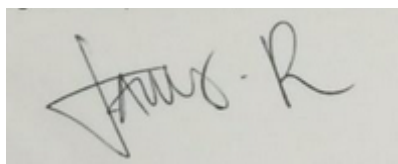


Governing energy consumption at the local level: the potential of community energy initiatives to act as vehicles in energy demand management.

Submitted by James Ross to the University of Exeter as a dissertation towards the degree of Master of Science by advance study in Sustainable Development

August 2015

I certify that all material in this dissertation which is not my own work has been identified with appropriate acknowledgement and referencing and I also certify that no material is included for which a degree has previously been conferred upon me

A handwritten signature in black ink, appearing to read 'James R', enclosed within a rectangular box.

Word Count: 9983

Abstract

The UK has set an ambitious target of an 80% reduction in greenhouse gas emissions by 2050. To achieve this target, shifts towards low carbon forms of energy will be required along addressing current growths in energy consumption. In an attempt to increase the knowledge surrounding effective methods to reduce energy demand, this dissertation aims to assess if community energy initiatives, in the UK, can act as vehicles in energy demand management. To answer this hypothesis, this dissertation's research questions aimed to establish; how community energy initiatives can address energy demand? What challenges do they encounter? How can these be overcome? And where do the main opportunities lie for community energy initiatives to reduce energy demand?

The results of this project established the overarching challenges community energy initiatives encounter when addressing energy demand, while at the same time exploring the solutions to these challenges and gaining an insight as to where the opportunities lie. Finally it was concluded that community energy initiatives can act as effective vehicles in energy demand management when successfully addressing certain criteria which include; public engagement, financial sustainability and reducing reliance on government support.

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Glossary

BP: British Petroleum

CCC: Committee on Climate Change

CEP: Community Energy Plus

CERO: Carbon Emissions Reduction Obligation

CHP: Combined Heat and Power

CPC: Community Power Cornwall

CSCO: Carbon Saving Community Obligation

CSE: Centre for Sustainable Energy

DECC: Department of Energy and Climate Change

ECO: Energy Company Obligation

EIA: Energy Information Administration

GDP: Gross Domestic Product

GHGE: Green House Gas Emissions

HHCRO: Home Heating Cost Reduction Obligation

HL: House of Lords

HTT: Hard To Treat

IEA: International Energy Agency

IPCC: Intergovernmental Panel on Climate Change

LEAP: Leadership for Energy Action and Planning

OFGEM: Office of Gas and Electricity Markets

ONS: Office for National Statistics

RHI: Renewable Heat Incentive

SWDCEP: South West Devon Community Energy Partnership

UK: United Kingdom

UN: United Nations

WEC: World Energy Council

WREN: Wadebridge Renewable Energy Network

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(1) Introduction

This section outlines the context of this research project to establish its rationale and importance. This section will also explain the project's research objectives.

(1.1) Context

Sustained growth in fossil fuel consumption, since the industrial revolution, has resulted in large scale depletion of natural resources (Yu and Zhu, 2012). Rising GDP and population growth have resulted in a 30% increase in global energy demand since 1980 (IEA, 2010). In 2014 68% of the UK's energy came from fossil fuels, all of which contribute to greenhouse gas emissions (GHGE) (DECC, 2014). Current trends for year on year energy demand growth predict increases of up to 50% by 2030 (IEA, 2010; BP, 2015). Increased pressures on depleted natural resource presents the risk of creating international political tensions over energy supply and security (Fox, 2006).

Failure to curb this growing energy demand, and reduce a reliance on carbon intensive energy resources, is widely believed to result in irreversible climatic change (Solomon et al, 2009; Meehl et al, 2007). Predictions on rises in global average surface temperatures have undergone much debate, with estimations ranging from 1.8°C – 4°C by 2100 (Schwanen et al., 2011; IPCC, 2013). Regional variations in surface temperature rises will create inequality issues as the poorest will be hit the hardest, due to a dependence on agriculture (Stern, 2007). This also brings gender inequality issues, as in many Sub-Saharan African countries, up to 90% of the female population work within the agricultural industry (UN, 2009). An urgency to mitigate further climate change has increased the political importance of attempts to reduce reliance on carbon intensive energy sources. This project therefore aims to increase the research surrounding local approaches toward energy demand reduction. This will be achieved through investigating the challenges and opportunities community energy initiatives are faced with when attempting to manage demand, in order to assess if they can act as effective vehicles in energy demand management. The research aims and questions will be explained in more detail in chapters 1.5 and 1.6.

(1.2) UK policy

The UK Government has outlined targets of a 34% reduction in GHGE by 2020, along with an 80% reduction by 2050 based on 1990 levels, in the Climate Change Act of 2008 (CCC, 2009). Due to an inability for all industries to reduce emissions by 80%, compromise must be made where possible to compensate (Boardman, 2012). 23% of UK carbon emissions can be attributed to domestic buildings, and therefore an emphasis on reducing energy demand is present within UK policy (Bioregional, 2012). Table 1 presents several of the UK's current policies aimed at reducing energy demand.

Table 1: UK energy demand reduction policy (Source: DECC, 2015a)

Policy	Description
Carbon Reduction Commitment (CRC) Energy Efficiency Scheme	Mandatory reporting and pricing scheme to improve energy efficiency in large public and private organisations.
Enhanced Capital Allowances	Financial support for businesses to invest in energy saving technology.
Climate Change Agreements	Energy intensive industries receive a discount towards the Climate Change Levy when meeting government agreed energy efficiency targets.
The Green Deal	Financial support for properties to invest in energy saving measures. Loans are repaid through saving gained as a result of the investment.
Combined Heat and Power (CHP)	Investment towards CHC encourages increases in energy efficiency through reducing energy waste.
Saline Fix	Financial support to public sector organisations in the form of interest free loans for energy efficiency improvements.
Energy Company Obligation (ECO)	Works alongside the Green Deal in order to increase building's energy efficiency along with reducing fuel poverty.
Domestic Renewable Heat Incentive (RHI)	Government incentive to reduce demand for carbon intensive energy forms through promoting the use of renewable heating sources. I.e. Installing a Biomass boiler, in which consumer receives tariff for energy generated.

This project will take particular interest in the Green Deal and the ECO as they aim to reduce existing UK building's emissions, and therefore incorporate domestic energy demand. Table 2 gives detailed descriptions about the Green Deal and the ECO.

Table 2: The Green Deal and ECO (Source: DECC, 2015a)

<p>About the Green Deal</p>	<ul style="list-style-type: none"> - Provide accredited impartial advice to UK homes, community spaces and businesses on improving energy efficiency. - Provide support to ensure energy efficiency measures are executed to the highest possible standard. - Eliminate the need for upfront payments on energy efficiency measures by providing loans with a repayment system from capital gains from energy savings. - Based on the 'Golden Rule' in which there is no maximum loan for a homeowner, however the costs for energy efficiency increasing measures must not exceed the potential savings from their average energy bills during the Green Deal's period up to 2020.
<p>About the ECO</p>	<ul style="list-style-type: none"> - Government scheme to obligate larger supplies (>250,000 customers) to deliver energy efficiency measure to domestic properties. - Act as a 'top up' to the Green Deal to help increase energy efficiency within HTT, low income and vulnerable consumer households. - Provide £1.3 billion annual support via <ul style="list-style-type: none"> • Carbon Emissions Reduction Obligation (CERO) • Carbon Saving Community Obligation (CSCO) • Home Heating Cost Reduction Obligation (HHCRO)

Targets	<ul style="list-style-type: none"> - Reduce carbon emissions from UK buildings by 29%. - 14 million households retrofitted by 2020. - Generate £7 billion annual private investment along with 250,000 jobs. - Address Fuel poverty issues within the UK.
The Green Deal is available to:	<ul style="list-style-type: none"> - Domestic and Non Domestic Buildings.
The ECO is available to:	<ul style="list-style-type: none"> - Private rented properties. - Owner occupied properties. - Consumers who do not meet the Green Deal's 'Golden Rules'.

(1.3) The Energy Trilemma

To simplify energy sustainability, it has been defined as addressing energy security, environmental sustainability and energy affordability (WEC, 2015). Managing these sometimes competing demands creates challenges for policy makers and is known as the 'Energy Trilemma' (see figure 1).

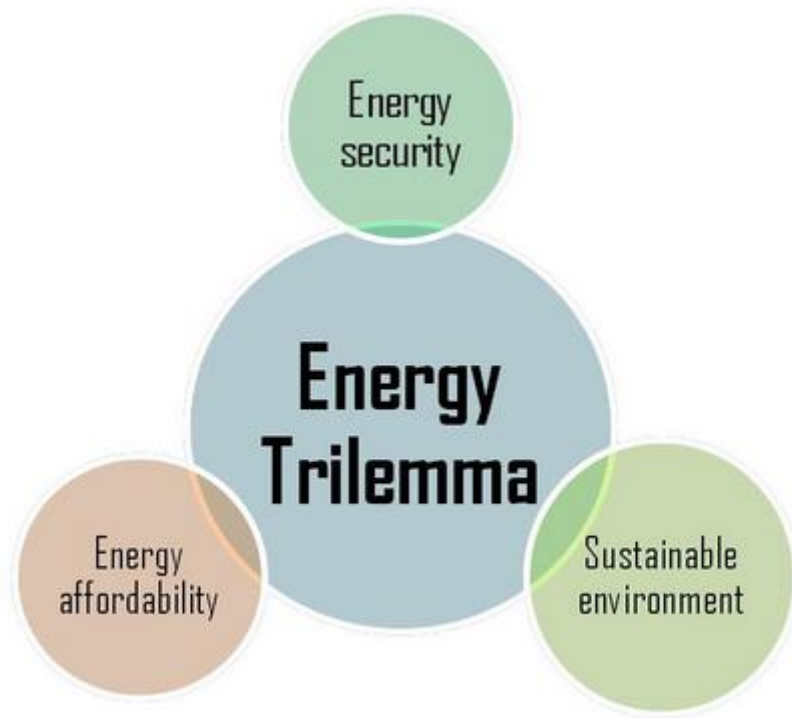



Figure 1: Domains involved in meeting the Energy Trilemma. (Source: Sendai, 2014)

The World Energy Council state the trilemma has “complex interwoven links between public and private actors, governments and regulators, economic and social factors, national resources, environmental concerns, and individual behaviours” (WEC, 2015). Satisfying environmental sustainability often means increasing renewable energy sources in the energy mix, however this can impede on energy supply and energy affordability as wind and solar energy are not as cheap or reliable as fossil fuels (Lomborg, 2007). Policy addressing elements of the energy trilemma often reflects political agendas of governments. Figure 2 indicates that the UK has a political focus towards ensuring sufficient energy supplies, over environmental sustainability and affordability.



