon Co-op in Manchester became increasingly concerned about the reputational damage to retrofitting co-ops:

> *"I'm so fed up. They've sunk half a million of funding in creating this huge organisation and we're busy doing this mostly voluntarily, and now people are wondering whether they can trust us or whether we'll do the same"* – Carbon Co-op project manager

Overall, the concept of the Energy Saving Co-operative created by the CEO, which gained much support locally and nationally, did not connect to the operational reality of running the business, resulting in a story that tells us of the rapid rise, then the rapid fall, of an organisation.

7.7 Theoretical reflections from The Energy Saving Co-operative

In relation to the multiple factors and actors that involved in the ESC's assemblage, this case study found that although climate change a dominant macro-level factor, the economic crisis also had a significant influence on its development. In terms of the influence of actors and factors at the different levels, there was really only one significant actor at the micro-level who furthered this cause. In comparison to Carbon Co-op's technical and peer-to-peer experimentation and knowledge priorities, ESC was more concerned with testingh a business model or brand, and a retrofit process. Actors specific to the Birmingham context had a significant influence on the ESC's priorities and vision initially, but internal dynamics alongside changes at the macro-level to policy and the ECO contributed significantly to its downfall, rendering its contribution to any systemic change minimal.

For the final case study of the Bristol Home Energy Upgrade questions are raised around whether these issues with the problematic national policy context are shared among all three cases, whether its landscape priorities and experimentation focus differ again or are shared with Carbon Co-op and ESC, and whether individuals at the micro level also have a significant level of influence on the development of the case as they have done for the first two cases, or whether actors at the other levels are more significant.

Chapter 8 - Case Study #3: Bristol Home Energy Upgrade

A tightly controlled local government policy experiment.

The Bristol Home Energy Upgrade was a short term grant scheme as part of a DECC and City Deals combined initiative piloting the Green Deal before its official launch. The BHEU was successful in retrofitting single measures to a significant number of privately owned and occupied properties in a short period of time, and providing clear lessons to local government in navigating different aspects of Green Deal and ECO. However, its tight adherence to policy, limited supply chain and its reproduction of existing governance networks in the city region limited learning and transformation in retrofit practices beyond the narrow policy lens. The table below shows some of its key features and the remainder of the chapter will explore the factors and actors that contributed to the BHEU's formation and orientation.

Defining features	Short-term, local authority-led scheme piloting Green Deal and ECO policies in practice. Providing subsidised solid wall insulation and boilers for homes in Bristol.
Key Activities	Creating a delivery partnership, marketing and promoting, advising and identifying eligible householders, identifying accredited installers, acquiring ECO subsidies for installations, managing grant funding.
Key priorities	Meeting government targets, addressing climate change targets, 'testing the market', testing policy.
Key relationships	Bristol City Council, Centre for Sustainable Energy (CSE) (delivery partner), with Scottish and Southern energy (ECO provider), OFGEM (ECO regulator) Bristol Energy Network (BEN) and local community groups.
Outcomes and effects	157 households retrofitted. 23 with solid wall insulation, 134 with boilers, central heating or heating controls. Contributed to further Bristol retrofit scheme and wider Bristol Energy Strategy.

Table 11 - Snapshot of The Bristol Home Energy Upgrade.

8.1 What was the Bristol Home Energy Upgrade?

The Bristol Big Home Energy Upgrade (BHEU) was a local authority-led pilot programme of domestic retrofit delivery to owner occupiers, in anticipation of the national Green Deal policy being launched in the UK. It provided subsidised domestic retrofit measures to households across the whole Bristol city area using grant funding from central government and supplemented by householders' own capital or loan finance. It ran between December 2012 and May 2013 and was managed and provided by partnership between Bristol City Council (BCC), and the Centre for Sustainable Energy (CSE). The main focus of the initiative was to *"kick-start the Green Deal in the region"* (CSE, 2013, p1) and to test out the practicalities of Green Deal and ECO at household level, including funding structures, capacity in the local supply chain and the take-up for Pay As You Save loans. It focussed specifically on privately owned and occupied homes, unlike other Go Early schemes in the country which either focussed on social housing or had private housing as a small component:

The technical measures on offer were limited to:

- Solid wall insulation (internal or external)
- Boilers and heating controls, e.g. thermostatic radiator valves, and one upgrade from electric heating to gas central heating.

This was largely because of a lack of accredited suppliers and installers for other measures such as underfloor heating or hard to treat loft insulation. Furthermore, only single measures were installed in each property, due to complications with getting hybrid or mixed installations to qualify for ECO subsidies.

8.1.1 Organisational form and governance

The Bristol Home Energy Upgrade was not an organisation in and of itself but a time-limited scheme comprising a partnership between Bristol City Council (BCC) and CSE, supported by Scottish and Southern Energy (SSE) (as the ECO provider) and Wessex Home Loans (as the finance provider). The partnership between BCC and CSE was a standard contractual relationship which had been competitively tendered, with roles and responsibilities between BCC and CSE clearly defined from the outset. BCC were responsible for 'scheme

management', which involved contracting partners, managing the grant monies from DECC, defining the scheme strategy (e.g. what was being offered, marketing), seeking out installers in the region, defining a marketing strategy, monitoring progress and reporting to DECC.

CSE was responsible for 'scheme delivery', which consisted of the following:

> *"If someone was interested they'd phone up CSE and somebody would have a chat with them for about twenty minutes […] finding out whether [the scheme] was right for them. If the people then said yeah this sounds good, they would get sent an information pack and be invited to get a GDA. Then they get an EPC, so we can calculate the level of grant and loans. They then communicate that back to the customer who can then decide whether to proceed with the installation if they want to. We as CSE are facilitators not managers – we give the householders a list of people who can do installs, the customer then chooses who does the install."* CSE project officer

Ultimately, BHEU was answerable to DECC through a two-weekly reporting process on its progress, and the release of funds for installations was dependent upon this reporting.

Figure 22 below shows the process for the householder and which organisation is involved at which stage.

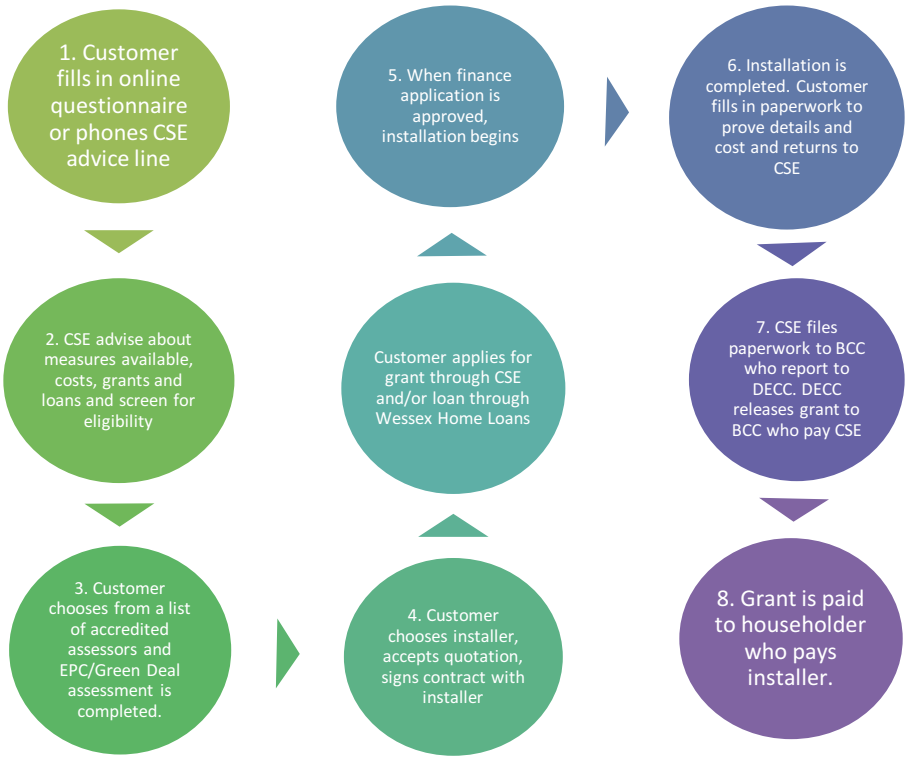


Figure 22 BHEU Customer journey and process.

8.2 The Bristol Home Energy Upgrade's priorities: Policy and delivery testing.

8.2.1 Priorities and targets

The Bristol Home Energy Upgrade's priorities were to test policy processes, contribute to future retrofit schemes and scenarios for Bristol, investigate the levels of interest in Bristol in solid wall insulation and to provide demonstrations - particularly of installations of external wall insulation – which normalised it as a process so that when the Green Deal started officially the product would not be considered unusual:

> *"What we're trying to do is kind of normalise this installation within Bristol. To make people think actually this is something I can do. You go to a house in your neck of the woods, similar to your house, where it's been done and you think maybe this is achievable for me so that was always part of the legacy plan."* BCC Project co-ordinator

The BHEU's initial targets were to complete approximately 150 solid wall insulation retrofits and around 150 heating system retrofits.

8.2.2 Experimental focus – what was it testing and why?

There was from the outset an explicit acknowledgement of the experimental nature of the BHEU in many ways, related to specific components of the national policy framework as part of a national transition between one retrofit policy regime – the previous CERT and CESP schemes – and another: the Green Deal and ECO. These 'tests' were largely being undertaken to inform future retrofit schemes in the Bristol city at a larger scale under the new policy context. The table below shows some examples of the BHEU's experimental focus.

Knowledge focus	Example and source
Testing ECO and Green Deal	*"the pilot aimed to test the underlying principles of the Green Deal and build the local market in advance of its formal launch in early 2013, utilising the emerging Green Deal supply chain (installers, advisors) and pay-as-you-save style finance to replicate Green Deal finance as closely as possible."* CSE final report, 2013.
	""We were testing everything really: how to get ECO signed off, whether ECO rates were enough for people, how ECO interacted with Green Deal and the PAYS finance mechanism, how to get payments to people… Every aspect from understanding the consumers to knowing how to use the software and calculating the grants, getting the right installers. It was an introduction to the logistics of delivery so that when the Green Deal and ECO starts for real they know what they are looking at." CSE Project co-ordinator
Testing the market	*"We were really looking into consumer interest. Whether this was what people in Bristol wanted."* BCC Project co-ordinator
Testing delivery of energy services.	*"It was a free for all pilot really. Looking at the form that delivery could take down the line, whether the council might want to be a provider, or a facilitator or what."* BCC Technical project manager
Testing methods of community engagement	*"Bedminster Energy Group were involved really to test different ways of engaging communities with energy efficiency and whether having a community group there added value or not."* CSE project officer

Table 12 – BHEU Perspectives on knowledge and experimentation

8.3 What contextual factors shaped the Bristol Home Energy Upgrade's priorities?

As shown in the assemblage diagram in figure 23 below and like the previous cases, the BHEU and its particular focus is the product of a range of issues and factors operating at at multiple levels, from the macro, through the meso-level down to the micro or individual level. These are shown as red and green text in Figure 23 below and this section will explore how they conditioned and shaped the BHEU's priorities and approach.

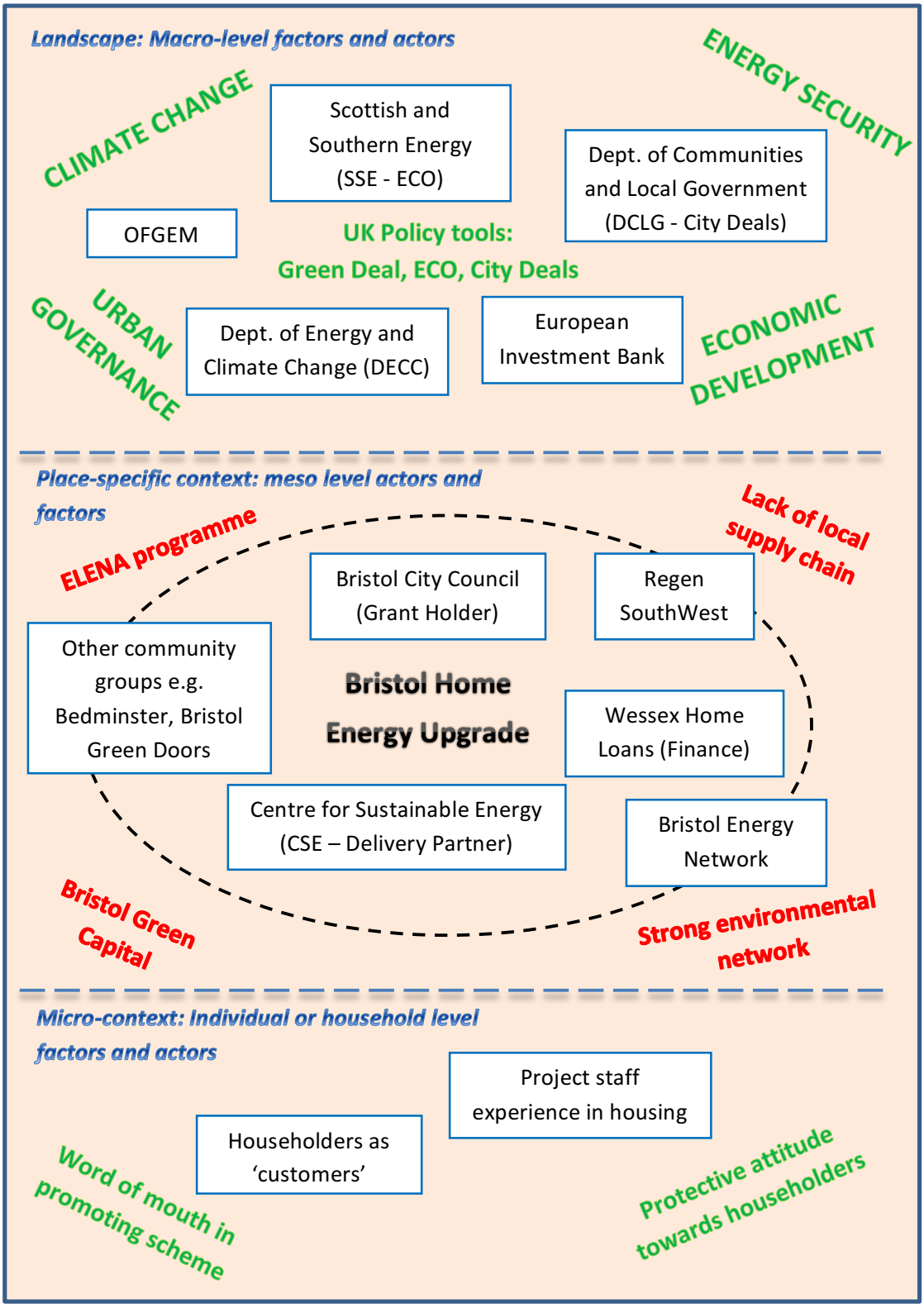


Figure 23 Bristol Home Energy Upgrade Assemblage as description

8.3.1 Macro-level factors – climate change, interurban reputation, and… policy again.

The presentation of Bristol's upcoming retrofit activities by a Bristol City Council officer at the RetroExpo event – a conference for retrofit professionals, workers, manufacturers and enthusiasts at the NEC in October 2012 positioned retrofit firmly as part of the climate change agenda and much less than other cities as part of an agenda around fuel poverty or unemployment, and most interview participants specifically mentioned climate change targets as the key motivation behind the scheme. However, despite this being a 'macro-level issue' the connection with this issue was made through Bristol's specific climate change targets rather than the UK's climate change targets, as explored further below.