RANK	Energy Security	RANK	Energy Equity	RANK	Environmental Sustainability
1	Canada	1	United States	1	Switzerland
2	Russia	2	Canada	2	Costa Rica
3	Qatar	3	Australia	3	Albania
4	Romania	4	Luxembourg	4	Colombia
5	Colombia	5	Switzerland	5	Norway
6	Denmark	6	Qatar	6	Sweden
7	Bolivia	7	Saudi Arabia	7	Uruguay
8	United States	8	United Arab Emirates	8	Austria
9	United Kingdom	9	Hong Kong	9	Denmark
10	Australia	10	Austria	10	France
11	Nigeria	11	France	11	El Salvador
12	Czech Republic	12	Oman	12	Gabon
13	Kazakhstan	13	Bahrain	13	Ireland
14	Argentina	14	Taiwan	14	Latvia
15	Slovakia	15	Norway	15	Mauritius
16	New Zealand	16	Finland	16	Paraguay
17	Indonesia	17	Kazakhstan	17	Panama
18	Peru	18	Iceland	18	United Kingdom
19	China	19	Sweden	19	Brazil
20	Sweden	20	Japan	20	Lithuania
21	Azerbaijan	21	Malaysia	21	Italy
22	Switzerland	22	United Kingdom	22	Portugal
23	Ecuador	23	Greece	23	Luxembourg
24	Bulgaria	24	Iran	24	Spain
25	Angola	25	South Korea	25	Angola

Figure 2: Index of countries addressing the Energy Trilemma. (Source: WEC, 2014)

(1.4) Community energy

Community energy represents a collective action that can involve a range of aspects. It usually involves a community acting together towards achieving a goal/goals which include reducing consumption, purchasing, managing or generating energy. Community energy initiatives can vary in size and objectives, however they usually have an emphasis on bottom up approaches towards energy management through incorporating local engagement, leadership and control, with the local region collectively experiencing the bulk of the benefits (DECC, 2015b). Community energy initiatives utilise community action to address issues surrounding energy. This approach allows communities to exploit their strengths and local knowledge along with bringing residents together with a common purpose. Community energy also presents the opportunity to localise energy systems, resulting in reduced losses in energy through transmission, which in the long run reduces overall energy costs

(Tipper, 2013). Increased community owned electricity generation would also put pressure on energy firms to drive down prices along with diversifying the UK's energy mix.

Community energy offers a solution to the energy trilemma as it allows communities to control energy prices, generate local supplies and utilise renewable energy sources. This decreases the UK's reliance on energy imports, which in-turn reduces the influence of international energy suppliers over energy prices.

(1.5) Research aims

Using academic literature and interviews with relevant stakeholders, this project aims to assess if community energy initiatives can act as effective vehicles in energy demand management, in order to help the UK achieve its ambitious GHGE reduction targets. In particular it will investigate the challenges and opportunities for community energy initiatives to reduce a community's energy consumption. To test the project's hypothesis the following research questions were used.

(1.6) Research questions

- 1) How do different community energy initiatives address energy demand?
- 2) What are the main barriers to reducing energy demand in community energy initiatives?
- 3) How can these barriers be overcome?
- 4) Where do the opportunities lie to effectively manage energy demand in community energy initiatives?

(1.7) Dissertation structure

Table 3: Structure of dissertation

Chapter 1	An outline of this research project's context along with an explanation of the research aims and questions.
Chapter 2	A review of relevant literature surrounding the topic of study.
Chapter 3	An overview and rationale of the methods used in this project to collect data.
Chapter 4	A presentation of the results and analysis of data collected.
Chapter 5	A Discussion and conclusion of the project's findings
Chapter 6	Recommendations for further study towards the area of research.

(2) Literature review

This chapter aims to give an overview of the existing relevant research in order to further establish the context of this dissertation. This literature review acts as guidance towards the chosen methodologies (see chapter 3) and forms the basis for this projects research questions (see chapter 1.6).

(2.1) Energy demand overview

Energy demand represents the required amount of energy to sustain a population's desired energy consumption levels. Addressing energy demand has been identified as an essential factor for the UK in meeting its targets of an 80% reduction in GHGE by 2050 (Prindle and Eldridge, 2007; Jackson, 2005). The UK government believe that to achieve these targets, energy use per capita must be reduced by up to 50% of 2015's levels (DECC, 2015a). The importance of reducing energy demand to mitigate climate change in the UK is reflected by its rise in political agendas, with the introduction of the policies listed in Table 1. Reducing energy demand is most commonly achieved through the strategies listed in table 4.

Table 4: Common strategies in reducing energy demand

Strategy	Description
Energy efficiency	Koopmans and Te-Velde (2001) define energy efficiency as the 'use of energy per unit of output'. It relates to how much energy is required to achieve a desired outcome, and therefore increasing energy efficiency will lower the required input of energy for the same outcome. An example of this would be insulating a building to prevent heat loss, resulting in a reduced requirement of energy to heat the building. Increasing energy efficiency is an attractive way to reduce energy demand, as consumers do not need to change their habits or living standards, and therefore this is a common approach adopted by governments (Shove et al, 2008).
Technical improvements	Improvements in technology act as another way to increase energy efficiency, as advances in forms of the generation and use of energy can reduce the required energy inputs for the same outcomes. Advancements in energy generation reduce the requirements for carbon intensive fuels, such as fossil fuels, providing cleaner sources of energy. Centralised infrastructure for electricity distribution and transmission is estimated to result in an

	<p>average annual loss of 6% (EIA 2014; OFGEM, 2001). Centralised energy production creates waste heat, which is not utilised and therefore up to two thirds of energy produced is wasted. Decentralising energy with the introduction of district heating that combines heat and power could reduce energy waste by over 30% (See figure 3).</p> <p>This along with smart electricity grids, renewable forms of energy and smart appliances could all reduce energy demand due to a reduced requirement for resources.</p>
Social behaviour	<p>Modern themes within society in the UK have gravitated towards consumer culture, in which there is an intrinsic link between energy consumption and living standards (Shove and Warde, 2002; Slater, 1997). Attempts to decouple living standards and energy consumption are argued to be realistic ways in reducing energy demand (Cullen et al, 2011). Rethinking the way people use electricity, heat buildings and power transport can have significant impacts on energy demand; however the challenge often lies with motivating changes without negatively impacting consumers.</p>

Efficiency of Combined Heat and Power (CHP) generation

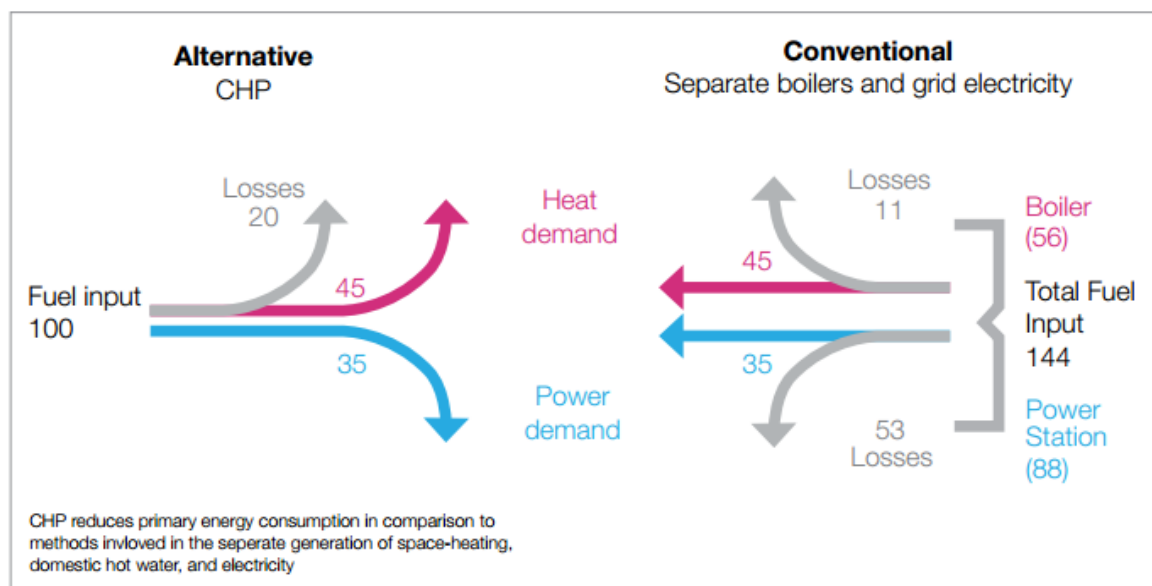


Figure 3: Efficiency of Combines Heat and Power (CHP) compared to conventional centralised generation. (Source: ARUP, 2011).

(2.2) Reducing energy demand

The need to reduce GHGE to mitigate climate change is clear, however challenges lie within achieving significant reductions. Willis and Eyre (2011) state that reducing energy demand is more cost effective compared to targeting supply. Keepin and Kats (1988) argue that energy efficiency measures can provide 2.5 to 10 times the emission savings compared to nuclear, however Brookes (1990) has since argued the accuracy of these findings. Domestic energy consumption, in particular domestic heating, contributed to a 3% rise in UK GHGE in 2010 as a result of a unusually cold winter (DECC, 2011a). This highlights the weighting of domestic energy demand in the UK towards GHGE, along with presenting the potential GHGE savings of reducing energy demand.

Hillebrand (2013) uses Germany's energy market to highlight successful energy demand policy in reducing GHGE. The paper identifies increases in energy efficiency, along with decentralising energy markets, to be the predominant factors in reducing energy demand. Utilising renewable resources to create local supplies of energy reduces energy losses from transmission, this combined with increasing energy efficiency within buildings resulted in Germany's 2014 energy consumption levels falling by 4% from 2013 levels (Morris, 2015) (See figure 4).