Bristol's engagement with the European Green Capital award, funded by the European Bank, also brought another supranational issue into the picture of BHEU, which was its position as a demonstrator of 'best practice' in sustainable living and governance to other European Cities. Retrofit was situated as one component of this, creating an outward-looking emphasis on the results of the scheme in terms of Bristol's reputation amongst other European cities.

> *"Bristol is increasingly recognised across the UK and Europe for our work on renewable energy, Green Deal and retrofit programmes, and thriving low carbon economy.*
>
> *"However, we need to up our game and ambition, and I am determined that Bristol becomes an environmental role model to inspire other cities around the globe.*
>
> *"To win this time we all need to rally round, and I urge people to visit the Bristol Green Capital website and back the bid."*
>
> (Bristol Green Capital 2013)

However, the most dominant macro driver for the BHEU was the change in policy regime: the anticipation of the launch of Green Deal and ECO as shown by the following quotation:

> *"So obviously Green Deal is going to start in earnest soon and one of the things we're doing is that we're quite interested in implementing a Bristol Energy Company. And that has a number of possibilities and it could be that we become a green deal provider, or we could be providing other energy services but we don't know exactly yet until we've had a go."* BCC Technical project manager

This also illustrates that many of the experimental features of the BHEU revolved around how Bristol's network and future plans (in the local authority in particular) would engage with retrofit under the Green Deal and ECO, and define its role under this particular policy context.

8.3.2 Meso-level factors: Bristol's targets, reputation, and political will.

A number of Bristol-specific factors relating to broader energy and sustainability issues had a significant impact on, firstly, the perceived need to act on retrofit and engage with the Green Deal in general, and secondly, the need to act on it in Bristol specifically, resulting in what the BCC energy services officer termed a *"concerted effort within the city around the whole sustainability and resilience thing."*

Firstly, Bristol's Climate Change Security Framework published in 2010 set citywide carbon emissions targets of a reduction of 40% of baseline levels by 2020 and an associated 30% reduction in energy use. These targets were consistently cited as part of the rationale behind tackling retrofit in a general sense, but particularly in relation to certain technical aspects of Bristol's housing stock:

> *"A large chunk, like about 30% is solid walled and 20% is conservation so that presents a unique issue for Bristol in terms of its housing stock and getting that consumption down. We have more listed buildings here than in Bath. You just don't get damp problems in the East like you do in the West – it's just so much wetter here. Bristol has so many damp problems from basically concreting up walls they shouldn't have done. And it's really important not to dumb this information down too much. We need to know this stuff to get quality installs done."* – BCC Energy Services officer

However, these carbon and technical factors in the rationale behind BHEU were very much seen as components in a series of Bristol-based projects around climate change and sustainability more generally. Bristol City Council was already engaged in a citywide investment programme focussed on energy (which shall be detailed below) and in addition, after applying twice previously, Bristol was eventually awarded the title of 'European Green Capital' for 2015. The quotation below illustrates the importance placed on this award and – particularly through reference to being a 'role model', Bristol's role as a demonstrator of good practice to the European community. The effort that had been made to gain the award, and the reputational elements to achieving this award such as a 'well-established

record' in the green sector (which in more detailed documents referred explicitly to Green Deal and retrofit) all added impetus to the BHEU.

> *Why Bristol?*
>
> *On the third attempt, Bristol was awarded 2015 Green Capital status as a city that can:*
>
> *Demonstrate a well-established record of achieving high environmental standards*
>
> *Commit to ongoing and ambitious goals for further environmental improvement and sustainable development*
>
> *Be a role model – part of an ever growing group of cities that aim to inspire and promote best practices to all European cities.*
>
> *Excerpt from http://bristolgreencapital.org/about/european-green-capital-award/*

A key factor in the 'collective effort' in Bristol is the presence of a strong, active environmental network and lobbying in the city region. The context of the Green Capital Award also created a self-image of being a pioneer among Bristol's 'green network' (in terms of the local authority, community organisations including CSE, small and medium businesses, and the citizens who supported the bidding process). But in this 'green network' was also entwined a specific energy network. The Bristol Energy Network comprises community or third sector groups, small businesses and individuals working on energy related issues and projects in and around Bristol. Contributing to BEN were groups with a range of retrofit interests, ranging from Bristol Green Doors, an open-home retrofit demonstration network, Transition Montpelier, who had completed a number of EPCs in their community, and Bedminster Energy Group, who provided energy efficiency advice in their local area and were engaged in a LEAF project testing community engagement with retrofit. A research project conducted by The University of Bristol specifically investigated the role of BEN and CSE in contributing to the success of Bristol based community groups in securing funding for community energy projects and contributing to Bristol's reputation as a 'pioneer' in climate and energy related issues (Bird et al, 2013).

Together these factors create a scenario of high political will around sustainability and retrofit, a view strongly held by the council officers, as shown in the following example:

> *"One of the biggest strengths of Bristol is the community energy network. We have got quite a lot of grassroots organisations here pushing the agenda, or even what*

> *are now large organisations that came up from grassroots. We've got the soil association, we've got CSE, Sustrans…There's definitely something about Bristol that has this kind of alternative, counterculture ambience to it"* BCC Retrofit officer

This view was shared by the wider network, and the next quotation describes not only the presence of the various organisations but also how this translates into a supportive context for practical action:

> *"Out of the LEAF funding Bristol won more projects than anywhere outside the M25, which is really incredible. And a lot of it was down to having the resources, the people and the ideas in the network, having CSE there supporting people with bids, and people just being informed about what was coming up – sharing information."* BEN representative

It was also felt that the presence of a supportive mayor who was also the 'portfolio holder' for low carbon and energy issues in the Core Cities group, provided some certainty around political support for retrofit:

> *"Because he's there for four years it gives us some consistency. We know it's not just going to drop off the agenda suddenly and because he's the portfolio holder as well, it gives us a voice outside of Bristol."* Technical project manager BCC

On top of this, issues around unemployment and economic decline seemed to be less of a factor in the Bristol context than in other urban contexts which allowed the environmental agenda to be the primary local driving force behind retrofit:

> *"Bristol unlike other cities hasn't suffered a major recession, it's a relatively wealthy city, we only have four or five wards in the lower 25% of the deprivation indices. So of course it's an issue, but really that means the environmental imperative is strongest."* BCC Technical project officer

8.3.3 Micro-level factors – protecting householders.

Whilst most of the strong drivers were already defined for the team working on the scheme by both national and local targets and drivers related to policy, there were some personal factors that provided additional motivation. For example, a number of the project officers from both CSE and BCC had previous working roles in housing services. This gave them a particular feeling of responsibility towards householders, creating a particular drive to *"get the best possible deal for the householder"* (CSE project officer 1). This protective attitude towards householders extended into various financial aspects of the scheme such as great efforts to make sure that works weren't disrupted even when there were cash flow issues between DECC, BCC, CSE and the installers behind the scenes.

8.4 How did BHEU address its priorities?

8.4.1 Funding

The BHEU originated from an award of £2m funding from the Department for Energy and Climate Change (DECC) that was connected with the Core Cities' City Deals, agreed in July 2012. Bristol City Council (BCC) was awarded this funding and a further £800k was offered by SSE for ECO funding. Attached to that funding were conditions from the UK government treasury that the total fund had to be used in particular ways, with 90% of it for capital spend (i.e. actual retrofit measures and works) and 10% for staff overheads, which impacted the nature and form of the scheme significantly in terms of its marketing as described below.

8.4.2 Activities

The funding for the project awarded to Bristol City Council by DECC was conditional on it being spent by 31st March 2013, which meant that the project operated on a very short timescale. The BHEU's main project activities consisted of:

- December 2012 – February 2013: Marketing. Because of the treasury's rules of using no more than 10% of funding for overheads (which were paying for staff time) marketing the scheme had to be done in ways that did not incur additional costs.
- December 2012 – February 2013: Finding accredited installers for the scheme (BCC and CSE). Communicating with installers about what is expected of them, signing them up to project code of practice.
- January – February 2013: Receiving calls to CSE advice line and online applications, processing applications. During this period the volume of calls and interest in solid wall insulation was so high in comparison to the number of accredited installers that were available, that BCC closed the scheme to SWI applicants after the first two weeks. Applications for heating system upgrades were received until the end of February.
- February – March 2013: Managing installations and grant/loan applications.
- March – May 2013: Extension granted to BCC by DECC until the end of May, installations continue to this point (two installations are shown in figure 24 below).
- May – July 2013: CSE complete project evaluation and report.

Figure 24 Two case study external wall insulation properties in Bristol - installed in April 2013 (Jackson, 2014, and Gitsham, 2014)

8.4.3 Strategy and identity

Household chooses assessor and installer

Letting the householder choose their assessor and installer and set up the contract directly between them rather had a number of functions. This was partly to protect the council and CSE against liability (in this model, the installer held the liability for any issues with the installation) and was partly because under the timescales of the project it would have taken too long to procure a single contractor to do the installations. It was also designed to test out the relationship between the householder and the green deal installers for future schemes, setting it up as though it was a 'normal' home improvements process facilitated by rather than provided by the council, which CSE termed 'householder led':

> *"The Bristol Home Energy Upgrade (BHEU) project was designed to trial a 'householder led' approach to energy saving home improvement initiatives and retrofit measures. Central to this aim was customer choice of both the assessor and the installer who were selected to undertake work at their property." From CSE report p7.*

As part of this process, householders were also provided with a brochure to answer important questions about the scheme, shown in figure 25 below, and providing a list of accredited organisations to choose from. As part of CSEs evaluation process, it was found that the vast majority of householders found this brochure very useful as part of the process.

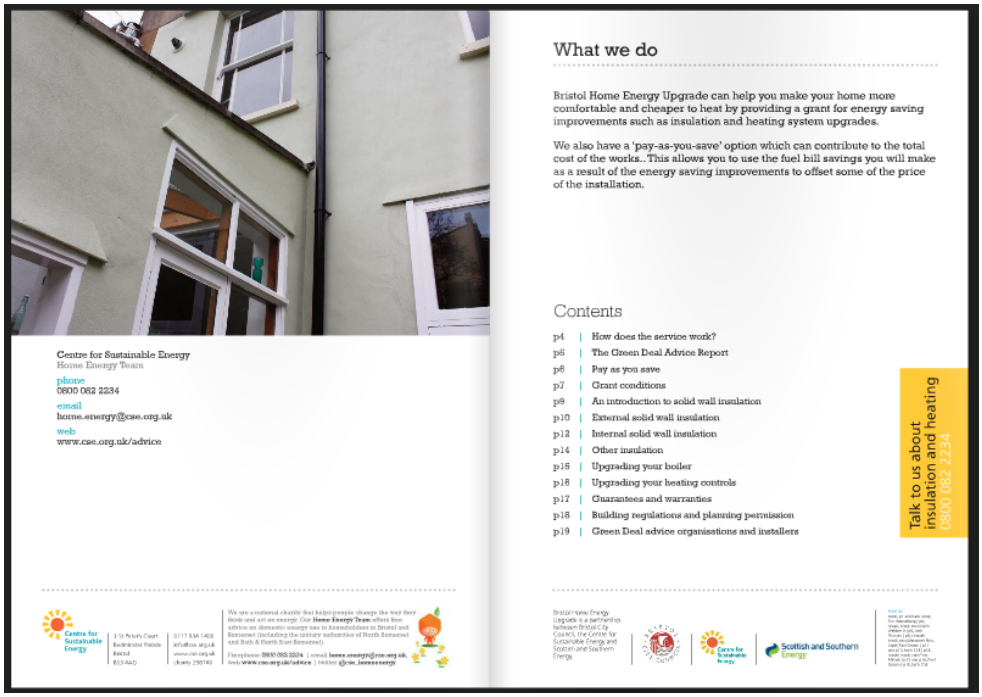


Figure 25 Contents page from 20 page CSE information brochure for householders (CSE, 2013)

Protecting the householder

One of the key elements of the scheme from CSE and BCC's point of view was that the project officers involved were determined that the complications with ECO and Green Deal happening behind the scenes would not impact on the householders:

> *"The thing is that systems weren't in place, they were being designed as we were delivering the scheme. Any scheme you deliver in that fashion – there are going to be changes. But those changes are going to be expensive and can filter down into a confusing process… It has to be a bulletproof 'if you do this you'll get this grant' – you can't mess that amount around. We managed it in a way that we knew we had the customer's interests at heart and we would never let that happen to them."* CSE project co-ordinator

This meant that significant issues with software, costing discrepancies and negotiations over grants and targets were kept away from the actual installation process and this was done largely using financial 'buffers' such as CSE paying grants to the householder out of their own accounts whilst they waited for negotiations over grants from DECC and ECO to be finalised. Furthermore, project officers were very keen to make sure that what they were offering to householders in terms of a price represented, in their eyes 'value for money'. This was fixed into a condition on measures and finance offered that it had no longer than a 15 year payback period:

> *"You've got to give somebody an offer that means that the payback for them in terms of their bill savings is reasonable you know, around 15-20 years. So if you've got an install cost of £12k and a grant of £6k, that means that they've still got to find £6k of their own money or loan, and if that saves them maybe £200 a year that's what, 30 years? It's too long."* BCC Project co-ordinator.

Single measures only

It is important to note that notions of 'householder led' and 'getting a good deal' for the householder were set within a context in which the technical measures and financial assistance – i.e. the 'offer' to the householder – had already been defined. Householders had virtually no choice about what they might install in their home beyond it being either solid wall insulation (either internal or external, not both) OR a new boiler, radiators or heating controls.

Deciding to install single measures only was a strategic decision that was linked to both technical issues with the software tools being used, and the principle of protecting the householder from scheme complications:

"The software being used to convert the EPCs couldn't cope with the idea of hybrid installations" – CSE project co-ordinator.