German energy consumption in 2014 at the lowest level since reunification

Primary energy consumption by source in Germany



Figure 4: Preliminary data of Germany's energy consumption from 1990-2014. (Source: Energy Transition, 2015).

Decentralising energy markets allows regions to utilise local energy resources, along with adopting energy management strategies that are created in a bottom up approach.

Stern (1992) argues a research bias towards conservation-behaviours and supply side fixes, rather than focusing on the barriers to reducing energy demand. Shove (2009) also raises the issue that despite an abundance of research surrounding the motivations of energy consumption, policy makers are inefficient at initiating behavioural change towards sustainable consumption.

(2.3) Understanding energy demand

Fouquet (2010) states 'Energy sector change is driven by bottom up approaches', arguing that to initiate long term energy demand reduction, social behaviour must be addressed in which local approaches are needed. Increasing energy efficiency and technology alone does not address the reasons behind energy consumption, and therefore only acts as a short term fix. Kuzemko (2013) discusses that consumers must be educated about why reducing energy demand is important, as in order to create a long-term change in energy consumption, consumers must be willing to participate in a shift towards a low carbon energy economy. Environmental awareness and responsibility must

become a theme within communities, in order to highlight the true cost of energy consumption. Mitchell (2008) raises this issue, arguing that as the UK energy sector is market led with a focus on price, consumers must be educated on the benefits of reducing energy consumption, as the environmental costs of energy use are currently not made fully aware to consumers. This highlights the importance of research that helps develop methods of educating consumers about energy consumption.

Although educating consumers will increase environmental awareness and responsibility, it will not necessarily result in changes in consumption. Caseldine (2012) discusses that the results of mitigating climate change cannot be observed within an immediate timeline, and therefore although people know it is a threat, it may not be a threat in their lifetime. Ford and Church (2009) found that consumers will only permanently change energy consumption patterns when they are in control of their actions and can witness results, rather than performing to please an external body. This would suggest that education alone will not prompt a change in energy consumption and therefore highlights the importance of research towards exposing the consumer benefits of sustainable consumption.

(2.4) Critique of policy attempts

Cullen et al, (2011) discusses that demand side policies are commonly viewed as unpopular by governments, and as a result often neglected due to the perception that energy consumption and living standards are intrinsically linked. Energy demand side policies, such as increasing a building's energy efficiency, often require locally tailored strategies due to varying building materials. This conflicts with the UK's predominant measures to reduce GHGE, characterised by top down, institutionally structured approaches that favour supply side fixes (Hoffman and High-Pippert, 2010).

Eyre (2011) and Shove (2009) both express that demand side policy often fail to reduce consumer energy demand as they do not address issues behind energy consumption, such as educating consumers on reasons to lower energy consumption. Implementing energy demand reduction policy without educating consumers, such as increasing a household's energy efficiency, can result in the rebound effect (Greening et al, 2000). An example of this is when an increase in energy efficiency results in an increase in energy consumption due to lowered costs per unit of energy. Demand reduction policy may also have wider implications at a range of scales which can counteract carbon offsetting (see table 5):

Table 5: Rebound effects of energy demand policy

Energy policy	Possible rebound effect
Increases in energy efficiency	Energy is required for the manufacture, transport and installation of equipment to increase energy efficiency.
Reductions in consumer energy consumption	Surplus consumer savings on energy bills may be used on carbon intensive goods, for example a holiday requiring a flight.
Increases in energy affordability	Cheaper energy bills may result in increases in energy consumption.

Increasing energy efficiency within fuel-poor homes is particularly susceptible to the rebound effect as they are previously unable to heat their homes to comfort levels, and therefore once energy costs are lowered, they will increase their energy consumption levels (Guertler, 2012). Howden-Chapman et al, (2009) conducted a study that found people prioritise heating their homes to comfortable temperatures over saving money.

Despite previous policy attempts and an increased public awareness surrounding climate change (Lorenzoni et al. 2007), UK household emissions have failed to significantly decrease during the period of 1990-2011 (DECC, 2011b). Fluctuations are likely due to changes in external temperatures and financial climates, rather than policy implementation (ONS/DECC 2012). However external factors, such as population and consumption changes, may be the dominant cause of the failure to significantly reduce domestic emissions, rather than policy having no impact, highlighting a need to address offsetting factors within energy demand.

Trends in social norms have shown a shift towards households increasing energy consumption. Figure 5 shows that between 1970-2008, housing with central heating increased from 36% to 86%.

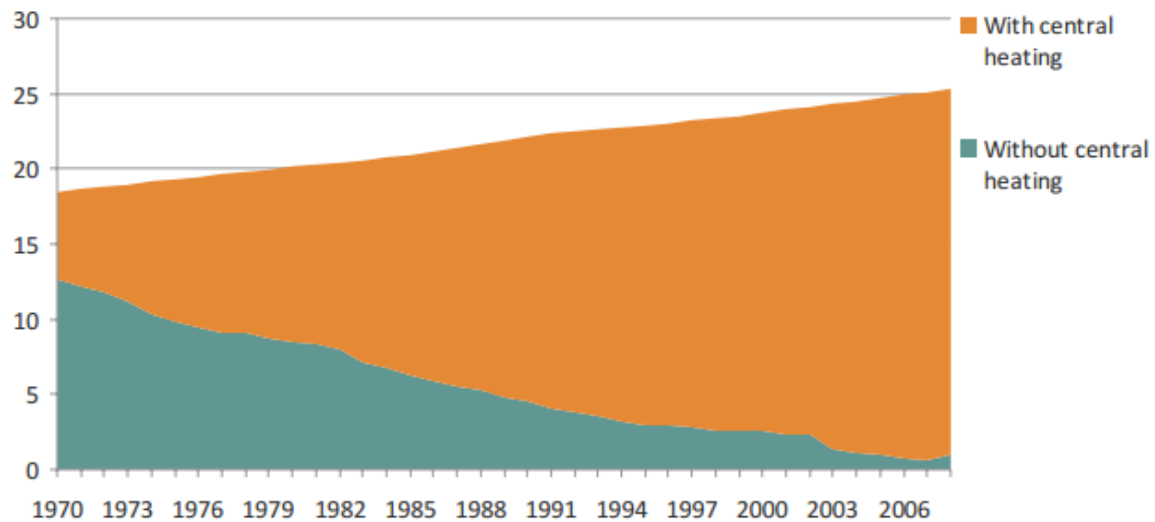


Figure 5: UK Households with central heating (millions). (Source: Palmer et al., 2011a)

This brings with it the risk of inefficient energy use, due to the unnecessary heating of an entire house, rather than only the occupied rooms. Shove (2010) discusses how ‘T-shirt’ temperature within households has emerged as a social norm within the UK, in which the average UK household internal temperature has risen from 13.7°C -17°C from 1970-2008, despite milder winters (see figure 6), (Palmer et al., 2011c).

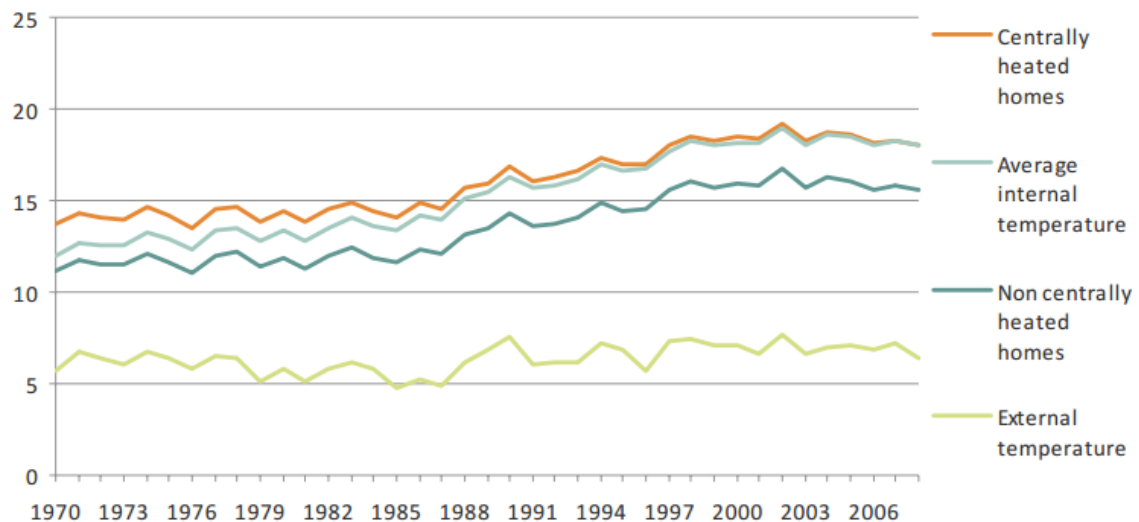


Figure 6: Average winter internal and external temperatures. (Source: Palmer et al., 2011c).

Shove et al (2008) discusses this issue to highlight a need for energy demand policy to address behavioural issues surrounding energy consumption, as society will not initiate a long-term shift towards sustainable consumption if it is inconvenient or perceived as undesirable.

A rising population can counter-act emission reduction attempts and is described by Boardman et al, (2007) as a major barrier to reducing energy demand. There is also the issue that average life expectancies are rising, and therefore the UK is experiencing an aging population (See Figure 7).

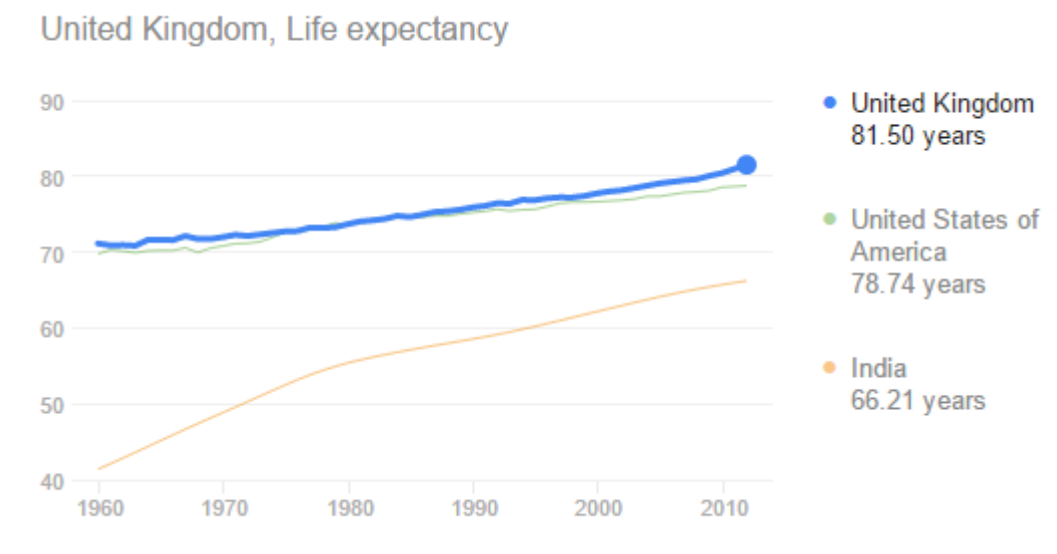


Figure 7: UK life expectancies from 1960-2015. (Source: World Bank, 2015).