This situation meant that either the householder would get less grant and subsidy for their installations than they had originally been promised, or that they would only be allowed to install one measure. It was decided that the priority was to fix the price for the householder, and only to install single measures.

'Free' marketing

The limits on overhead spending from the DECC grant meant that BHEU had to find free ways of marketing the scheme. This consisted of BCC creating a scheme website and emails sent internally around the council, CSE using social media and mailouts to existing contacts to promote the scheme, using BEN to disseminate information about BHEU on its newsletters and other communications with its members, a radio appearance from the Energy Services team manager at BCC and a press release with support from the Mayor:

> *"One of the other really good things that we did was we got George Ferguson who's the mayor of Bristol and in his first week of post one of the first things he did was to launch and support the scheme which was really good because he's a good person to*

have backing the scheme at the start. Hes' very high profile - quite visible." BCC project co-ordinator

The scheme was not targeted at people with particular motivations for undertaking retrofit (e.g. environmental or comfort), and was instead promoted to any interested parties through various outreach routes, with promotional material largely highlighting the financial assistance available. This resulted in applicants who had varied underlying motives for wanting to undertake retrofit ranging from an elderly couple with concerns about having a cold house during the winter, to a married couple who were concerned about their rising energy bills, and a young couple who were already committed to retrofit for carbon savings (CSE, 2013).

8.5 Who was involved in the Bristol Home Energy Upgrade and how did they influence it?

As discussed in the previous cases and shown in figure 23, multiple actors, factors, processes and issues that involved in each case. This section will overview the contribution of the significant actors and relationships involved in the Big Home Energy Upgrade at all levels and the negotiations of interests that influenced the case. This is not intended to talk through all of the actors (shown in figure 23 in white boxes), but to highlight the key influences, the particular interests and priorities they brought to the BHEU and how they affected its composition and orientation.

8.5.1 Macro-level relationships

Department for Energy and Climate Change

As described, the BHEU was largely based upon experimentation with Green Deal and ECO. DECC clearly enabled this through the provision of funding, but it also had the role of the rule-maker, with certain stipulations and expectations, such as the very short term nature of the scheme being set by their own budget spending deadline of March 31st. Many of these rules and stipulations were not co-ordinated with one another, resulting in a constant back and forth between BCC and DECC in negotiations.

For example, stipulations of only a 10% spend of the grant on overheads altered the strategy from the original bid significantly:

> *"Originally there was a lot more funding allocated for communicating the scheme, engaging with householders, reaching out to households who might not otherwise be able to access it. Testing installations to make sure they were high quality, and for making sure that the supply chain were ready and prepped for it. But because there was only 10% for non-capital spend we had to roll back a lot of that."* CSE officer

Both the timescale and the budgetary 'rules' also had implications not only for the cost of the retrofitting process for the householder, but also the likelihood of them being able to get their retrofit done within the timescale. Target numbers of homes were based on grants covering only materials and installations rather than the retrofit processes as a whole:

> *"The problem is it's all focussed on the measure, so all the other preliminary costs get added to the bill – so if you've got a party wall issue, or a damp issue, or a wall needs pinning, or whatever, there's a lot of work that goes into that to sort it out and it's expensive, especially if you need planning permission which costs you another £500 or whatever it is these days. All of that? Not funded. Who bears the cost? The householder. And these are things that we have to co-ordinate and inform about and there is no budget or time built in for that."* Technical project manager, BCC

DECC also required that as a pilot scheme for Green Deal, the scheme had to use Green Deal accredited contractors and assessors to do the work, which resulted in a lack of suppliers for the scheme and an inability to meet the BHEU's targets. At the same time, despite the focus on Green Deal accreditation and the lack of funding for marketing, DECC also dictated the way that the scheme was communicated, insisting that it did not refer to the Green Deal.

> *"There were only two accredited solid wall contractors in the whole of the city region and talking to one of them they said they might be able to do something like ten installations by the end of March – our target was 150 – you know – it's pretty clear that we're not going to be hitting targets if the supply chain is not there."*

> *"We weren't allowed to use the term Green Deal in our marketing… it was a green deal pilot scheme but DECC didn't want us to do that in case it caused confusion about when the Green Deal proper came along."* BCC Project officer

ECO structure – OFGEM and CSE.

As the ECO regulators, OFGEM defined the reporting requirements for ECO to be awarded for different installations. This included the need for installations to be reported within the month they were done and it included the signing off and ratification of different softwares and calculation programmes for converting survey and installation data into a calculation of ECO subsidy. Some of these rules were unexpected for both SSE and for CSE and BCC. These

misunderstandings and stipulations for reporting and qualification made it very hard for BHEU to use the ECO from SSE as they had intended:

> *"ECO is, as you know, ridiculously complex. Not to put too fine a point on it the view was that ECO would be available at the start of the scheme to be used in tandem with the DECC subsidy all in this pot we could kind of dip into. As it turned out none of that was ready. SSE brought in £800,000 to go along in the bid but the ECO didn't become available until the end of January. So ultimately we used DECC funding for all of it and we didn't really use that much ECO funding. It was only going to be used for the solid wall insulation because ECO can be used for that, but almost all the solid wall insulation applications came in within the first couple of weeks, and you can't apply ECO retrospectively*." BCC Project co-ordinator

This situation required significant adjustments, sometimes of thousands of pounds, to the levels of grants being offered to households, and worries on the part of CSE and BCC that households would be vulnerable to price increases on their installations. However, for both CSE and SSE experiencing these issues with the process of reporting and what was needed for installations to count as part of the ECO was considered valuable learning:

> *"Working with SSE was better than expected to be honest, their role was really in helping us through those ECO issues – helping us understand how our reporting needed to be different or changed, but also us helping them from a delivery perspective saying you know this isn't information we can get – and them telling us they need it for OFGEM, and trying to find ways of dealing with that."* CSE project co-ordinator

8.5.2 Meso level actors and relationships – Bristol's specific capacity and influences.

The BHEU scheme was comprised of a small number of different actors at the meso level. Their roles in the project and impacts that they had on it are outlined below.

Bristol City Council

Bristol City Council as the grant holder and leader of the BHEU inevitably had the single biggest influence on its form and orientation locally. One aspect of this was that in 2012 Bristol City Council was awarded a £2.5m technical assistance grant from the European Bank as part of its European Local Energy Assistance (ELENA) programme. The conditions of the grant were that in the three year ELENA programme BCC had to attract investment from elsewhere of at least 25 times the value of the grant, or £62.5m. This provided an incentive to start work on creating partnerships, projects and activities which would enable them to

meet this condition. The ELENA programme was made up of three strands, one of which involved the creation of a 'Bristol Energy Company' which would potentially provide energy supplies to domestic and commercial properties, and energy efficiency services such as retrofit. This meant that BHEU was not only piloting the Green Deal, but its own model under the ELENA programme and beyond, which heavily shaped the experimental focus of the BHEU in terms of testing the council's role.

Existing relationships that BCC had also allowed it to mobilise a quick response to the invitation to bid for the Go Early funding that DECC issued – previous partnership work with CSE on CERT and CESP meant that there was a familiar working relationship between the two organisations and BCC was already working with Wessex Home Loans, a not-for-profit company operating across the SouthWest, providing low cost subsidised loans to people whose privately owned and rented homes were in a poor condition but who couldn't afford to upgrade them. This meant that BCC was able to circumvent broader issues around Green Deal in terms of the cost of loan finance and where it would come from:

> *"I've worked with them on my other job actually – in private housing where I do surveys and if people's houses aren't ok they're offered the opportunity to take the loan. We were very lucky to have that company and that mechanism already working locally."* BCC Project co-ordinator.

Furthermore, by far the largest proportion of completed installations – over 100 - originated either from BCC staff, or from direct communications between BCC staff and their own personal connections, and BCC were responsible for firstly consulting and secondly procuring CSE as the project delivery partner for BHEU, which defined the scheme.

Centre for Sustainable Energy

CSE is a national charity focussed on policy research and community projects relating to energy, including energy efficiency. CSE shaped the design of the scheme from the outset by assisting with the original bid to DECC with Bristol City Council as a consultant, and were awarded the tender on the basis of their existing expertise in the policy area and their willingness to share and disseminate learning in the wider Bristol network, all of which were built into the principles and experimental approach of the BHEU as detailed above:

> *"because we've been looking at and analysing ECO and Green Deal as a policy area for a few years now, we have that in-house expertise in terms of a true*

understanding of being able to deliver it in the way that ECO is designed – we understood what that entailed" CSE project co-ordinator

"CSE's knowledge of ECO was far superior to mine so really I let them take the lead on that" BCC project co-ordinator

CSE's capacity provided considerable staff resources with five permanent project staff and an advice line staffed by around ten people, who provided the first level of advice to interested householders. CSE were also able to build on an existing relationship with Regen South West to try to address the lack of accredited retrofit installers, and connect with their initiative which supported small works contractors in gaining Green Deal accreditation.

Bristol Energy Network

Observations from the Bristol Energy Network meeting in December 2013 showed the interactions between the council and the network at the start of BHEU, with a council officer there informing them about the scheme, seeking assistance from the community groups present, offering referral fees for those who referred people who went onto have installations, and discussing ways of sharing or piggybacking onto existing outreach capacity such as an emerging 'Green Doctor' scheme of street-based energy advisors.

Bristol Energy Network's monthly, face-to-face meetings of multiple community groups, and the existing tools of their newsletter and email list provided CSE and BCC with ready-made channels of communication into communities that were engaged with and interested in energy and retrofit related issues. Using community groups for referrals generated 55 applications and 11 installations which was the second biggest proportion of installations, behind those originating from BCC staff.

Some specific examples of community group engagement include Bristol Green Doors, who communicated the scheme through their own newsletter, generating 11 referrals and 3 installations. BHEU also utilised Bedminster Energy Group, who had already gained LEAF funding for a project testing community engagement strategies, incorporating this experiment into BHEU to conduct a neighbourhood to neighbourhood comparison of whether there was a difference in the number of leads gained from outreach in an area with an active community group (Bedminster), and an area without. The experiment concluded

that there was indeed a larger number of referrals in Bedminster than the area without the community group (CSE, 2013), learning which was incorporated into CSE's final report.

However, community groups were not able to shape the design and implementation of the scheme in any way and were passive conduits of the scheme rather than active participants, simply passing on information that grant subsidised boilers and solid wall insulation (largely external wall) were available. Their role had been predefined by the structure and offer of BHEU rather than them having any contribution to defining that offer.

8.5.3 Micro-level relationships

Micro-level relationships, other than the word of mouth communication of the BHEU between BCC staff and their friends, did not emerge as a particularly important element of the development of the BHEU. Because the scheme was so closely tied to existing organisational relationships and tightly bounded by its policy-testing approach, individual personal interactions were largely sidelined. (It should be noted though that this observation could be a product of having conducted the case study data collection largely after the initiative had ended, rather than being there 'in the thick of the moment' when these things could be perhaps more readily discussed.)

8.5.4 Internal dynamics and negotiations

There were a series of internal struggles with the BHEU, particularly around ECO and a lack of supply chain, that although CSE had committed to protecting the customer from, placed considerable strain on the scheme.

ECO woes: availability, software and misunderstandings.

The CSE were using a particular software tool to score the potential carbon savings for a household from particular measures, because they were under the impression that this software was an ECO compliant tool for scoring. However:

> *"They sort of went back on that and it turned out that's no longer a signed off methodology. It all filters through so when you do the green deal assessment report you need to be able to manipulate the data to score it appropriately, so everything that OFGEM require at the end is really required right at the beginning built into the property's data. And all of that was misunderstood at the outset... We wanted to use multiple assessors with different data and we had different streams of data coming into us that required different scoring and it transpired that for ECO compliance we'd*

need to have a different system. So that meant the ECO jobs that we did, we said we'd give the customers a certain grant, and we could only claim less of a grant from SSE because of the difference between how we scored it and how the signed off scoring was. So we had to supplement that gap with our own project finance." CSE project co-ordinator.

These complications with ECO meant that CSE operated almost continually in a position of financial risk. It was paying the grants to the householders in order for them to pay the installers, while it waited for the reports through both the reporting to DECC to receive the grant and through the ECO qualification process with OFGEM. This positioned CSE as a financial buffer for the householder against ECO issues, but also for the installers as well – protecting them against cash flow issues. As the installations progressed, CSE began to insist that customers returned their ECO paperwork within three days so that reporting to OFGEM was done by the end of the month that the measures were installed in, otherwise the installation wouldn't qualify, and their financial risk was further increased.

"We had to take huge risks to be able to deliver the project in that way. We drew the line at where those risks were. We knew we'd be able to get the grant from DECC but with ECO it was never guaranteed. We had an alarmingly huge float for a charity operating on a NFP basis" CSE project officer.

ECO funding not being available early on also meant that in order for BHEU to stick to its commitment to a fixed price and level of subsidy for the householders, it would need to use more of the funding from DECC to fill the gap where ECO was missing. This meant getting approval from DECC to use the funding in this way which resulted in a constant process of negotiation:

"We had to chip away at that – DECC kept granting us a week's leave to use their funding at a time, and another week and then another week, expecting it to be resolved. And there was always a risk that they'd say no and there'd be a problem with the cost of the installs. As a project co-ordinator this puts you in a position of some anxiety." Project co-ordinator, BCC

Further negotiations with DECC involved an extension on the finishing time of the project from the end of March to the end of May 2013, and for some of the project funding to be carried over for this, because of the lack of supply chain and other delays in the scheme.

"It was pivotal really. If we hadn't got the extension we would have got maybe five solid wall installs done." Project co-ordinator, BCC

Lack of accredited installers

BCC also took on a much more active role than it had intended in terms of building a supply chain for retrofit – they had not realised there would be so few Green Deal accredited installers locally and ended up having to compromise on their intentions of using Bristol-based firms – only four of fifteen installers were Bristol based, with, for example, one of their SWI installers coming from Plymouth, which is 121 miles away. Furthermore, this lack of installers particularly for SWI meant that the scheme had to be closed to solid wall insulation applicants after just two weeks:

> *"We decided that we'd got to stop taking applications for SWI. We'd got maybe 100 applications in and only two people on the list. The worry was that we'd have massive reputational damage if we didn't stop it there…. There were one or two people saying this is idiotic – you're running the scheme and there's nobody to do the work. It looks foolish. So we had to kind of pull the plug while we tried to rectify that."* Project co-ordinator, BCC

Community benefit

Among the much-hailed Bristol Energy Network there were also question marks about the benefit that the scheme really brought to the community groups charged with marketing it for free. As a Bristol Green Doors representative stated about the £450 that the organisation received in referral fees (for three referrals):

> "*it's hardly world changing, is it?".*

More seriously, Bedminster Energy Group, which had received the LEAF funding to experiment with outreach, felt that it had been put in a position where it was very stressed by the work, especially in extremely short timescales. The group was run by volunteers who felt overwhelmed by the responsibility and this caused scepticism within that group about working with policy schemes in the future.

8.6 What were BHEU's achievements and outcomes?

BHEU completed 23 external wall insulation jobs in four months, which both CSE and BCC considered a significant achievement. It also installed heating system upgrades, including one entirely new gas connection. Through the process of the scheme BHEU also increased the number of accredited solid wall insulation installers in the area from two to twelve.

However, the expectations on BHEU were that it would make a significant contributions to Bristol's future schemes. In 2014 Bristol embarked on a scheme entitled Warm Up Bristol, which was funded from DECC's Green Deal Communities programme. There were some notable contributions to this from the BHEU:

Community Groups:

BCC continued to use community groups and the BEN in Warm Up Bristol but acknowledged the need to focus not only on using but also supporting community groups. These intentions were written into the procurement for Warm Up Bristol's main delivery partner as KPIs that the partner must adhere to, although the form that this support might take is unclear.

Learning about lack of supply chain:

BCC took very seriously the issues with a lack of accredited installers and took action to increase this and communicate the scheme differently to installers for Warm Up Bristol, stressing the amount of work that would be available and making it more appealing to those small works contractors that may not yet be accredited but could make use of the opportunity:

> *"It showed us that there was a serious lack of solid wall insulation installers in the area and what we've now done is to go along to events that Regen South West or the Local Economic Partnership are doing and telling them what we're up to – what's coming up in terms of other programmes, and really highlighting the demand for their services and giving them everything they need to know about how to get accredited so they can access some of that work."* Technical project manager, BCC

Unmet expectations

There were, however, a series of intentions that did not come to fruition and some unmet expectations across the network. From the website of the newly approved Bristol Energy Company – the energy services company that learning from BHEU was supposed to contribute to - it appears that the only energy efficiency retrofit services the company offers are those of Warm Up Bristol – another policy-bound, grant funded scheme. Intentions to create a 'Bristol Installer Group' to aggregate small suppliers to create volume and prevent them from being carved out of the ECO market by larger companies never materialised.

There were also disappointed householders due to the installation of single measures only, which was seen as a significant hindrance to the scheme:

> *"One of the problems that we had within Bristol is that you couldn't do hybrid installations under this scheme. Lets say a house in Bristol has got a mixed finish with a nice brick finish on the front. So what you would ideally do is externally insulate the back, which is relatively easy to do, and then internally insulate the front, so you don't lose the façade, the nice aspect of your house. And we couldn't offer that under the scheme. There were some disappointed householders who were really interested but it just couldn't provide for them because we couldn't do internal and external wall insulation at the same time."* – BCC Energy Services officer.

Furthermore, a number of concerns were raised about the assessment and EPC process, which was seen very much as a 'tick box' exercise using rudimentary techniques and not as an in depth, useful household survey.

Persistent policy issues:

BHEU acquired some significant learning about the policy context for retrofit and achieved a number of things in this regard. It overcame one of the most noted issues with the Green Deal policy framework which was the high cost of green deal finance, by using Wessex Home Loans, who offered loans at 4% to Green Deal Finance's 7%. However, by piloting this loan mechanism, BHEU was able to highlight that the combination of ECO and Green Deal finance (even with ECO working effectively) would not cover the costs of the installations that the national policy agenda was promoting, thus not addressing its goal of alleviating upfront costs (CSE, 2013). It also successfully qualified 4 installations for ECO subsidies, despite significant setbacks with software, calculation processes and reporting requirements. However, this low number, given the high amount of ECO funding pledged by SSE demonstrates the significant problems with getting ECO to qualify. Consequently, the Warm Up Bristol Scheme does not attempt to utilise any ECO subsidies for its measures. Other issues that were still a problem for the Warm Up Bristol project include a lack of clarity around how to integrate retrofit with planning:

> *"We are still in discussions with planners about a resource for householders where they could find out what is acceptable to do to different property types in terms of a finish, in terms of living in conservation areas, types of roads and residential areas. We need guidance for things like, are you permitted development, do you need it checking, or do you need full planning permission?"* Energy Services Officer, BCC

Overall, the outcomes of BHEU focus on small steps towards a vision of citywide retrofit that is enacted almost entirely by the local authority's delivery of national policy. Whilst there is sustained and serious commitment by BCC and its officers to retrofit as a significant part of its energy-related activities, the BHEU and its successor, Warm Up Bristol, present no possibility beyond these types of schemes, of other forms of governing retrofit activity in Bristol:

> *"It's really shown us that the demand is there, particularly for solid wall insulation – it was heavily oversubscribed for that. And we are now doing a housing stock model for the whole city and we can tell that nearly 40% of the city is solid walled, whether or not those properties have already been caught by previous schemes like the Bristol Energy Efficiency Scheme which was free stuff, and then by BHEU, so it contributes to that too, seeing where the opportunities remain."* Technical project manager, BCC

In this vein, BHEU didn't establish any new relationships or include any other actors into the process of defining and governing retrofit in the city region: community groups, suppliers and installers had no active part in defining this or any future scheme, and with single measures installed, there was minimal technical learning in terms of the complexity of whole house retrofit.

8.7 Theoretical reflections from the Bristol Home Energy Upgrade.

Compared to the ESC and the Carbon Co-op's, BHEU's influential factors and actors at different levels of the assemblage differed somewhat. Whilst climate change was, again, a significant issue, there were also other macro-level factors influencing this case study not present in the other two. Interurban competition and reputation across Europe was manifest in the influence of the Green Capital award, and national policy and government actors – particularly DECC – had a much stronger direct influence on the case's organisation and orientation. Whilst local, meso-level actors specific to the Bristol urban context were significant in enabling BHEU, they had less influence on the form and shape it took than in the other two cases, and personal values at the micro-level were far less significant in this case than Carbon Co-op and ESC. However, the experience of the policy context as being complex and problematic was very much shared between the three cases. BHEU's experimental and knowledge priorities differed from the other two though, with a much more obvious focus on policy learning than governing or technical experimentation.

Chapter 9 – Discussion: Assembling urban domestic retrofit experiments – what do they tell us?

Before the discussion proceeds it is necessary to recap on the original questions of the thesis. These are:

- How and why do such different responses to 'the same' issue of domestic retrofit emerge from different urban contexts?

And;

- How are these different place-specific responses both enabled and limited in their transformative potential by the macro-context in which they operate?

The purpose of this thesis was to investigate how and why, despite operating within the same national policy context, very varied responses to the 'problem' of domestic retrofit might emerge in different urban contexts. This discussion has three components. Firstly it uses the examples of three different responses – the Carbon Co-op in Manchester, the Energy Saving Co-operative in Birmingham and the Bristol Home Energy Upgrade in Bristol to illuminate and explore different experimental approaches to addressing the key socio-technical issues around domestic retrofit. These variations tell us about the importance of context and how the agency of people and organisations come together to create place-specific, unique capabilities to act, and demonstrate different forms of localised experimentation and unevenness in urban responses.

Secondly, this discussion also uses the differences in priorities and approaches in the cases to contribute to an understanding of how macro-level pressures on contemporary energy issues in cities such as climate change, energy security and economic concerns can be mediated and interpreted differently as a result of the specific features, relationships and interests in and around the different cities they operate in, alongside mediating local or meso-level pressures and personal interests.

Finally, the discussion will establish the forms of change that were intending to, and did occur as a result of the three cases, and explore the enablers and limitations to these

changes, specifically returning to the macro-level, or landscape, and its particular role in shaping the nature of the responses and their effects and outcome.

9.1 Cross case analysis

Table 13 below shows the key differences between how each case has approached the key aspects of domestic retrofit identified in the literature review: technical issues people, behaviour and householders' motives, and organising or governing retrofit.

	Carbon Co-op, Manchester	**Energy Saving Co-operative, Birmingham**	**Bristol Home Energy Upgrade**
Technical issues	Top priority: Rigorous survey method, detailed design and post-installation monitoring. Fewer, high quality retrofits.	'Beyond technical experimentation' – technical risks assumed to be dealt with, but survey and vetting process designed to ensure quality and accuracy.	Lesser priority: Many technical challenges avoided by single measure installations.
People and behaviour (householders' role and motives)	Active role in organisation, design and experimentation process. Builds on ethical and value based motivation for retrofit.	Active through membership, but seen as a 'market'. Tried to accommodate hybrid motivations for retrofit.	Passive recipients, seen as a 'market'. Mostly appealed to financial and comfort-based motivations for undertaking retrofit.
Organising and governing retrofit:	Bottom-up organisation, middle-out projects. Attempted retrofit 'with' the city but ended up retrofit 'in'.	Top-down organisation, middle-out projects. Attempted retrofit 'with'.	Top-down project delivered by local actors. Retrofit 'on' the city.

Table 13 - Cross case comparison

9.1.1 Technical issues with retrofit

Carbon Co-op made technical issues a distinct priority, with great attention on survey methods, detailing and the preference to retrofit a small number of homes to a high technical standard, using a wide range of interrelated measures as well as using specific insulation materials that presented lower hygrothermal risks. They also sought to add to knowledge about the 'performance gap' by installing energy monitors in each of the homes before and afterwards, in order to accurately assess the reductions in energy use from

retrofitting. BHEU sidestepped these issues of technical risk and complexity through the single measures strategy they adopted in their scheme, offering either internal or external solid wall insulation – not both - or heating upgrades, and only one measure in each home, and did not have a monitoring strategy in place. Energy Saving Co-operative, on the other hand, were not limited to offering solid wall insulation and boilers, also offering a broad range of technical options including windows, floor insulation, microgeneration, heating controls and others, but did not engage with the specific issues around detailing, moisture risks and the performance gap, assuming that these issues were less important than addressing the business and operational elements of the problem. In the BHEU the responsibility for installation quality was placed on the installers through direct contracts between themselves and the householders, whereas for Carbon Co-op, the single contract with the contractor on behalf of the householders positioned them and URBED with this responsibility. ESC also took direct contractual responsibility, and attempted to ensure quality in installations through a vetting process for its installer members.

These differences were a direct result of the levels of influence and power that different actors in the assemblage had: one of the actors with the greatest influence on Carbon Co-op's strategy was URBED and many of the householder members were technically minded, having worked at URBED or in other technical professions, providing a high level of technical – particularly design - knowledge in the micro- and meso-levels and embedding this priority and sense of responsibility into Carbon Co-op. In the ESC's case, its approach was so heavily defined by one person at the micro-level, who had decided they were 'beyond technical experimentation', that there was little strategic room given to the exploration of technical risks. In BHEU's case, rather than a conscious decision to avoid technical risk, their technical approach was heavily affected by internal software issues and efforts to comply with ECO. The added meso-level issue of a lack of accredited installers in the Bristol area added further limitations to the technical capacity of the BHEU experiment.

9.1.2 People and behaviour

The different ways that each case engaged with householders' motivations and issues of behaviour also illustrate the variation and unevenness in responses. Carbon Co-op dealt almost exclusively with pro-environment motivations and values: each whole house strategy was based on meeting the UK's 80% reduction in carbon emissions in each house, showing

the combined influence of the interests of its activist founders and members at the micro-level, and the macro-level issue of climate change and the UK's specific emissions reduction target. ESC approached this differently, trying to engage with different motives through a bespoke package offering a range of technical measures, financial incentives and project management services to address the issues that Brown (2013) and Haines and Mitchell (2014) raise of the complex decisions that householders make about retrofit. This 'bespoke customer service' element of ESC had been made a priority by a combination of the CEO's vision, as well as meso-level factors such as competition with Birmingham Energy Savers and Green Deal, and the influence of Northfield Ecocentre representing householders needs. Unlike BHEU which largely promoted itself using a simple financial incentive of subsidies for solid wall insulation and heating systems, ESC engaged with varying motives, focussing on comfort and reduced bills for the competition winner, for example, and at the same time appealing to pro-environment and ethical motives through its co-operative branding. The BHEU's simple marketing strategy, though, was a result of its dependency on DECC's funding - budget rules reduced the initiative's ability to act on issues of motivation, even though Bristol City Council and CSE would have liked to.

Furthermore, because Carbon Co-op's board and membership consisted mostly of householders with retrofitting experience there was continuous and open discussion about issues and problems between stakeholders of all the bumps in the road such as issues with ECO and difficulties with contractors, and efforts to understand householders' retrofitting experiences through detailed feedback. But because of the influence of CSE's protective attitude towards customers, BHEU took the opposite approach to Carbon Co-op in relation to communicating difficulties with ECO and pricing, with CSE accepting considerable risk to act as a buffer against these financial issues.

In terms of local factors enabling and limiting these approaches, Carbon Co-op's relationships with other community groups and previous experience of community engagement meant they had considerable capacity in engaging householders, and similarly in the context of Bristol - despite BHEU having no marketing or community engagement budget - both internal local authority communication channels and the existing network of community energy groups offered routes to communicate their promotional message. This differed from the Birmingham context in which ESC had to establish these relationships and

seek out routes for marketing and community engagement from scratch – discovering limited capacity in the kinds of environmental organisations it wanted to work with and therefore struggling to engage householders in the area and pursue its ambitious vision.

These different approaches to householders, motivation and engagement also reflect different roles and levels of input of householders – in the case of Carbon Co-op, householders are active participants in both the definition and execution of the experiment and its links to other householders, whereas in BHEU and ESC householders were more passive recipients of predefined services – viewed as a 'market' to be developed. ESC did intend that through membership householders could actively shape the co-operative, but in fact most of it had already been defined by the CEO and it did not last long enough to observe this influence. This connects to the next aspect of comparison - by whom and how domestic retrofit has been organised and governed differently in different contexts – and what this tells us about localised capacity to act.

9.1.3 Organisation and governance of retrofit

Beyond simply supporting a narrative of each case study, the function of producing an assemblage diagram depicting Carbon Co-op, Energy Saving Co-operative and Bristol Home Energy Upgrade in turn is that it becomes possible to compare both the range and the position – in terms of what level they operate at - of the actors and factors involved in each experiment. Some clear differences and similarities emerge when one compares the three. Firstly, the network of the BHEU appears to have far fewer actors and factors involved in it, as opposed to the ESC and Carbon Co-op, which incorporate a much greater range of actors and factors – and therefore perspectives and issues to be negotiated - at all levels, especially the meso-level. The ESC network includes fewer actors and factors at the micro-level than Carbon Co-op and a range of influences at the meso-level and landscape level, all of which impacted on its approach as described above.