Studies have found that those above the age of retirement (>65) spend on average above 85% of their time at home, which results in a 50% higher energy requirement to the national average (HL, 2005). Kronenberg (2009) found that an ageing population poses a significant risk to domestic emissions levels, as although travelling less, their increased requirement for heating will lead to an overall increase.

Market based measures that incentivise increases in energy efficiency through lower energy bills can be hindered by factors that are non-technical or economic (Caprioglio, 1988). Landlords who let property do not benefit directly from reduced energy bills that are the result of increases in energy efficiency (Shove, 1998). When tenants are not responsible for their energy bills (i.e. the landlord pays utility bills), they have no incentive to reduce energy consumption on price alone. Tenants are also unlikely to invest in energy efficiency measures if they are unlikely to stay the duration of time required to experience the financial benefits of their investment (Howarth and Anderson, 1993). This dilemma is reflected by private rented accommodation having the lowest number of loft insulation in the domestic building sector (Utley and Shorrick, 2006).

The Green Deal is fundamentally based on the 'Golden Rule' (see table 2), this means it is reliant on market-based instruments, in which the defining factor is price, and therefore the cheapest option is chosen rather than the greatest carbon saving option. This is reflected by the largest uptakes being loft-insulations, followed by cavity-wall insulations. This creates a disadvantage for Hard-to-treat (HTT) homes (i.e. Properties that are off the gas network, Have no loft space, solid walls, High rise blocks), as the costs of increasing their energy efficiency is much higher, and therefore creating difficulties achieving the Golden Rule. HHT homes also contribute largely to domestic emissions, as they represent 38% of England's housing. Therefore the Green Deal excludes a large proportion of UK domestic emissions (CSE, 2011). This also brings social issues as 70% of properties in rural regions of England are categorised as HTT, compared to 35% in urban areas (CSE, 2011). This indicates that the Green Deal potentially excludes large regions of the UK.

Michael-Roberts (2012) argues that the UK government's strategy to reduce emissions through the Green Deal and ECO, has not learned from previous attempts, and fails to provide a fair deal for business, consumers and the climate. This is down to failing to address several issues that include attractiveness to consumers, education, decarbonising energy supply and the rebound effect. In particular the main issues lie with high interest rates of 7.5% for consumers, prioritising the cheapest strategies over those with the largest carbon savings, and exclude a large proportion of UK households.

This further implicates the need to increase research surrounding effective energy demand policy, in order for the UK to meet its emission reduction targets, as space heating contributes the largest percentage towards domestic energy use (Palmer et al., 2011b).

(2.41) Summary of issues and challenges

Table 6: Issues and challenges in reducing energy demand policy makers face.

Issue	Challenge
Demand side policy unattractive	Highlighting the benefits of reducing energy consumption to consumers
Lack of education	To increase environmental awareness and responsibility
Unsustainable social values	'T-shirt' temperatures and what is seen as 'comfortable' living must be addressed
Population changes	Increasing populations and rising life

	expectancies call for measures to focus on increasing energy efficiencies in a way that is available to all
Focus on price	Including environmental values within costing
Varied UK housing infrastructure	Addressing all types of building throughout the UK in order to increase energy efficiencies in all areas (i.e. rural and urban)

(2.5) Community energy

The potential for community energy in reducing the UK's GHGE has been widely acknowledged in literature, along with experiencing growth in the government support and funding available, as the benefits extend to economic regeneration, increased energy security and public engagement for low carbon forms of energy (Hain et al., 2005; Hinshelwood, 2001; Walker, 2008). Jaccard et al. (1997) identifies community energy as a realistic option to reduce GHGE as it presents the opportunity to implement renewable sources of energy, engage communities over energy issues, utilise an area's resources and increase energy efficiency with localised energy distribution. Jaccard et al's (1997) research concludes that the effectiveness of community energy initiatives to reduce GHGE is dependent on the availability of funds, along with having motivated individuals within the initiatives. This coincides with research from Elias and Victor (2005) and Lomborg (2007), which theorise that countries are most effective at reducing their GHGE once they reach a level of development in which they can provide funding for low carbon energy developments, such as community energy initiatives. This allows energy consumption and living standards to be decoupled as increases in energy efficiency along with the utilisation of renewable energy sources reduces energy demand, and reliance on fossil fuels, without a change in consumer behaviour.

Community ownership within community energy initiatives; in which residents own shares, or a community benefits from profits, has seen increased public acceptance and involvement of renewable energy developments (Devine-Wright, 2005; Stamford, 2004). This acts as a solution to Ford and Church's (2009) dilemma of consumers requiring observable results in order to change energy consumption, as community ownership allows communities to benefit directly from surplus energy production, and therefore encourages sustainable energy consumption. Hoffman et al (2013) present the issue that community energy initiatives are only adopted by environmentally aware communities; however community ownership may act as a solution to this as communities benefit

directly from community energy initiative's successes. Peters et al (2012) discusses that community involvement within community energy initiatives can encourage further renewable development due to influences and relationships between neighbouring communities. This indicates that community ownership incentivises communities to participate in community energy initiatives for reasons other than just environmental motivations.

Community energy initiatives within the UK have already proven successful in lowering GHGE at a range of scales through increasing renewable energy sources. The Wadebridge Renewable Energy Network (WREN) formed with a goal to keep money spent on energy within the local economy by making use of local natural resources. Over £900,000 is generated annually which is kept within the local economy, along with an annual carbon emission reduction of 1717 tonnes (LEAP, 2013). Small scale projects such as Gorran Highlanes provide participating residents with a 3-4% revenue return on investments with an installation of 2 wind turbines (CPC, 2015). The potential for community energy initiatives to act as vehicles in demand management has been highlighted by Wood and Newborough (2013). Their study found that increasing awareness of energy consumption within community energy initiatives in British Columbia, through installing smart meters, led to a reduction in energy consumption by 30%. However there is a lack of research addressing effective methods for community energy initiatives to address energy demand in the UK.

(2.6) Summary

The potential of reducing energy demand in lowering GHGE has been established throughout the literature mentioned. Current attempts by the UK to utilise energy demand management have been heavily criticised, and therefore highlighting the importance of further research towards effective demand reduction. Community energy has been described as a realistic option to help develop a low carbon energy economy, while at the same time addressing inefficiencies within the current centralised energy market. Examples abroad have shown how community energy initiatives have effectively lowered energy demand; however there is a lack of research assessing the opportunities and challenges for community energy initiatives to address energy demand in the UK. Can the community aspects of community energy initiatives increase successes in motivating sustainable energy consumption? Where do the opportunities and challenges to reducing energy demand lie within community energy initiatives and how can policy support these? Can community energy initiatives act as effective vehicles in energy demand management? These questions will form the foundations of this dissertations methodologies and analysis.

(3) Methodology

This section will discuss the methodologies used to answer the research questions of this project. It will outline the different approaches used to gather primary data along with justifying this approach. Participants of this project will be listed along with their specific roles within their organisation. The limitations and reasons for rejecting alternative methods will be explained.

Following successes in similar research projects conducted by Michael-Roberts (2012) and (Higgins, 2012), this project adopted a qualitative approach. This approach allows the researcher to gain in-depth detailed data which captures attitudes, insights and behaviours towards a topic, rather than the purely statistical data that quantitative research provides. This also allows the opportunity for new themes to be introduced due to the open structured nature of the research methods (Flick, 2009).

(3.1) Collective case study

A collective case study will be developed using a range of community energy initiatives to highlight different approaches adopted towards energy demand management. Stake (1995) identifies this approach to allow researchers to gain an insight into an issue through identifying a range of examples that address similar topics. Examining case studies offers a means of investigating and understanding complex social issues that involve multiple factors contributing to a phenomenon (Berg et al, 2004). Table 7 gives a description of the organisations used in this project.

Table 7: Organisations used in this project

Organisation	Description
Community Energy Plus (CEP)	Social enterprise that works in partnership with a variety of public, private and third sector organisation (including community energy initiatives) to support innovative projects relating to energy efficiency and renewable energy.
Community Power Cornwall (CPC)	Co-operative with the aim to help the delivery of community energy initiatives in Cornwall.
Regen SW	Independent not-for-profit organisation working with industry, communities and the public sector to revolutionise the generation, supply and use of energy.

South West Devon Community Energy Partnership (SWDCEP)	Partnership that works closely with community groups and local authoritative groups with the goal of creating a more sustainable energy future.
Wadebridge Renewable Energy Network (WREN)	Not-for-profit company/ community energy initiative that utilises local community action to implement renewable resources and manage energy demand.

(3.2) Interviews

A semi-structured approach was adopted for the interviews in order for the interviewee to expand on topics and give their own insights and perspectives, while at the same time guiding the interview towards the topic of study (Cohen and Crabtree, 2006). This approach also allows interviews to encourage open-ended discussions that are not constrained to the limits that surveys typically experience, in which structured questioning poses the risk of unintentional bias in responses (Langevin et al., 2012). The informal nature also allowed the interviewee to feel comfortable in discussing relevant topics in order to fully understand the context of the interview along with introducing relevant information to increase the accuracy of the findings (Conrad and Schober, 1999). Interview questions were adapted towards each interviewee's experience and expertise surrounding the research topic, in order to gain insights that were unique to the participant.