What these diagrams also illustrate – but only alongside a discussion of the nuances behind them - is different forms of organisation of retrofit and therefore differences between the levels of influence of actors and factors at different levels of the assemblages. Using Williams et al (2013)'s models of top-down, bottom-up and middle-out retrofit, and Hodson and Marvin's typology of retrofit 'on', 'in' and 'with' the city, the three cases illustrate how

the power and drive for each of the cases comes from different levels of the assemblage. For example, the range of actors at the meso-level of Carbon Co-op would suggest that Carbon Co-op is a middle-out response. In fact, there was an almost evolutionary process of development of the Carbon Co-op – a grassroots, bottom-up organisation that grew from a series of personal connections and shared values at the micro-level, responding to different national policies and the interests of different local actors, enabling connections that led to middle-out projects, represented by the range of actors at the meso-level: the relationships and partnerships at this level enable their activities to take place, but don't necessarily govern the organisation itself. BHEU on the other hand is the opposite: we know from the lack of actors and influence at the micro-level that it is not a bottom-up response, and that the direct reflection of policy processes, and central government rules and stipulations shows the characteristics of a top-down response – or in Hodson and Marvin's (forthcoming) terms, retrofit being done 'on' the city from above or outside. However, BHEU's activities are carried out again by key actors at the meso-level, its successful activity was enabled by local relationships and capacities such as the presence of Wessex Home Loans as a finance provider, CSE and its advice line and customer service capacity, and the existing influence of the European Bank funded ELENA programme supporting the retrofit agenda, thus delivering its activities from the middle-out. The ESC is also more complex than a simple typology suggests. The influence of the CEO at the meso-level might suggest it is a bottom-up response, but in fact what his vision created was a national scale organisational approach which was imposed – again in a top-down manner – upon the places it wished to work in, once again using what Janda (2013) calls 'middle actors' to populate its projects at the local level. However, there was a greater acceptance of those middle-actors' views, priorities and interests in the ESC than in the BHEU which reflects more closely an attempt – albeit a failed one - at Hodson and Marvin's idea of collaborative retrofit 'with' the city. What is interesting about these different forms is that they can also change, with Carbon Co-op beginning as a retrofit project 'in' a city without much relationship with formal governance structures, and moving into a retrofit 'with' the city situation through the Go Early and Stockport-based projects.

These comparisons and significant differences demonstrate clearly the geographical unevenness in responses to the issue of retrofit, illustrating a prominent trend in urban

development and governance as identified in the literature. The next section will explain exactly how this unevenness is produced through a process of assemblage, mediation and negotiation.

9.2 Assemblage as process: Explaining variation through multi-level relationships

9.2.1 Mediation and negotiation of landscape and local issues.

The importance of the organisational forms described above is not just descriptive in terms of the cases. What these different forms also create is what Hodson and Marvin (2011) and Bulkeley and Schroeder (2011) argue is different balances of landscape and local issues and the priorities and interests of different actors, through processes of mediation. They, along with Rutland and Aylett (2008) argued that intermediaries – organisations or projects like the cases above – constituted differently in different urban contexts can have vastly different effects because of how they balance different stakeholders' perspectives and interests. Intermediaries constituted of a narrow range of actors and perspectives – such as the BHEU - produced a narrow vision and orientation both technically and in householder engagement, whereas inclusive intermediaries with varied perspectives and interests can end up with less consensus but better representation – such as the ESC or the Carbon Co-op.

In our cases we see this through the varying levels of importance of landscape and local issues in each case and how these were mediated and negotiated through the responses: The economic crisis was an important landscape factor for Energy Saving Co-operative because of both the local installers' experience and influence of it, and the perceived value of the co-op brand that the CEO hoped for, and although an indirect driver through policy, climate change was less of an explicit priority. Carbon Co-op connected directly and strongly to the landscape issue of climate change because of the personal interests and commitment of its members. It also related to issues of social justice through its co-operative form and again through the activist roots of many of its members, making it ideologically at odds with market solutions. Both Carbon Co-op and Energy Saving Co-op were influenced heavily by personal commitment to the co-operative form, and selecting this form brought into the assemblage influence from the wider co-operative movement at the macro-level. BHEU, on

the other hand, related to climate change through Bristol's citywide engagement with carbon reduction targets, and did not have any particular engagement with social justice or the co-operative movement. BHEU was also able to position climate change as its highest priority over economic concerns because of the specific way in which Bristol – less so than Birmingham, for example – was perceived to be less affected by the economic crisis. Energy security and fuel poverty on the other hand, although significant in policy, were not really explicit issues for any of the cases and were only very lightly addressed through their proxy connection to lower fuel bills. Partly this is due to the focus of all three case studies being on 'able-to-pay', or privately owned and occupied homeowners, a deliberate commonality built into the research design to enable effective comparison, but one which has natural consequences of focussing on initiatives which are by their nature less likely to engage with households in fuel poverty.

The only case that engaged directly with issues of interurban competition and external investment was BHEU, through its connections to the European Green Capital award and its concern for its external reputation as a 'green city': the other cases did not seem to feel these pressures as keenly, being too consumed by their own internal agendas: although GMCA's perspective on retrofit was partly to do with 'competitive advantage', Carbon Co-op was not part of this agenda. Speculatively, this could be related to the grassroots nature of Carbon Co-op – not embedded in the strategic urban priorities of Greater Manchester, and the new and emerging network in Birmingham created by ESC which did not connect to an existing city-regional governance network, leaving them somewhat disconnected from the strategic urban priorities of contemporary cities highlighted by Hodson and Marvin (2010).

Balancing landscape and place-specific pressures

In terms of balancing these landscape issues with local issues, all three cases related differently to place specific pressures. Interestingly, all three cases mentioned the high number of solid walled properties as being a specific contextual factor that influenced the need to work in those three cities, which indicates that although many actors may have thought this was context specific, it in fact was a shared issue. ESC engaged with local issues around unemployment through the inclusion of Jericho and NWS in their membership, but this was not because of a desire to act on this specific issue, it was a negotiated condition of

attempting to utilise their strengths as well established suppliers in the city-region to further ESC's progress. BHEU – with its more narrowly constituted network and vision - made effective use of local capacity and reputation in lobbying and community energy-related activity, but this had little benefit for the grassroots organisations, whose perspective was not included in its creation. Carbon Co-op, on the other hand, did not really engage specifically with Greater Manchester's economic priorities despite its meso-level connections, performing a role based on its commitment to grassroots action on climate change, representing the dominance of this issue in Carbon Co-op's identity and activity.

Linking these processes of mediation to the internal dynamics, struggles and decisions that were made within the initiatives, we can see how certain things were prioritised over others: for Carbon Co-op, the deliberations about identity and mission statement were a product of these very clear priorities, and the issues around burnonut, roles and conflict at the installation stage could be attributed to the organisation's grassroots approach being thrust into a new citywide project management role. The negotiations about grant funding replacing ECO funding that BHEU had with DECC, and the buffering role of CSE were the result of a top-down approach and the dominance and power of DECC and the ECO market, and for ESC the internal struggles of low sales and profits reflected the business approach and the dominance of commercial interests both of the ESC itself and its funders.

9.2.2 Advocating context-sensitivity and thinking relationally

These cases and the differences in importance and influence of different actors interests show clearly the importance of acknowledging the particular urban contexts in which these responses occur and the richness and detail of the relationships around them, connecting with Swyngedouw's (2004) suggestions that urban responses to energy issues tend to be made up of place-specific governance coalitions or 'geometries of power', which have different capabilities to act. Comparing the three figures below shows us that these assemblages of actors, each including individuals, commercial organisations, national and local state institutions and third sector organisations at various levels have certainly created different, place-specific levels of interest and capacity in different areas of the retrofit issue through processes of mediation, demonstrating that the actors in each of the networks are not only defined by their own attributes and the influence they bring but by their relationships to other factors and actors in the assemblages, termed relations of exteriority.

For example, in figure 27, Birmingham's superior supply chain capacity alone appears to be a contextual advantage over Manchester and Bristol, yet in the network it was embedded in, it made little difference to the financial failure of the ESC and its transformational outcomes. Manchester and Bristol's networks of environmental organisations may appear to have similar advantages, but when one was involved in a more bottom-up response and one was involved in a top-down response, their ability to influence the network was completely different resulting in vastly different effects in terms of contributing to a wider transition, as shown in figures 26 and 28. These relations of exteriority therefore produce unevenly distributed agency resulting in a context-specific (context not just referring to the locality but the broader contexts too) capacity to act that is manifest in the cases engaging with landscape issues and local pressures to different extents, and in their different approaches to the specifics of householder engagement and technical expertise, finance and the supply chain. The varying influences of the different actors and their horizontal and vertical relationships in different parts of the responses produce unique collective capabilities, features, outcomes and effects of each assemblage in its specific context as shown below in the diagrams depicting the process of assemblage of factors and actors from different levels, mediation of issues and priorities through internal dynamics and negotiations, and the production of a place-specific experiment for each case.

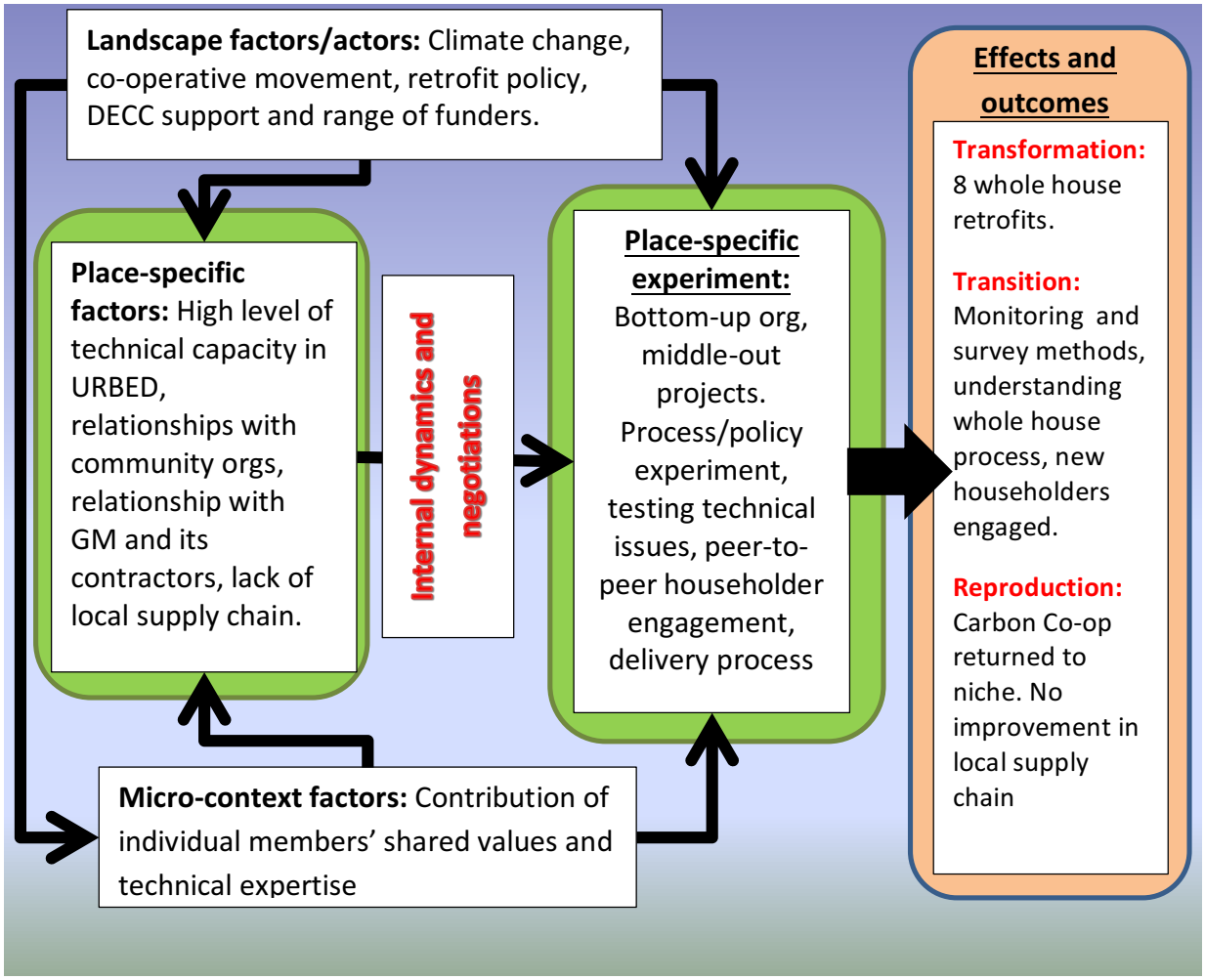


Figure 26 Assemblage as process - Carbon Co-op

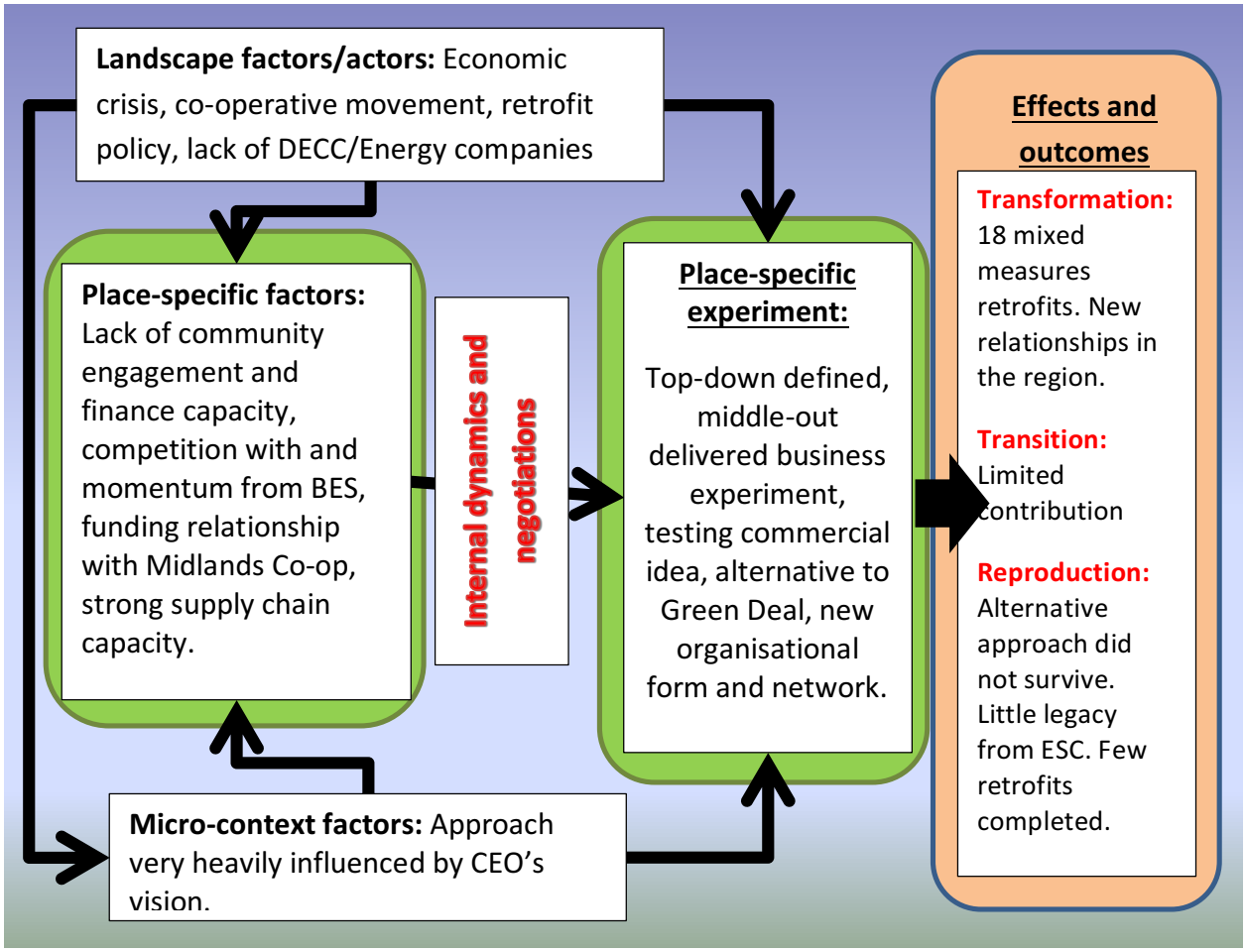


Figure 27 Assemblage as process - Energy Saving Co-operative

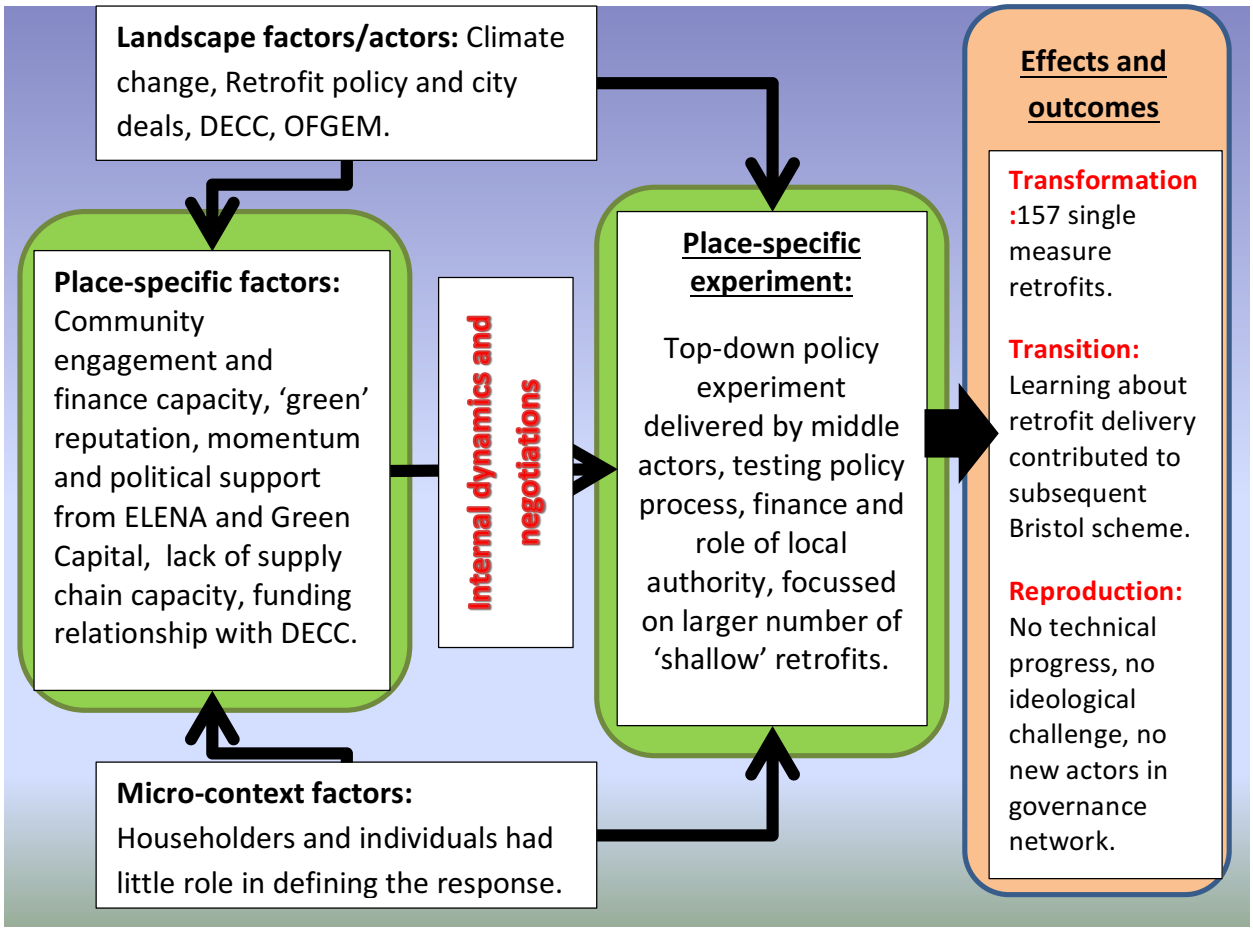


Figure 28 Assemblage as process: Bristol Home Energy Upgrade

The lessons that can be taken from this is that the form, focus and orientation of such experiments cannot be attributed to a few issues, but to many factors and their interrelations within and outside the place in which the assemblage acts, which come together through the process of creating an experiment. This illustrates the place-specific immanent causality embraced by assemblage theory and explained in chapter 3 (pages 84, 88 and 92), showing how the causes of and contributing factors to these particular urban responses lie both within and without the experimental assemblage, and operate at multiple spatial scales. Looking inside the experiments at their internal dynamics and negotiations has shown us that people and their agency, with individual attributes and motivations, are in some cases, particularly the Carbon Co-op and the ESC, as influential as the broad pressures at the macro-level, and the fundamental message is that in all cases, the mobilisation of local resources, capacities and capabilities at the meso-level has a huge effect on both the shape and nature of the responses, as well as the process of balancing different interests, pressures and priorities.

Having explained how these different kinds of experiments have been produced, the following section will explore specifically the nature of the testing and knowledge involved in the three cases and what this tells us about the trend towards urban experimentation identified in the literature review.

9.3 Learning about experimentation through domestic retrofit at the city level.

It is clear from this comparison that the three cases are testing and learning about different things, which is another way of illustrating the unevenness in urban development and responses around the socio-technical issue of energy efficiency. Along with the differences in the ways that each case approached the technical issues, householder engagement and motivation, and organisational aspects of the domestic retrofit problem, these variations in experimental approach and focus show us clearly that a complex, multi-faceted socio-technical problem has produced differently constituted responses at the local level depending on which areas are focussed on.

The mini-table below shows the experimental and knowledge foci of each case study, showing that certain areas and forms of knowledge were of greater importance in each case than others – for example, technical excellence and learning as a priority for Carbon Co-op, whereas this was not a priority for Energy Saving Co-op or BHEU. BHEU's tight policy focus steered its learning towards a relatively narrow brief of testing policy delivery and in particular, the local authority's role in that delivery, whereas Energy Saving Co-op had a much more loosely defined process of experimentation, testing a business proposition in its entirety rather than particular parts of the domestic retrofit system or problem.

	Carbon Co-op	**Energy Saving Co-op**	**Bristol Home Energy Upgrade**
Experimental focus	Testing technical solutions and co-ordination of the whole house retrofit process. Learning about householder experiences of retrofit.	Testing a business and commercial idea, new form of governance of retrofit. Some focus on tacit knowledge and demonstration of retrofit.	Testing 'delivery' of policy – learning about financial tools, marketing, particular focus on local authority role.

Table 14 - Comparing experimental foci

9.3.1 Identifying forms of experimentation

But in terms of the kinds of experiments that these cases represent, and what they can contribute to understanding the trend towards urban experimentation on socio-technical issues, there are some valuable insights. Carbon Co-op started its life most closely resembling a grassroots niche at the local level, relying heavily on individual passion for tackling on energy efficiency, voluntary capacity and working very much on the basis of testing and building an alternative ideology around energy use through community empowerment and small-scale technical innovation. However, through its involvement in the Green Deal Go Early project its experimental nature was shifted from being an 'alternative' or 'niche' to being integrated with a city-regional strategy, thus acquiring some features of a direct policy experiment – testing the Green Deal process, for example. After the Go Early project, however, this element of Carbon Co-op's experimentation ended and it returned back to its grassroots base and 'niche' status, focussed on its peer-to-peer support, unique technical approach and householder experiences, and moving on to other experimental exploits such as smart networks.

The Bristol Home Energy Upgrade shows most of the characteristics of a bounded sociotechnical experiment (BSTE): it was bounded in both space (Bristol only) and time (It had to end in April 2013) and was explicitly trying to produce a particular type of knowledge and create a socio-technical configuration around a particular technology – in this case deliberately trying to promote and normalise solid wall insulation in the Bristol context. It also had an explicit role as a policy experiment, testing out how the specific priorities and features of the national policy framework such as assessments, loan finance, ECO, solid wall insulation and boilers, would come together in practice to deliver completed retrofits through a local delivery partnership. Its knowledge focus was clear – it was trying to generate policy delivery knowledge to lead into further schemes of the same kind – which it did. In this sense the BHEU had the clearest experimental approach, but because of its close relationship to policy it was also the most narrowly constituted in terms of the learning from it, which was not designed to challenge aspects of the policy environment it was testing, more to road-test and marginally refine them.

Energy Saving Co-operative, on the other hand, was ultimately a business experiment, which makes it more difficult to align with the models of experimentation presented in the

literature. It lacked crucial elements of BSTEs because it wasn't bounded in space and time – its ambitions ranged between the local and the national scale - and it was intended to be ongoing. Furthermore, whilst actors involved in ESC acknowledged its experimental nature, it was not designed to produce knowledge of a specific type, and stakeholders had varied views about the knowledge it was producing, from demonstration of retrofit to co-operative models of working and exploring alternatives to working with large energy companies. As a start-up business it shares some qualities with that of a niche experiment – an attempt at socio-technical innovation at the beginning of its path - but its ambitions were systemic. Aiming for no less than a cultural and ideological shift in governing and organising retrofit, it attempted to create an entirely new system from scratch with its 'best of big with the best of local' organisational model, at times working outside of policy like a living lab, and at other times working with it such as gaining Green Deal accreditation.

9.3.2 Trending now: Governing by experiment.

However, where all of the cases are similar is that none of them operated completely outside of formal policy processes as it was argued by Evans and Karvonen (2011) that an urban living lab would. Carbon Co-op and BHEU, with their involvement in the Green Deal Go Early projects, were to different extents explicitly charged with delivering elements of national policy at the local level. Even Energy Saving Co-operative presented elements of a policy experiment in terms of creating a market, orchestrating a process from assessment to installation and co-ordinating an industry around retrofit. Its marketing and branding strategy also relied on its positioning relative to the Green Deal – needing this comparative relationship with policy to appear as a 'better' option for householders.

What this exploration shows is that even though there is significant variation between the experiments in terms of their type, form and focus, their engagement with that macro-context produces some significant similarities. It supports the view that, as argued by Bulkeley and Castan-Broto (2013a) a dominant form of governing is through experimentation: all of the experiments represent a form of governing by experiment, not only by testing specific elements of state policy, but by the fundamental premise of acting on general goals and priorities defined at the macro-level. It also shows how conceptually different 'types' of experiment can overlap or coexist in the same response and even how the form and orientation of an experiment can change over time – particularly in the case of

Carbon Co-op, contributing to a more nuanced and flexible understanding of what urban experimentation looks like in practice.

9.4 Forms of change – outcomes and effects

The table below outlines the areas in which each case either transformed something about the retrofit 'system' either locally or beyond, contributed incrementally to a wider transition process, or actually reproduced the status quo – i.e. did not change anything.

The combinations and negotiations of different interests and issues, different relationships with other actors and interests and issues at different levels, has produced differences in experimental focus and the differences in approach to the key issues surrounding domestic retrofit in cities have in turn produced a particular place-specific responses to the issue of domestic retrofit, which have produced particular outcomes and effects. Carbon Co-op's focus on technical knowledge resulted in transformative and transitional effects – albeit only on eight houses – in these areas of the socio-technical system, acting on particular components such as the survey method and process, post-installation monitoring, and the design process. Other more people-focussed or value-based areas of learning such as the detailed evaluation of the experiences of the householders, the development of peer-to – peer support and their experiences of legal processes and understandings of contract forms continue to be of use internally to Carbon Co-op and its members, but were not linked to any higher order learning or transformation in the wider industry.

Changes resulting from the Energy Saving Co-operative are comparatively less. The new network and relationships it formed around retrofit were truly transformative at the time, connecting actors and interests such as local, Birmingham based installers, with community organisations that were ideologically aligned. However, because the business ultimately failed, the transformative business model and retrofit service it was trying to establish was unable to have any impact or do what it had intended in providing an alternative to Green Deal. Because of the starkness of Energy Saving Co-operative's rise and fall, in comparison with Carbon Co-op which still operates as an organisation, and Bristol Home Energy Upgrade, which contributed directly to further retrofit activity, it is very difficult to identify any incremental changes that Energy Saving Co-operative contributed to a transition process.