(3.3) Pilot interview

To gain an estimate of time required for each interview a pilot interview was conducted on colleagues. This revealed that interviews would last between 30-45 minutes. The purpose of the pilot interview was also to confirm that the semi-structured approach was appropriate, along with allowing time to practice and refine questions. The pilot interview highlighted the importance of allowing time for the interviewee to express their thoughts on topics and issues which had not been touched upon with initial questions.

(3.4) Interview structure

Face to face interviews were used when possible as Opdenakker (2006) discusses that social cues, such as body language, can give the interviewer extra information on top of the verbal answer to a question. Telephone interviews were used as an alternative. Although concerns have been raised over the quality of data from telephone interviews compared to those face to face (Burke and Miller

2001), Jordan et al's (1980) study found little difference in quality of data collected from telephone and household interviews.

The location and times of the interviews was decided by the interviewees following recommendations from Longhurst (2003) as this allows the interviewees to feel comfortable and pick a schedule that would not rush them for time, which in turn increases the chances of gaining insightful data. Consent was gained from each interviewee to record each interview with a Dictaphone; this method was used to eliminate the distraction of a constant pressure of writing notes (Valentine, 1997).

(3.5) Data collection

Interviewees were selected based on their involvement within different community energy initiatives, in order to gain relevant information regarding the research questions of this project. A variety of stakeholders were interviewed to gather different perspectives to avoid bias within the results. Table 8 identifies participants and their roles within community energy initiatives.

Table 8: List of Interviewees

Interviewee	Organisation and role
David Atfield	WREN, Academic and Student Liaison.
Householder 1	Consumer, Resident involved within a community energy initiative in which their community part owns renewable energy generation sources.
Householder 2	Consumer, Resident involved within a community energy initiative in which their community part owns renewable energy generation sources.
Jerry Clark	WREN, Technical Director.
Kate Royson	SWDCEP, Coordinator.
Neil Farrington	CEP, Senior Manager in Renewables and

	Communities.
Nicola McCheyne	CEP, Senior Manager in New Projects and Energy Policy.
Olly Frankland	Regen SW, Business Support Manager.
Paul Martin	CPC, Executive Director.
Sam Angwin	WREN, Operations Assistant.

(3.6) Analysis

The information gathered from interviews was transcribed using the method of thematic coding. This process allowed data to be categorised into themes in order to compare data gathered from different interviews (Flick, 2009). Thematic coding also allowed the extraction of quotations to support viewpoints, along with providing insight on topics raised.

(3.7) Limitations

Table 9: Limitations of project

Limitation	Description
Applicability to wider populations	Walker (2008) identified that community energy initiatives are often only driven and adopted by environmentally aware individuals, and therefore results gained in this project may contain an element of bias and may not be applicable to wider populations.
Time constraints	Time constraints limited the number of community energy initiatives used within the collective case study, and therefore results may not give a definitive representation of all community energy initiatives. This also limited the number of individuals that were interviewed as several public figures within community energy initiatives were not available during the time period of this project.

Questionnaire	A questionnaire designed for residents within the chosen case studies was rejected due to a low response rate, limiting the representation of householders to several interviews.
Nature of the topic of study	Due to the nature of the topic of study, participants within the project may refrain from giving honest answers that they believe reflect badly on them/ their organisation (i.e. wasteful energy consumption and lack of successes in strategies).
Bias	Finally the qualitative aspects of the research also create possible bias due to the researcher's personal biases and idiosyncrasies (Marshall and Rossman, 2010). Therefore the results and analysis in the following sections should be seen in light of this.

(4) Results and analysis

(4.1) Overview

This chapter will discuss the findings gained from this project's primary research methods (see chapter 3) in order to address the proposed research questions (see chapter 1.6). This chapter will present key themes that were unearthed in a structure that follows the order of the research questions; firstly outlining how community energy initiatives address energy demand. Secondly discussing the key barriers to energy demand reduction that community energy initiatives encounter, thirdly how these barriers can be overcome, and lastly where the opportunities lie for community energy initiatives to effectively manage energy demand.

(4.2) How community energy initiatives address energy demand

Table 10 presents the dominant strategies adopted by the examined community energy initiatives in an attempt to reduce energy demand.

Table 10: Community energy initiative's approaches towards energy demand reduction.

Strategy	Description
Energy efficiency	This involves retrofitting properties in order to increase

	energy performances. An example of this is loft or wall insulation. This allows consumers to reduce their energy consumption without altering their everyday routines.
Energy monitoring devices	The distribution of devices such as smart meters. These devices provide consumers with data concerning their energy usage at different times of the day. This allows consumers to increase their energy usage awareness to highlight where they can reduce their energy consumption.
Managing energy demand periods	Providing incentives to shift energy demand to times of peak renewable outputs. This can involve high tariffs during times of high solar output to incentivise consumers to use appliances during the day, as opposed to evenings. Other examples showed the distribution of slow cookers to allow consumers to cook during daytime working hours, rather than evenings.
Behavioural change	Encouraging consumers to reduce energy consumption by highlighting the environmental impacts of GHGE. This involved providing information on ways to reduce energy consumption. An example of this was informing consumers on alternative forms of transport available to use other than their car.

(4.3) Key barriers

Multiple barriers were raised by representatives of community energy initiatives, with many barriers being interlinked and differing from initiative to initiative. Several key themes emerged throughout the interviews which have been categorised into the following:

- Finance
- Public Engagement
- Education
- Government Policy
- Strategy

(4.31) Finance

A key barrier present among interviewees was a challenge to satisfy financial demands to sustain community energy initiatives in achieving their objectives. These financial barriers were categorised as:

Reliance on funding

Interviews revealed that a key barrier for community energy initiatives to manage energy demand was a reliance on funding. It was highlighted that many consumers were unwilling to provide upfront investments towards energy efficiency measures or methods to increase their energy awareness such as smart meters.

“Many consumers do not want to undertake measures if they are required to pay for it, despite the long term savings they may gain... People will happily spend £10,000 on a new kitchen, but not on making their house more energy efficient.” (WREN. Source: Author Interview).

This has resulted in schemes to retrofit housing reliant on government funding programs, such as ‘The Green Deal’, along with the successful distribution of smart meters dependant on sufficient levels of funding. This also presents a challenge in that consumers are not fully aware of the financial benefits of increasing a property’s energy performance, as aesthetic improvements such as a new kitchen are seen as more desirable.

Financial strategy

A common issue was that large proportions of consumers are comfortable and can afford their energy bills, and therefore have no incentive to pay for energy saving advice. Consumers suffering from fuel poverty do not have disposable incomes, and therefore cannot afford energy saving advice. This creates difficulties in generating a sustainable income for community energy initiatives purely from offering energy advice, further implying a reliance on funding. It was highlighted by CPC that community energy initiatives must have established viable financial planning and governance structures in order to obtain funding. A negligence of these aspects has previously seen projects with suitable renewable development sites rejected. This issue has created challenges for community energy initiatives, whose initial goals are to reduce energy demand, as focusing on this solely will not always generate an income. This raises the question as to can community energy initiatives act as a viable business through primarily focusing efforts on reducing energy demand. A predominant reliance on funding increases an organisation’s vulnerability, and therefore changes in government policy can dictate their existence (Berger and Udell, 1998).

Interviews with CEP revealed that community energy initiatives are often reliant on volunteers, however providing accurate energy advice, regarding up to date policy, requires a full time post that many volunteers cannot commit too. Ideally a professional is needed to fill this position in an accessible location for a community, as has proven successful with WREN's energy shop. However the challenge lies with funding this position as a CEP representative discussed that "We are yet to find anyone who is willing to pay for energy advice", further indicating a reliance on funding for community energy initiatives to reduce energy demand.

(4.32) Public Engagement

Engagement between local organisations and communities has been argued as essential in initiating behavioural change toward sustainable practices (Peters et al., 2010). As highlighted by Shove et al. (2008), individuals will not change energy consumption patterns if it creates inconveniences for them. Local organisations therefore must work closely with communities in order to create convenient solutions towards lowering energy demand. This view was agreed upon by all those interviewed, with a common consensus that community energy initiatives must work closely with local communities in order to develop effective solutions towards energy demand reduction. Despite acknowledging public engagement as a crucial element in reducing energy demand, many of the organisations interviewed revealed they experienced challenges in effectively engaging communities due to the following reasons:

Scepticism and mistrust

It became clear that trust between communities and community energy initiatives was essential in successfully engaging the public. However it was identified that community energy initiatives, in their early stages of development, often experience scepticism and a degree of mistrust with consumers, as they believe that the initiatives may have hidden agendas that may not be beneficial for the consumer.

"Large volumes of cold calls [an unsolicited visit or telephone call, in an attempt to sell goods or services.] from private firms pushing hard sales for things such as solar panels have created suspicions around several of the initiatives we have worked with."
(SWDCEP. Source: Author interview).

This creates an issue that community energy initiatives have difficulties in distinguishing themselves away from cold calls. This issue was reflected in interviews with consumers, as it became clear that they did not trust, or give their attention, to organisations/ companies that they were not familiar with, due to receiving large volumes of cold calls. This was reflected by several community initiatives

discussing that a major issue they experienced while engaging with communities was establishing that their goals aimed to benefit the local community, not exploit them for profits.

It was discussed by several community energy initiatives that negative press surrounding The Green Deal had resulted in poor uptake by their communities. This had led residents to believing that they could receive better deals by financing energy efficiency measures privately. This was reflected by WREN, who explained the acceptance of Green Deal assessments was high, however the uptake of Green Deal packages was low, indicating that residents believed the Green Deal was not entirely beneficial or that they were better off going elsewhere. This is reinforced by statistical data showing households have undergone 445,000 assessment reports, but only 8,200 have up taken financial plans (Howard, 2015). In some cases it was described that this issue had resulted in trusted local suppliers not signing up with The Green Deal due to the paraphernalia associated with it, which in turn discouraged consumers as they cannot obtain installations through suppliers they trust. Building on this issue, it was revealed that several community energy initiatives have experienced trouble with installers due to poor communication and low industry standards. This has previously resulted in rushed, unfinished and unsatisfactory energy efficiency instalments that left consumers displeased, with the only point of contact with the community energy initiative. This has damaged the reputation of several community energy initiatives and created further degrees of mistrust. This highlights a need for higher industry standards, and a demand for information regarding reliable installers shared between community energy initiatives to ensure customer satisfaction is met.