Form of change	Carbon Co-op	Energy Saving Co-op	Bristol Home Energy Upgrade
	Eight houses fully retrofitted. Occupants' energy use reduced, comfort improved and homes' appearance transformed. Created new monitoring device.	New relationships formed around domestic retrofit in Birmingham. Over 100 homes retrofitted – comfort and appearance of homes transformed.	23 solid wall insulation jobs completed and 134 heating system upgrades installed - comfort improved and appearance of homes improved.
	The 8 houses build detailed technical and tacit knowledge of retrofit process. Self assessment tool improves survey process. Guidance note opens up regional dialogue about planning. Community champions gradually engage more people with retrofit.	Very little incremental change resulted from ESC.	Initial contribution to long term retrofit goals in city-region. Learning about retrofit process and roles contributed to Warm Up Bristol. Increase in number of accredited installers in the city region.
	Carbon Co-op returned to niche status - not incorporated in GM strategy. Key actors at grassroots and regional level remain largely the same. Supply chain not improved.	Failure of the business and lack of legacy. ESC business model did not provide an alternative to Green Deal. Local supply chain did not acquire any extra work or build industry, jobs or local economic growth.	No challenge to policy-based approaches and stipulations. No new relationships or actors brought into retrofit governance network. No significant progress on technical understanding of whole house retrofit or planning issues.

Table 15 - Forms of change from the case studies

On the other hand, the Bristol Home Energy Upgrade shows potentially more incremental contributions to a long-term process of change in the city region in relation to retrofit. Not only did it change the physical properties of 157 homes, the highest of the three cases, it

directly informed processes involved in Warm Up Bristol, a larger retrofit programme run by the council, offering learning about marketing, the role of community groups and their needs, and it contributed to a better populated local supply chain. However, the transformative effects of the BHEU are limited by the shallow nature of the single measure retrofits themselves, which in comparison to the whole house or hybrid retrofits of the other two cases are far less dramatic in terms of energy savings. There is little transformative effect in terms of the governance of retrofit in the area with the initiative reusing existing relationships rather than including new actors and perspectives. Furthermore, the transitional changes resulting from the BHEU are also limited to following a narrow, policy defined approach, rather than contributing to any alternative or challenge to that model or to any significant technical innovation around retrofit, and problems with planning processes persist.

9.5 Enabling and limiting change: never underestimate the landscape.

This section will examine the effect that the macro-level or landscape explored in chapter 5 had upon all the cases, acting simultaneously as both an enabler to all of the projects and the single most significant inhibitor to progress.

In the multi-level perspective (MLP) the landscape is described as a series of 'macro-societal' shifts taking place away from the socio-technical issue at hand, which interact with existing regimes in order to open up opportunities for change. An example of this could be the issue of climate change creating emissions reduction targets and energy security concerns creating particular drivers for retrofit, with global trends towards neoliberal, marketised policy and new state spaces creating particular governance styles. What this analysis does that is different from the MLP conceptualisation is that it directly connects these landscape issues with the actors involved in the domestic responses on the ground, through the assemblages, rather than the landscape issues remaining as detached 'background' processes. It acknowledges direct links such as the personal motivation of householders involved in Carbon Co-op to address climate change, or the direct impact of the financial crisis and the changes in policy on the installer members of Energy Saving Co-op, or the specific intention of BHEU to create a market in Bristol in line with policy trends towards marketization. This means we can see how the landscape directly affects local practices in both enabling and limiting ways. However, the most significant way in which the landscape affects local practices is through policy.

9.5.1 Policy experiments with an incomplete system

The exploration of policy in chapter 5 showed us how landscape issues and factors such as growing neoliberalism in the economic West, climate change, economic crisis, energy security and fuel poverty have become embodied in national policy and regulation relating to domestic retrofit, shifting and competing for importance over time and steadily increasing the prominence and importance of domestic retrofit of existing, privately owner occupied homes as a political issue. At an ideological level there has been a move towards neoliberalised policy, with an increased focus on carbon pricing and market incentives, along with an absence of regulation on energy efficiency and retrofit of existing housing. The responsibility for enacting a systemic change in energy efficiency of domestic properties

in the UK has been passed down to localised public-private coalitions of actors through competitive funding pots from central government. In terms of how this enabled the three cases, the anticipation of an industry created by the Green Deal and ECO framework inspired Energy Saving Co-op to create something 'better' in Birmingham and seize what the CEO saw as a business opportunity. The growing prominence of retrofit as an issue for climate change activists, and the deliberate connection of the Green Deal Go Early projects to the City Deals created the conditions in Manchester for Carbon Co-op to evolve, acquire funding and take an active role, and of course BHEU was a direct product of and response to DECC's Green Deal Go Early funding call.

But whilst localised experimentation and variation have been encouraged both directly and indirectly in these ways, certain aspects of a desired approach to retrofit have been specified quite clearly through both EU and national policy, such as the mandatory household survey or 'Green Deal Assessment', the provision of loan finance as a financial incentive, and the provision of subsidies through the Energy Company Obligation to vulnerable households and for particularly expensive measures such as external wall insulation. There is also a distinct technological specificity in the policy climate which is a historical trend in UK energy efficiency policy, and is manifest in the nature of the subsidies and loan finance available, which primarily supports solid wall insulation and heating system retrofits, with other measures less supported or conditional upon these measures. The result is picture in which certain areas of the retrofit 'system' outlined by Vergragt and Brown (2012) and Swan (2013), are overemphasised – such as the markets, supply chain accreditation and social housing aspects, while others are neglected, such as the regulatory 'push' elements, user behaviour, motivation and preferences, along with support for only certain specific products in the technical areas of the system.

The true effects of this macro-context on the possibilities for change become especially apparent when we view them through the biographies of the case studies. Looking at the forms of change coming out of each case it is clear that each one makes attempts at, or sometimes enacts successful changes, in different parts of the system: the survey, monitoring and householder engagement aspects addressed by Carbon Co-op, the procedural policy and governance aspects addressed by BHEU, and the business or 'market' elements as well as new local relationships addressed by ESC. But as Swan (2013) and

Vergragt and Brown (2012) warned – these innovations and steps of progress in domestic retrofit are only addressing small parts of the system. To achieve systemic change, all parts of the system should be in harmony, and in this case they are not, because there are fundamental elements missing from the policy and regulatory setup, and a significant misalignment between the motives and values of the actors involved and those who have constructed that setup.

Despite their local and contextual differences, the constant factor in all three cases is that the policy context was extremely difficult to work within, and despite navigating and relating to it differently, it caused significant problems for each case. For BHEU, the constraints of trying to work within the bounds of ECO reporting, and the limitations that Green Deal accreditation put on the technological options available compromised the deepness of the retrofits and carbon savings, but compliance with these constraints enabled a much higher number of retrofits and greater scale of activity. For Birmingham the lack of clarity around the extent of ECO funding and the inability to gain an ECO deal put an end to a flagship project that set into motion a sequence of events that ended the ESC's business, and not conforming to the Green Deal policy framework or receiving funding from DECC left ESC financially vulnerable as well as the local partners who had invested and collaborated with it. For Carbon Co-op, navigating the changes to subsidies available due to changes in ECO, and managing issues with planning created strain on the organisation and on the householders, reducing the number of retrofits they were able to complete and worsening the personal experiences of the process. Its constant shifting in activities and seeking funding from multiple sources creates instability and risk for the organisation, hindering its ability to continue working on the problem.

Furthermore, there is an ideological misalignment between the value-based approaches of the people and organisations involved at the local level, whose priorities range from genuine commitment to tackling climate change, to community empowerment, strengthening local economies and industries and protecting householders and citizens from harm, rather than those of policy which focus on markets and competition, upscaling and largely engage with retrofit motivations only on a rational financial basis.

So despite the influence of local capacity on the shape and balance of each assemblage and on the way it approached certain elements of the retrofit issue, the policy landscape has a direct impact on the power distribution and relationships in the networks:

- With ECO the only source of subsidy, and energy companies in control of who they award these subsidies to, energy companies have a distinctly large amount of power in terms of how they can dictate the success or failure of a project or response, and across all three cases, ECO and its surrounding processes in fact provided very little support and presented substantial obstacles.
- The Green Deal framework created a very particular process and approach that all initiatives had to fit into, but its mandatory aspects created conflicts and practical problems at various points and for multiple actors in each network e.g. assessments, planning, accreditation for installers.
- The control of central government – largely DECC - over the localised networks is contradictory to the rhetorical encouragement of localised experimentation, with conditionality and co-option of local responses through funding dependency, or vulnerability to failure without it, as warned of by Whitehead (2013).

9.5.2 Resistances to change – dependency and power.

In terms of what this means about how the macro-level limits the transformative potential of localised responses, Geels (2014) highlights the role of politics and power in resistance to low-carbon transitions, suggesting that different forms of power from material and instrumental, to discursive and institutional, help to reinforce the existing interests of those in powerful positions in existing regimes. This prevents change from occurring in response to pressures of climate change and energy security.

The UK policy setup aimed to create an entirely new system for addressing reduced domestic energy use through the particular financial, technical and tools it prioritised, showing that even though the domestic retrofit 'regime' is yet to be established, elements of discursive and institutional power – through policy – are being used to define an ideologically rigid rationale and approach. Through the funding dependencies and uneven material power dynamics this generates between the local experiments and the state, this rationale and approach has been very difficult to challenge despite its obvious flaws

illustrated in the experiences (and frustrations) of the participants in the case studies. Elements of progress and learning that did not fit ideologically with the market-making, financially driven, and technically specific policy approach were less protected and supported by central government than those which did: there is little or no incorporation of Carbon Co-op's peer to peer approach, or ESC's co-operative local supplier network approach in DECC's Green Deal Communities programme. Conversely, it tends to support collaborations between local authorities and larger private building contractors or energy companies rather than grassroots approaches with strong values.

Furthermore, these experiments have made very little impact on the actual scale of the issue – outlined in chapter 1 - which prompted them. The focus on boilers and insulation was specifically designed to tackle the high proportion of domestic energy use that is taken up by space heating, the specific focus on solid wall insulation was intended to tackle the house types that lose the most heat and require greater energy use through heating to compensate, and the focus on loan finance was designed to address the largest tenure type in English housing – privately owner occupied, and presumed 'able to pay' rather than fuel poor. However, the outcomes and effects of the initiatives do very little to impact these areas. It is impossible to know at this stage whether the change and effects from them collectively may form part of a longer term shift – through improving tools such as surveying and design, householder experience and process-based learning, or financial and business learning. But the closing of the Green Deal Finance Company in 2015, significant reductions in ECO – the only subsidy supporting the retrofit industry - places serious doubt over whether any of the existing framework or process is still considered viable, making the potential the potential incremental contributions the three cases make pale in comparison.

Viewing this part of the issue through Reddy's (2013) framework, it seems clear that these barriers at the macro-level in policy, regulation and ideology, are not possible for local actors to effect change upon directly – they have, as discussed, either worked around or within policy constraints, rather than being able to challenge those constraints. Like Seyfang et al (2013) this discussion challenges the idea that systemic socio-technical change can be brought about by the development of niches and localised experiments, because without a supportive policy context and enabling landscape, there is a fundamental barrier to systemic change. It also shows how place-specific and contingent 'niche experiments' and their

effects and changes are, and supports analyses suggesting that the knowledge generated from living laboratories and other forms of urban experiment do represent only one form of knowledge – rather than 'the ultimate' knowledge - which is not always transferrable to other contexts, and cannot always have any effect on dominant political or ideological forces.

In relation to the debate around the theoretical contribution of assemblage thinking to studies of political economy in City journal (see McFarlane, 2011 and 2011a, Dovey, 2011, Brenner et al, 2011 and Farias, 2011), this process shows assemblage thinking to be very helpful for connecting political economy to localised activity, through showing how the political economy of neoliberal capitalism that has encouraged networked, fluid governance and interurban variation and uneven development, yet stifled alternative ideologies in this way.

9.6 What is needed? An ideological landscape shift.

Any prospect of deliberately enacting a transition in this area thus requires far greater attention to the 'missing' areas of the system such as regulation, understanding complex motives, developing a whole suite of interrelated technologies other than insulation and boilers and ideological alignment between national policy and the local and personal agendas and priorities of the actors charged with addressing domestic retrofit. What could improve the situation is a landscape shift in the way policy is constructed – moving away from marketization, technical obsessions, carbon pricing and inconsistency, and towards equity and dependability especially in subsidies, supported by stricter and better regulation of energy efficiency in existing buildings and support for creative technical approaches. This could better support longer-term development of alternative approaches and make room for varied motives for retrofit, technical innovation and supply development, and truly give power to the local organisations working on it instead of to the energy companies. A landscape scenario like this could potentially open up space for more niche level responses to produce creative solutions to the problem and construct and inclusive equitable regime for domestic retrofit that addressed climate change, energy security and economic concerns together. This would be the regime desired by the academics, policy makers and grassroots actors who share such enthusiasm for retrofit but have so far struggled to find a solution under the limiting ideological approach dictated by policy.

Chapter 10 – Conclusion: What has domestic retrofit shown us about pressures, policy and people in urban contexts?

10.1 Revisiting the research questions

Firstly, it is necessary to return to the original questions posed at the beginning of the thesis and demonstrate how they have been answered over the course of this doctoral journey. The first aim of the research was:

i. *To understand how and why different responses to the issue might emerge from different urban contexts, despite operating under the same policy context.*

The thesis has established that such divergence in domestic retrofit experimentation in English cities is a product of their different, context specific process of assemblage. These different processes of assemblage are partly due to the style of policy and governance in relation to both cities and energy efficiency in the UK, which encourages localised experimentation and variation. However, it is also due to the inherently contingent and 'messy' nature of localised urban responses to energy issues, dependent on features of the places in which the experiments have emerged such as organisations with specialist retrofit knowledge, environmental networks, and supportive local government. Finally this variation is also partly a product of the level of influence and the roles of individual people who are working on and in these initiatives, whose motives, values and level of influence varies enormously depending on the relationships between them and the other factors and scales. The relationships, negotiations and dynamics between these levels and between the actors and factors at all levels produce differently orientated experiments with different approaches.

The second aim was:

i. *To ascertain whether the policy context in which these responses operate acts as an enabler or a limitation to the transformative potential of these responses.*

As discussed in chapter 9 the research has also established that the policy or 'macro' context – which is a combination of both global landscape issues and trends, and UK specific policy features and trends such as shifting priorities and preoccupations with particular technological fixes - both enabled and limited the changes emerging from the different case

studies. It enabled by encouraging localised activity and offering funding for domestic retrofit initiatives, thus creating opportunities and spaces for experimentation and varying approaches as described by (Hodson and Marvin, 2014). However, landscape issues in and of themselves created pressure to respond at all levels – people and organisations often engaged directly and personally with these pressures rather than just through policy, particularly with climate change and economic issues such as the perceived upcoming value shift towards co-operatives as a result of the financial crisis.