Community participation

It became clear that several community energy initiatives' demand reduction schemes had struggled to effectively engage with their local communities, which was reflected by low participation rates. It was highlighted by SWDCEP that setting up workshops with the aim to educate consumers on methods to reduce energy consumption requires time, effort and capital. When attendance of these events is low, valuable resources are wasted and morale is impacted, discouraging future efforts. It was also discussed that workshops may not influence sustainable behavioural changes across a whole community;

"Participants within workshops do not always represent whole communities; instead sometimes they are predominantly those with spare time on their hands, for example retirees" (SWDCEP. Source: Author interview).

Several of the initiatives revealed that previous energy demand reduction schemes had received low participation levels in rural areas when focusing on leafleting and workshops alone. This theme arose several times, with a consensus that schemes focusing on singular methods of public engagement

would often receive reduced participation levels, therefore presenting a need to increase resources targeted towards engaging communities.

(4.33) Education

The need to increase education around the benefits, and desires to reduce energy consumption, among consumers was a theme that repeatedly arose during the interviews. The challenges were categorised into:

Technology

Interviews with household consumers within a community energy initiative, aimed at managing the purchase of energy, revealed that the distribution of smart meters was not always enough to increase a consumer's energy consumption awareness. When discussing smart meters during a consumer interview it was stated that:

"It is still here in the box because it seems too fiddly to install. It says you need things like a powered USB, internet connection and so on... If someone came and plugged it in and showed us how to use it I would use it." (Householder 1. Source: Author interview).

This highlights that distribution alone will not always lead to an increased use of smart meters, therefore presenting a need to have professionals install and educate consumers on how to operate and understand a smart meter fully. This also highlights that the availability of technology to promote reduction in energy demand is not the sole factor in reducing energy demand as it must be accompanied by sufficient levels of education to ensure effective use and understanding. However this also increases financial challenges experienced by community energy initiatives.

It was revealed that the information regarding the actual cost of energy efficiency improvements were unclear among consumers.

"Private companies offer consumers deals if they sign up within x amount of days in order to push a hard sale, however even with these discounts the prices are often still much higher than the actual costs as these companies are trying to maximise their profits." (WREN. Source: Author interview).

Consumers are advertised false information regarding the costs of energy efficiency improvements which can make them unattractive, highlighting asymmetric information within the market.

Understanding the need for reduced energy consumption

A challenge that emerged was that consumers wanted to know quantifiable data on how much money they would save once installing energy efficiency measures, however this information is not

always available/ guarantee-able as it is dependent on the consumer's energy usage. It was revealed from multiple community energy initiatives that consumers had returned, after undergoing energy efficiency improvements, complaining that they were not seeing the savings they expected, however this was due to a misunderstanding of the potential long-term benefits. "We are working against a degree of reduced understanding" (WREN. Source: Author Interview).

Many consumers expected short term results and were not interested in the long-term benefits. An issue also emerged that due to lowered energy bills, a proportion of consumers had increased their energy consumption as they could raise their comfort levels at no extra cost. This supported findings from Guertler (2012), presenting a need to educate consumers on the external benefits and desires to reduce energy consumption, in order to maximise potential carbon savings of energy efficiency instalments.

(4.34) Government Policy

Government policy emerged as the largest barrier towards effective demand reduction due to the following reasons:

Uncertainty

A significant barrier identified by interviewees representing community energy initiatives was the uncertainty, and a lack of longevity within government policy to support energy demand reduction. Constantly changing political agendas create issues when planning long term, due to uncertainties over funding streams. This issue was strongly expressed by CPC, as changing political agendas have negatively impacted the development of renewable energy, and hence impeded the ability for community energy initiatives to reduce dependences on fossil fuels and lower consumer energy consumption. This indicates a reliance on public sector support for community energy initiatives to act as effective vehicles in energy demand management.

Short term policy to reduce energy demand for carbon intensive sources, i.e. tariffs on solar energy, was described to have created several problems;

"Short term policies that are subject to change, for example solar tariffs, have led to companies cropping up and dissolving once a change in policy occurs. We have seen people enter long term contracts on roof leases for solar on the premise of receiving a high tariff for solar energy, however if the tariff drops, it's no longer attractive to them, which in turn prevents us from leasing the roof for solar installations." (WREN. Source: Author interview).

This highlights that the emergence of companies aiming to exploit short term policy can prevent community energy initiatives in supporting the reduction on energy demand for low carbon sources, when changes in policy occur. Interviews with consumers highlighted further issues with the emergence of companies based on short term policy;

“We constantly receive nuisance calls from companies trying to sell solar panels to us on the basis on high tariffs; however we have friends who have bought into these schemes and not received what they were expecting... It has given us an element of mistrust as to the motives behind some community energy initiatives” (Householder 2. Source: Author interview).

The issue of mistrust within consumers arising from uncertainties within government policy was highlighted by SWDCEP as consumers do not always receive the support they may have initially expected. This therefore negatively impacts public participation within community energy initiatives.

Planning

WREN called for a more “level playing field” in the distribution of funding for energy demand reduction schemes. It was described that when chances for ECO funding become available, larger companies acquire the majority of available funding within hours of its release, leaving no chance for smaller community energy initiatives to utilise it.

The Green Deal was criticised as being expensive for consumers in the long run, and therefore unattractive. It was discussed that the Green Deal’s high interest rates of 7% are not financially competitive;

“Most consumers can receive lower interest rates when putting costs of insulation measures onto their mortgages... This is reflected by a poor uptake of The Green Deal” (WREN. Source: Author interview).

However it was mentioned that despite the low uptake of Green Deal packages, the high uptake level of assessments indicates that consumers are interested in ways to reduce their energy demand. This may also suggest that consumers are going elsewhere once getting an assessment in order to receive a better deal, further indicating a need to re-evaluate how The Green Deal offers support to consumers.

Policy support for insulation was criticised due to the varied infrastructure across the UK. It was discussed that challenges had been created due to fitting properties into singular categories, whereas in reality older homes have had new sections built on over time, and therefore cannot be

so easily categorised. It became clear that there was a demand for more localised approaches in order to fully understand an area's housing stock and how it can be effectively treated.

Community energy initiatives within Cornwall highlighted a challenge that 56% of the county's housing is HTT, and therefore insulation measures may not result in sufficient carbon savings, meaning many homes fall out of policy support. This suggests that focus towards reducing energy demand must be done through varied efforts, rather than just increasing energy efficiencies. This created issues for several of the community energy initiatives interviewed as it became clear that reducing energy demand through initiating behavioural changes was more challenging than increasing energy efficiencies.

Agenda

A consensus emerged that consumers were most interested in lower energy bills, opposed to environmental concerns and reducing energy consumption. This indicates that consumers have a demand for energy efficiency improvements, as it lowers their energy bills. However it was highlighted by CEP that government agendas to lower the costs of energy could jeopardise this, as if energy is more affordable, then consumers are less concerned about reducing consumption. According to Guertler's (2012) research, this poses the risk of increasing energy demand due to the rebound effect (see table 4). This would also increase the challenges for community energy initiatives in encouraging consumers to undergo energy efficiency improvements, as the financial benefits are reduced, implicating a need to increase focus on behavioural change.

(4.35) Strategy

Several strategical barriers became present within interviews. The challenges identified are categorised into the following:

Monitoring

Several interviews revealed that a key challenge to reducing energy demand was difficulties in monitoring the impact of different schemes. An example given by SWDCEP was that loaning out smart meters at energy fairs to encourage consumers to reduce their energy consumption cannot always be monitored, and therefore its direct impact on energy demand reduction is unknown. A lack of quantifiable data prevents community energy initiatives from measuring exactly how successful different demand reduction strategies have been.

“You cannot always measure the full extent of energy usage before you implement a scheme, and therefore you cannot be full aware of the results.” (CEP. Source: Author interview).

Community energy initiatives conducting events, such as open homes, can also increase energy awareness amongst consumers, which in turn may lead to changes in individual's energy consumption. These impacts are unmeasurable as consumers are acting on their own accord, further creating issues monitoring impacts. Community energy initiatives can measure how many people attended an event, however it is unknown how many people will have taken action. Further challenges lie within measuring long term impacts of a scheme;

“You may have a big effect in the first 3 months, however after this period behaviour might rebound to what it once was... We do not receive funding to monitor the impacts a year or so down the line.” (CEP. Source: Author interview).

A lack of funding for ongoing monitoring prevents community energy initiatives from fully understanding the long term effectiveness of energy demand reduction schemes. To highlight this issue, smart meters were once again used as an example by CEP, as they had found that smart meters have different impacts when placed in different locations within a house hold, i.e. there is an optimal position. CEP have found households often keep smart meters in an optimal position for the first 3 months, however it is commonly moved to places of less effectiveness over time, and is eventually lost.

Organisational goals

Several interviews revealed that community energy groups commonly form to address unique local issues, and focus on these issues alone. If reducing energy demand is not a concern then they will not focus on it. Many do not explore what energy means for their area, instead focusing on providing quantifiable solutions to energy issues, i.e. building a wind turbine.

“The motivation is generally not around demand reduction. When they contact us, it is usually about how they can build a wind turbine or a solar farm... They generally never address the energy hierarchy or explore what energy means for their area” (CEP. Source: Author Interview).

Managing energy demand is therefore not always a priority for community energy initiatives as the benefits associated are not always fully understood or addressed. Building a solar farm can guarantee capital returns; however reducing energy demand cannot do the same. This therefore makes it less attractive from a business' view point and results in advice around energy consumption

to being reliant on funding. “We are yet to find anyone who is willing to pay for energy advice” (CEP. Source: Author Interview).

(4.36) Summary

This section highlights that community energy initiatives encounter several challenges when attempting to manage energy demand. The key issues lie within challenges in engaging local communities, reliance on funding and uncertainty within government support creating risk within long-term planning. Although several challenges were listed, the organisations interviewed believed that these did not prevent community energy initiatives from acting as effective vehicles in energy demand management, as many of these challenges could be overcome. These solutions will be discussed in the following section.

(4.4) How to overcome these challenges

The challenges listed in chapter 4.3 were described to act as the key barriers to preventing community energy initiatives from effectively reducing energy demand. However solutions to several of these challenges were recommended by those interviewed. These solutions are explained in table 11.

Table 11: Solutions to barriers listed in chapter 4.3

Challenge	Solution
(Finance) Reliance on funding and financial strategy	It was outlined by CPC that community energy initiatives can generate reliable income streams through the development of renewable energy sources, although this requires initial funding. It was discussed that if a community energy initiative’s loan is spent purely on reducing an area’s energy demand, through energy efficiency improvements, there will be no return for this investment. Instead to incorporate longevity, investments should be made to reduce a reliance on funding, for example developing a source of renewable energy generation alongside increasing an area’s energy efficiency. However CPC discussed that focusing purely on generating income streams, through renewable energy generation, runs the risk of community energy groups ignoring the energy hierarchy.

	<p><i>“If you install solar on leaky roofs, you are ignoring the energy hierarchy and not addressing fundamental energy issues within a community” (CPC. Source: Author Interview).</i></p> <p>Therefore a balance of the two is needed to satisfy longevity and effective energy demand reduction.</p> <p>A consensus emerged for a call to increase consumer’s awareness surrounding the benefits of reducing energy consumption, predominantly through energy efficiency improvements. It was suggested that a property’s energy efficiency and potential energy bill savings must be accurately portrayed in its total value. This would allow community energy initiatives to illustrate to consumers how much value they can add to their property through undertaking energy demand reduction measures, along with quantifying the costs they would save in the long-term.</p> <p><i>“Consumers are less concerned about reducing their consumption or saving the environment, they just want to reduce their energy bills” (WREN. Source: Author Interview).</i></p> <p>This highlights the potential of effectively illustrating the financial benefits to consumers, as energy efficiency improvements allow reduced energy bills without reducing consumption. Community energy initiatives can therefore act as information ports to advertise financial benefits.</p>
(Public Engagement) Scepticism and mistrust	<p>The most successful examples of schemes to reduce energy demand, discussed by the examined community energy initiative, all involved high levels of public engagement. A consensus emerged that to overcome scepticism and mistrust issues within a community, information must be spread by word of mouth by individuals within that community. To initiate this, information regarding the community energy initiatives should be available in trusted locations that consumers can discover on their own accord, for example in a GP surgery. Consumer interviews revealed that they became aware of their local community energy initiative via email and friends. These methods allowed them to conduct research in their own time</p>

	<p>and make a decision unpressured, and described this as an essential factor in joining their initiatives.</p> <p><i>“A key factor for me joining was that I had time to do my own research without anyone pressuring me to join.” – (Householder 1. Source: Author Interview).</i></p> <p>Other successful methods discussed included having trusted members of a community involved in the development of the community energy initiative. This along with aspects of community ownership ensured that residents within a community believed the community energy initiative had the local region’s best interests at heart, and therefore increased levels of trust, reinforcing Devine-Wright’s, (2005) and Stamford’s, (2004) research surrounding community ownership.</p>
(Public Engagement) Community participation	<p>Interviews with organisations, which had worked with multiple community energy initiatives, revealed that for schemes to engage communities successfully, multiple methods that support each other must be in effect. For example fliers should be distributed in trusted locations, with information regarding future events, such as fairs and workshops. This must be done with consistency, as continued exposure to the same methods increases awareness within communities as residents are exposed to an abundance of information in accessible locations. The energy shop model has proven successful in cases such as WREN, as it acts as a consistent location for residents to gain information regarding methods to reduce energy demand. As consumer interviews revealed, a defining factor in participation in community energy initiative schemes, was an absence of pressure to participate and an ability to conduct personal research to inform decisions. The energy shop model allows community energy initiatives to distribute information, from a known location, to communities in a manner that does not pressurise or force it upon residents, as they can come and go as they please. However it was highlighted that this method requires a community energy initiative to have already gained a degree of acceptance within a community.</p>

(Education) Technology	<p>It was discussed that technology, with the aim of increasing energy consumption awareness among consumers, must be distributed by professionals who can inform and demonstrate to consumers on how to use and understand the technology. This measure was suggested by the consumers interviewed in this project, as they often saw the technology as complicated and a hassle.</p> <p>In order to overcome asymmetric information surrounding energy efficiency improvements, it was suggested that community energy initiatives with focal points, such as an energy shop, can act as information hubs to provide consumers with information on actual prices of energy efficiency improvements. This would decrease the information gap between suppliers and consumers, and therefore make improvements more attractive to consumers due to an accurate portrayal of costs.</p>
(Education) Understanding the need for reduced energy consumption	<p>Howden-Chapman et al's (2009) claims were reinforced by the research collected, in which the majority of consumers were firstly interested in increasing comfort levels, followed secondly by financial savings, whereas environmental benefits were not a priority. This therefore indicated that information regarding the benefits of reducing energy demand should firstly relay comfort and financial benefits over those environmental in order to promote behavioural change. It was however revealed that consumers were interested in the degree of their energy savings in terms of the possible environmental benefits they may be achieving. This indicates that energy monitoring, possibly through smart meters, can educate consumers on their energy consumption, and hence prompt sustainable consumption habits when progress can be measured.</p>
(Government Policy) Uncertainty	<p>To overcome policy uncertainty, there was a common consensus towards a call for policy with longevity, in order to allow community energy initiatives to conduct long term planning without the risk of change. It was suggested that long-term intergovernmental strategies should be agreed upon in order to provide a solid framework for community energy initiatives to work</p>

	<p>alongside. It was also recommended that The Green Deal's 'Golden Rule' should include carbon savings within its cost benefit analysis as to support methods to achieve the greatest carbon savings, rather than just the cheapest route.</p>
(Government Policy) Planning	<p>The current top down approach towards categorising properties for energy efficiency improvements was heavily criticised by several community energy organisations interviewed. To overcome this a consensus emerged for a call to localise the distribution of funding, as local organisations understand an area's housing stock, and how to effectively address it. This view was particularly argued by organisations interviewed in Cornwall, as it was described that the region's uses of energy were the 'polar opposite' to uses in regions such as London.</p> <p><i>"Addressing energy demand in Cornwall compared to London are polar opposites, the two areas have completely different energy uses, infrastructures, demographics, political agendas... they couldn't be more different" (CEP. Source: Author Interview).</i></p> <p>WREN discussed the potential of the Domestic Renewable Heat Incentive (RHI) as a way to reduce energy demand for carbon intensive energy sources in HTT domestic properties that cannot achieve large increases in energy efficiency. Costs of renewable heating installations are recovered rapidly due to high tariffs received for energy generation. However cuts to the domestic RHI are making it unavailable and unattractive for third parties to do installations.</p> <p><i>"They have kick started an industry but taken the stool out from underneath it" (WREN. Source: Author Interview).</i></p> <p>The potential exists to overcome the challenge of reducing energy demand for carbon intensive sources in HTT homes, however government cuts jeopardise this.</p>

<p>(Strategy)</p> <p>Monitoring</p>	<p>Due to limited funds, the importance of communication, to share information, between different community energy initiatives was identified as crucial. This allows smaller initiatives to learn from previous schemes conducted by other organisations. Information regarding optimal smart meter locations and effective ways of public engagement can be shared to allocate funds efficiently.</p> <p><i>“Communication is key; many smaller organisations cannot afford to monitor their schemes in the long run, and therefore information regarding previous successful schemes crucial” (CEP. Source: Author Interview).</i></p>
<p>(Strategy)</p> <p>Organisational goals</p>	<p>To overcome financial strategy challenges in offering energy advice, it was discussed by several of the community energy initiatives that organisations can act as a point of contact between suppliers and consumers. Revenue can be generated through charging commission from suppliers for providing recommendations to consumers. Community energy initiatives can provide accurate information on how and where to go about undertaking energy efficiency improvements, with trusted local suppliers. Without a financial strategy for community energy initiatives to secure income streams, their sustainability comes into question, and therefore funding may be denied, highlighting the importance of this aspect within organisations.</p>

(4.41) Summary

This section highlights a consensus among interviewees that the existing challenges towards energy demand management do not act as a deterrent for community energy initiatives to manage energy demand. This section presents data to suggest that although community energy initiatives encounter challenges towards reducing energy demand, solutions to overcome these exist. This highlights the potential for community energy initiatives to effectively reduce energy demand.

(4.5) Opportunities to reduce energy demand

A clear consensus was present among interviewees that current government approaches towards energy demand reduction are not sufficient. A call for incorporating more bottom up measures within the current top down approach became clear.

“Energy use on one side of the country is the polar opposite to that on the other, and therefore you cannot roll out a one size fits all policy and expect results... More bottom up approaches are needed to utilise local knowledge to effectively engage communities.” (CEP. Source: Author Interview).

Community energy initiatives offer a bottom up approach towards addressing communities over energy issues, and therefore their potential in managing energy demand became clear within interviews. This section will outline the discussed opportunities community energy initiatives have to act as effective vehicles in energy demand management.

(4.51) Local approach

A consensus emerged that the largest opportunity for community energy initiatives to act as effective vehicles in energy demand management was utilising a local approach towards community engagement.

“The most important factor for successful public engagement was recognising that everyone within a community is an individual and finding something that will work for them and making it easy for them” (CEP. Source: Author Interview).

SWDCEP identified that an ability to engage communities in a street by street approach can result in high public engagement, as it encourages discussions over energy issues between neighbours. Consumer interviews revealed this to be a major aspect influencing shifts towards sustainable consumption, as those joining alongside neighbours incentivised interviewees to reduce energy consumption, as they felt part of a collective action. This reinforces Peters et al (2012) findings that communities have influence on nearby neighbours, which can result in increased participation within community energy initiatives. It was described that local approaches, such as open homes and energy fairs, incorporate social aspects, which are essential in community engagement.

“These events allow community energy groups and suppliers to engage with consumers on a person to person basis, rather than just looking at everything as number... It allows consumers to see things working on the ground rather than just theory” (Regen SW. Source: Author Interview).

Energy fairs are low cost and can put local suppliers in contact with consumers. Community energy initiatives can also benefit financially through referral fees. Therefore benefits are experienced by community energy initiatives, suppliers and consumers. However challenges can arise from dependences on volunteers at these events, due to unprofessionalism within marketing, which can result in reductions in attendances.

It was described that addressing local issues allows community energy initiatives to build trust within communities once community benefits become present. Trust can also be established through incorporating local representatives within an initiative. This also allows community energy initiatives to develop in-depth local knowledge. This suggests that different initiatives understand how to engage their local regions, opposed to larger organisations rolling out one size fits all schemes. WREN used an example of large scale loft insulation advertisements conducted by British Gas only resulting in 3 installations within their local region; however advertisements conducted by WREN for the same installations resulted in 200 installations. This highlights the opportunity for community energy initiatives to utilise local approaches to reducing energy demand.