However, this context also limited transformation, in part due to an ideological gap – rationales for action and problem solving approaches differ from markets and specific technologies in macro-context to a complex array of other rationales often based on more pro-social value-bases at the meso and micro levels, connecting with the issues of differing 'worldviews' identified by Brown and Vergragt (2008) in their example of a Bounded Socio-technical experiment (BSTE), and the challenges with transferring learning from experimentation in an unsupportive policy and regulatory context that they outlined in their exploration of domestic retrofit in Worcester, MA (Vergragt and Brown, 2012).

This, combined with resistances to change through instrumental and institutional constraints such as funding dependencies and technical specificity (Geels, 2014) either co-opted transformative responses into the dominant policy approach, or prevented them from moving beyond the experimental niche phase.

10.2 Implications of the work presented in this thesis.

10.2.1 Raising questions for policy

One of the reasons that the work in this thesis is important is that the experiences of the people involved in the case studies and the macro-level analysis in Chapter 5 exposed some significant and acute issues with the effectiveness of domestic retrofit policy and the conditions it creates for practical action. The sporadic, inconsistent and fragmented nature of policy creates uncertainty for domestic retrofit professionals and householders alike, and the constraints and stipulations of policy create an incomplete system for local actors to experiment in and with, thus discouraging really creative responses that could generate systemic change. The research also exposed the ineffectiveness of specific policy tools such as ECO, which is not reaching households and supporting costly retrofit activity as it was

intended to do. Similarly the Green Deal, - which was too complex for industry and householders alike to understand and engage with - has not initiated an overhaul of energy efficiency in English properties as hoped, thus not meeting policy priorities of significantly reducing carbon emissions from energy use in homes, reducing reliance on fossil fuel or protecting against fuel price hikes and improving energy security. Varying local capacities and capabilities to respond also creates greater challenges for some contexts than others, often varying between different parts of the 'problem'. These findings beg questions about what policy changes would better support retrofit activity. Stable policy that is more sensitive to the ways in which problems can be felt and interpreted differently in different contexts, with different levels of capability to act, and is less dependent on large energy suppliers (in whose best interests, perversely, reducing energy use in homes is not) would be a step forward. Furthermore, addressing the overreliance on markets and finance in so many areas of policy (from loan finance for householders to allowing the influence of bartering with ECO prices to ride roughshod over local projects) should be a priority, along with more stringent regulation of, and more consistent, accessible financial support and subsidy for retrofit in the privately owned and occupied sector. These changes could combine to make something that is currently a 'hard-sell' into a necessary and normal part of home improvements, which could in turn support consistent work and revenue for local retrofit supply chains, thus meeting local economic development objectives.

In terms of progress on the localism agenda, there is certainly evidence from the cases that city-based actors are keen and committed to creating and enacting their own strategies for addressing the issue of domestic retrofit, and that certain policy programmes such as the Green Deal Go Early programme enabled and empowered them to do so – in the cases of Bristol and Manchester at least. Whilst this research relates to the specific issue of domestic retrofit, it connects to, and supports, Hodson and Marvin's (2010a and 2010b) findings that cities are trying to enact their own low carbon transitions, by connecting, utilising and protecting their own organisational resources, and to some extent are able to attempt it. However, the potential for successful transitions resulting from these attempts is questionable because of the macro-level constraints on them, as discussed at the end of Chapter 9.

As a result, the key recommendations to policymakers in the field of cities and domestic retrofit would be:

- There should be fewer conditions and constraints on funding from national government to city-based projects (such as requirements to blend finance, involve ECO partners, and create unrealistic target numbers of properties), giving greater freedom to places to govern themselves and their retrofit strategies, making the best use of their own strengths and resources and creating responses that are tailored to their local contexts.
- Assuming there is a desire to increase retrofit activity, policy messages promoting retrofit should not assume that householders' motivation is primarily financial, or environmental. Complex motivations and concerns should be acknowledged and addressed, with bespoke, one-to-one advice and information for each household.
- The importance of detailed, technical information and advice should not be underestimated. This should be provided by reputable organisations such as architects or experienced retrofit contractors and should be bespoke to each household and its peculiarities.
- Community groups should not be assumed to have adequate technical expertise or voluntary capacity to promote and advise householders about retrofit. They can be very useful for mutual support and networking, but are often already stretched for resources and being placed in positions of excessive responsibility is often destructive to them. They should be allowed to define their own level of involvement rather than have roles imposed upon them by national or local government.
- Gaps and unevenness in resources and capacity at the local level should be plugged using a national, overarching retrofit organisation or hub, which can add support to local schemes in a bespoke manner, e.g. if they are struggling with particular parts of the retrofit process such as outreach or technical advice.
- There should be greater willingness from national policymakers to learn from localised projects and experiments in retrofit without predefining the learning that is required - i.e. with an open mind. This includes learning from those retrofit experiments deemed 'unsuccessful' or not in line with dominant approaches.

10.2.2 Reflection: contributions to knowledge and existing literatures.

This thesis has encouraged holistic, interdisciplinary, joined up thinking in academic approaches to studying both domestic retrofit specifically and socio-technical issues in urban contexts. The topic and methodological approach required perspectives and ideas assembled from a range of approaches in order to effectively account for and investigate issues that emerged. It has made an original contribution to knowledge in three significant ways.

Firstly, it has taken a uniquely urban focussed perspective on domestic retrofit, looking at the responses of city-based actors to this issue under certain policy and political conditions. Much research has looked at urban responses to energy and climate change issues, localised responses to sustainability challenges, and even some that investigate domestic retrofit in specific contexts (e.g. Williams et al, 2013). But none has compared city-based domestic retrofit responses in this way with a particular focus on the urban nature of the responses. This research supports the arguments in the literature suggesting that landscape political changes have resulted in networked urban governance styles, particularly in relation to climate and energy issues, that produce uneven results and development in different places. In terms of urban governance of energy issues, we have seen clear evidence of 'glocalised', 'geometries of power' in the urban context, that connect spaces and territories of activity to organisations, interests and ideologies at higher levels, at some risk (Swyngedouw, 2004). We have also seen networks of varying levels of representation that are fluid and often temporary (Bulkeley and Schroeder, 2011 and Rutland and Aylett 2008).

Secondly, it has synthesised a range of issues and pressures at different scales and in different academic disciplines in a holistic analysis, using themes and concepts from dramatically different literature traditions and theoretical approaches. This produced a new hybrid theoretical framework in 'Experimental Assemblages' for addressing the socio-technical issue of domestic retrofit in a context-sensitive way. The real value of this framework is in how it captures the contingency of place in defining urban experiments, at the same time as successfully incorporating influential factors from the global scale, through national policy right down to the scale of individual people and technologies and the impact of complex interrelations between them.

The experimental assemblages framework also captures the change orientation of the 'thing' – organisation, project or initiative - under question by examining its goals and intentions around knowledge and learning. The cases and discussion show that the focus of learning within experimental assemblages was also highly contingent on the people and organisations involved. The knowledge foci of the different initiatives varied significantly within the specific topic of domestic retrofit and thus learning and was often difficult to articulate or predefine, taking an almost organic form in some instances. Furthermore, there was evidence of learning between cases which is very significant in terms of understanding how localised experiments use and interpret place-specific knowledge and experiences of retrofit. Further study could be done to identify how this knowledge is applied, modified or rejected when entering new contexts.

The cases and discussion have shown unevenness and urban experimentation 'in action' through the lens of domestic retrofit and the differences in responses between urban contexts. It has, however, moved towards a more fluid understanding of 'types' of urban experimentation, showing that experimental assemblages can at once display features of BSTEs, grassroots niches, urban living labs and policy experiments in varying measure, rather than these representing categorically separate forms of experimentation. It also challenges perceptions of Bulkeley and Castan-Broto (2013) and Evans and Karvonen (2011) that these experiments sit outside of formal policy approaches – with all of them operating in response to, or dependent upon policy in some way such as through funding or anticipation of policy trends. However, all cases demonstrated the other commonly cited elements of urban experimentation highlighted in the literature of messiness, contingency and embeddedness.

It has also engaged with ideas around the organisation of retrofit in terms of roles and responsibilities, such as middle-actors and intermediaries, finding that the 'models' of retrofit outlined by Williams et al (2013) and Hodson and Marvin (forthcoming) and the roles of intermediaries and middle-actors (Karvonen, 2013 and Janda and Parag, 2013) are not as clearly delineated as the literatures present. Whilst helpful as guiding concepts, what this research has found is that these roles and forms of organisation are in fact interchangeable, that retrofit responses and actors can shift between roles and forms over time, or occupy multiple positions at once. This raises questions about exactly what a

retrofit experiment actually is – is it an organisation, a project, a network or simply a platform for creating any one of these things?

Finally, the research clearly illustrates the context dependency and place specific nature of the responses – the particular manifestations of Carbon Co-op, Energy Saving Co-operative and the Bristol Home Energy Upgrade could not have emerged in other contexts because they were so fundamentally a product of the local networks, organisations, resources and even individuals that influenced their creation and development. This clearly supports the arguments of Smith and Raven (2012), Seyfang (2009) (Hielscher, Seyfang and Smith, 2013 and Raven et al, 2015) for the importance of context sensitivity and looking inside local experiments at their internal dynamics, their relations to wider contexts, and the limitations of these localised experiments to effect change without a supportive policy context that is aware of these factors.

10.2.4 Limitations to the research

A key limitation of the research is that, partly due to the holistic approach adopted, and partly due to the timing of the fieldwork coinciding with the development and assemblage of the cases rather than the installation phase, it identifies such an enormous range of issues and factors that it can't examine them all in depth.

Taking on an approach that synthesised all these issues at once was a lot more complicated than originally thought – bringing together literatures and theoretical approaches that cover urban politics, low carbon and sustainability issues, socio-technical systems, actor network theory, and the interdependent technical, behavioural and organisational issues around domestic energy efficiency, has been a significant challenge, and creating a framework that linked these, utilising different elements from different approaches, was a very difficult task.

This means that some detail is lost in the analysis of the multiple socio-technical issues touched on, particularly the practical and technical intricacies of retrofit and the complex motives and decision making processes for householders. For example, there is a consistent acknowledgement of the technical complexity of whole house retrofit and the difficulties with co-ordinating measures in one installation, selecting materials and understanding the influence of householder behaviour, but the details of this and how they played out in each case have not been explored in detail and therefore the research is limited in its

contribution to knowledge and progress in this particular area. It is hoped that what it does bring in lieu is an increased awareness that any study of the many specific socio-technical facets of domestic retrofit should acknowledge both the macro-societal and local level pressures and influences on these issues. This was exacerbated by access differences and differential data between contexts and cases which made it difficult to compare like for like. The timing of Bristol Home Energy Upgrade being finished, the closeness and welcoming nature of Carbon Co-op and the conditionality attached to researching Energy Saving Co-operative produced different levels of detail on different aspects of each case, which presented difficult choices about what was reported and what was not – hence losing some of the detail as described above.

Furthermore, this thesis has dealt primarily with retrofit of privately owned and occupied housing and responses to this issue aimed at people who were able to pay for their retrofits. However, there are different pressures on the social housing sector and the privately rented sector (which is soon to be subject to regulated minimum standards for energy efficiency), and fuel poverty continues to be a political and socio-economic problem with serious consequences, none of which this research was able to explore in great detail.

Furthermore, the practical and logistical challenges of being a lone researcher limit the scope of such 'big' research: whilst selecting a small number of in-depth cases as an approach has certainly illuminated some significant challenges and themes pertaining to domestic retrofit in cities, the theoretical findings cannot generate grand theories or generalizable knowledge. This means that the findings from this research cannot be used as examples of 'how to do' or 'how not to do' domestic retrofit in cities, or used to make claims about how the issue is governed in all cities. What they can do is show us what general urban trends and processes such as governing by experiment, urban variation, networks and interests around energy and climate issues look like in different contexts, or how specific socio-technical issues with domestic retrofit, such as householder engagement, technical risks and organising retrofit can be approached in different ways in different contexts. These findings are certainly more modest than grand theories, but are still valuable.

10.3 Future directions for this research

10.3.1 Other applications of the framework

There are a number of ways in which the framework and methodological approach employed in this research could be applied to further research, some of which could address some of the limitations above. For example, whilst there is a wealth of research into domestic retrofit in relation to fuel poverty or energy vulnerability more broadly, this research approach and framework could quite easily be applied to urban or place-based research at other scales that specifically focuses on other housing sectors or domestic retrofit aimed specifically at those at risk of or experiencing issues related to fuel poverty.

The urban experimental assemblages framework could also be used not only to study domestic retrofit but any socio-technical issue that needs to incorporate global and place specific pressures and individual people, technologies and physical elements of the built environment all at once. It could be used to study local approaches to water and transport issues, for example, or place-specific experiments in other areas of the energy sector such as district heating, smart networks or micro-renewables.

There are also other, complimentary frameworks available for looking at the issues surrounding domestic retrofit. Ideas emerging from this PhD have already been built upon in an EPSRC Impact Acceleration Account (IAA) project investigating domestic retrofit systems in Haringey, London. The IAA research uses a multi-level, multi-factor approach similar to the experimental assemblages framework, but adds to it a 'suburban infrastructures' approach, incorporating an appreciation of features of contemporary suburbanism rather than the urban context as a whole, and allowing a view of what kind of service the system is providing to the place in which it has emerged, and whether it is effective and equitable.

10.3.2 Potential Publications

There are a number of potential publications from this work:

- A policy critique paper giving voice to experiences of retrofit at the city level and exposing the ideological gap between policy and practice.

- An empirical paper presenting different approaches to domestic retrofit emerging from different city contexts, demonstrating unevenness and variation in capacity and progress in different urban contexts.

The most significant potential publication is currently in draft and is based on the experimental assemblages theoretical approach, intending to engage with the debate around assemblage thinking and connect it to a developing research agenda around urban experimentation. It is Intended for submission to City journal and its working title is:

"Using the concept of experimental assemblages to describe and explain domestic retrofit in different UK cities."

It will demonstrate how the framework combines concepts from socio-technical experiments with urban assemblage theory to capture the dynamics, knowledge politics and change orientation of retrofit initiatives in different urban contexts.

10.3.3 Summing up

Hopefully this thesis has offered the reader some insight into why domestic retrofit is important, and how policy, people and place are important to domestic retrofit in urban contexts, opening up a research approach and agenda that could go in many different directions. The quote below from one very wise participant captures the essence of this thesis nicely:

> *"Things emerge where they do because of the relationships that are there."* Carbon Co-op Generating Success partner.

It should also serve to remind us that there is likely no single 'answer' to the problems of climate change, energy security and economic crisis that converge around domestic retrofit in cities, especially not one that will emerge from multiple local experiments and be replicated elsewhere. However, the efforts of those who try, in their own contexts, in their own ways, to do their part to address these issues, should be commended.

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