Building trust within communities was identified as both a key challenge and opportunity, as once gained, residents view community energy initiatives as a reputable source of information. This leads on to the next key opportunity identified.

(4.52) Education

Once a community energy initiative has established itself within a community, research revealed that they had an opportunity to educate consumers on issues surrounding energy through increasing their local community's energy awareness. A significant strategy outlined was the distribution of energy monitoring devices to allow consumers to gain an understanding of their energy consumption patterns. This gives an opportunity to all residents within an area to increase their understanding over their energy consumption, opposed to solely the residents whose energy provider offers devices.

Consumer interviews revealed that if a community energy initiative was established as a reputable local source, they would accept information distributed via emails and phone calls. Along with this they expressed enthusiasm over consistent locations to obtain information regarding energy issues.

"I would find it very useful if there was an easily accessible shop that I could visit to find out about possible support [Regarding energy] might be available to me" (Householder 2. Source: Author Interview).

This presents the opportunity for community energy initiatives to act as information hubs to provide consumers with accurate advice towards available support towards energy reduction; this may include policy support, reliable local installers and methods to reduce energy consumption. This highlights the potential of community energy initiatives in increasing energy awareness.

(4.53) Strategy

The importance of partnerships and communication between community energy initiatives was discussed as an opportunity for initiatives to share information surrounding effectively engaging communities, local knowledge and accurate energy saving advice. SWDCEP described that establishing communication links between initiatives can allow successes in energy demand reduction schemes through learning from previous examples, in which different methods of public engagement had been failures or effective. CEP mentioned how community energy initiatives can be effective in engaging local residents, and therefore involving community energy initiatives in large scales schemes can increase public participation over multiple regions. This suggests that community energy initiatives can be effective tools in conducting energy demand policy, as they allow nationwide schemes to be implemented through local approaches.

It has been established that community energy initiatives can reduce demand for carbon intensive forms of energy through implementing renewables (Hain et al., 2005; Hinshelwood, 2001). WREN and CEP both highlighted that community energy initiatives also have the potential to reduce energy demand for carbon intensive energy sources through managing energy demand times. This can be achieved through incentivising energy consumption during peak times of renewable outputs through tariffs. CEP's Energy Fit Kitchens scheme is currently proving successful at shifting energy used for cooking towards times of peak renewable outputs, through providing slow cookers to consumers. This highlights community energy initiatives can be successful vehicles in encouraging behavioural changes towards sustainable energy consumption.

(4.54) Community ownership

Responses towards community ownership gained mixed responses from those interviewed, partly due to lack of involvement with projects including this aspect. However those interviewed with experiences of community ownership, within community energy initiatives, strongly praised it as a method to increase; public participation, acceptance for renewable developments, energy awareness and responsibility within communities, along with reducing NIMBY attitudes, reinforcing research conducted by Devine-Wright (2005) and Stamford (2004). It was explained that the reasoning for this was consumers are given a direct involvement with energy development, in which they benefit from the successes, which in turn increases energy awareness. This also has the

potential to increase the successes of energy demand reduction attempts by community energy initiatives, as residents are more likely to participate in schemes conducted by organisations of which they are stakeholders (Reed, 2008). However it was outlined that projects involving community ownership must relate back to the affected community, expressing how it will benefit them in order to avoid opposition from outspoken residents.

CPC used community ownership within Ladock Parish as an example of how it can engage local communities and spark debates over energy. Individuals who live or work within Ladock parish can join the organisation as a member for a fee of £2, in which members vote on how revenue generated from the renewable instalments is used to benefit the community. This resulted in the local community coming together over a real issue that benefited the local area, whereas previous events, such as local governance, had received low public participation. Examples were given of how providing financial incentives for residents, such as 5% returns on investments, can encourage public participation and support from residents who are not environmentally concerned. This also attracts investment towards projects in order to reduce reliance on funding. This presents an opportunity that by involving local communities, through community ownership, community energy initiatives can act as effective vehicles in energy demand management through effectively engaging with local residents.

(4.55) Summary

This section highlights several of the opportunities that allow community energy initiatives to act as effective vehicles in energy demand reduction. The key opportunity identified throughout interviews was that a local approach can successfully engage communities in ways that top down policy cannot. Community energy initiatives can address energy issues in a manner that is tailored towards local attitudes, and therefore satisfying Fouquet's (2010) call to address local behaviours and attitudes towards energy in order to promote sustainable consumption.

(5) Discussion and conclusions

This project contributes towards the knowledge surrounding effective methods to reduce energy demand, in an attempt to reduce reliance on carbon intensive forms of energy. The purpose of this dissertation was to assess if community energy initiatives can act as effective vehicles in energy demand reduction through answering the research questions laid out in chapter 1.6. The results of this project established the overarching challenges community energy initiatives encounter when addressing energy demand, while at the same time exploring the solutions to these challenges and

gaining an insight as to where the opportunities lie. In order for community energy initiatives to act as effective vehicles in reducing energy demand, the following categories must be addressed.

Public engagement

Coinciding with research from Shove and Warde (2002), public engagement was identified as a crucial component to effective energy demand reduction. It was described as both a challenge and an opportunity for community energy initiatives to engage with communities. Without effectively engaging a community, community energy initiatives are unlikely to influence behavioural changes towards sustainable consumption. However the local approach of community energy initiatives was seen as a successful way to engage communities, as effective public engagement was described as being dependent on recognising that everyone within a community is an individual in order to develop effective convenient solutions that are adapted locally. This further supports Fouquet's (2010) claims of the importance of bottom up approaches to initiate energy sector change.

Government support

It became clear that a lack of government support was the largest barrier preventing community energy initiatives from acting as effective vehicles in energy demand management, due to a heavy reliance on government funding. This supports Jaccard et al's (1997) findings that community energy initiative's ability to deliver change is dependent on the availability of funding. Uncertainty within policy has created issues in long term planning, and therefore the sustainability of several community energy initiatives. During the course of this dissertation a prime example of this issue arose, with the UK government ending support provided by The Green Deal on the basis of low uptake. Although undergoing much criticism, The Green Deal offered a form of financial support to reduce energy demand. Currently there is no alternative policy to replace the removal of The Green Deal, indicating a shift in political focus away from reducing energy demand. Plans are also announced for cuts in the feed in tariff, which will no doubt discourage the development of renewables. The implications this has for community energy initiatives highlight a need to become less reliant on government support, as future constrictions in government support would result in further reductions to their ability to manage energy demand.

Finance and coordination

Community energy initiatives must generate forms of income in order to sustain themselves and continually achieve their objectives. Examples showed that community energy initiatives can successfully generate income streams through acting as intermediaries between installers and consumers, through charging commission. However external forms of income generation were often

needed to finance demand reduction schemes, i.e. renewable installations. It was outlined that community energy initiatives can become less reliant on government funding through generating such income streams, and therefore more resilient organisations. Achieving a balance between financial planning, establishing governance structures and addressing energy demand was identified as crucial in the success of community energy initiatives.

It is argued in this paper that community energy initiatives have the potential to act as effective vehicles in energy demand management, if these factors are addressed accordingly. Main advantages lie within local approaches towards issues surrounding energy, in which community energy initiatives can engage local communities through locally adapted methods. However, coinciding with existing literature, the research collected further exposed community energy initiatives' reliance on government support. This implies that future changes in the UK's political agendas may determine community energy initiatives' effectiveness at managing energy demand. This therefore highlights the need to reduce community energy initiatives' financial dependence on government. Community energy initiatives have the potential to help the UK meet its 2050 GHGE reduction targets through effectively managing energy demand; however the key lies in developing viable business models in order for initiatives to become more self-reliant and therefore sustainable.

(6) Further Study

This dissertation highlights the potential of community energy initiatives in managing energy demand, however at the same time detrimental challenges were also unearthed. This highlights the need for further research into effective ways to overcome these challenges. In particular a call for research towards methods to reduce reliance on government support emerged. This study focuses on organisation within SW England, and therefore results may not be applicable to wider regions, expanding the collective case study would increase the accuracy of results.

(7) References

- Berg, B. L., Lune, H., and Lune, H. (2004). *Qualitative research methods for the social sciences* (Vol. 5). Boston, MA: Pearson.
- Berger, A. N., and Udell, G. F. (1998). The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle. *Journal of Banking & Finance*, 22(6), 613-673.
- Bioregional, (2012). Retrofitting district heating systems. [online] Available at: <http://www.bioregional.com/files/publications/hackbridge-retrofitting-district-heating-systems-may2012.pdf>. [Accessed 12 May 2015].
- Boardman, B. (2012). *Achieving Zero: Delivering future-friendly buildings*, Oxford: Environmental Change Institute.
- BP, (2015). *BP Energy Outlook 2035*. [online] Available at: http://www.bp.com/content/dam/bp/pdf/Energy-economics/energy-outlook-2015/Energy_Outlook_2035_booklet.pdf [Accessed 23 Feb. 2015].
- Brookes, L. (1990). The greenhouse effect: the fallacies in the energy efficiency solution. *Energy Policy*, 18(2), 199-201.
- Burke, L. A., and Miller, M. K. (2001). Phone interviewing as a means of data collection: Lessons learned and practical recommendations. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (Vol. 2, No. 2).
- Caprioglio, P. (1988). Evaluation of the Energy Demonstration Programme, Energy Efficiency and Renewable Energy Projects. *CEC, Directorate General for Energy*.
- Caseldine, C. (2012). Conceptions of time in (paleo) climate science and some implications, *Wiley Interdisciplinary Reviews: Climate Change*, 3, 4, 329-338.
- Centre for Sustainable Energy (CSE), (2011). *Analysis of hard-to-treat housing in England*. [online] Available at: https://www.cse.org.uk/downloads/reports-and-publications/insulation-and-heating/building-performance/analysis_of_hard-to-treat_housing_in_england.pdf [Accessed 14 Jul. 2015].
- Cohen, D., and Crabtree, B. (2006). Qualitative research guidelines project. *Robert Wood Jonhson Foundation*.
- Committee on Climate Change (CCC), (2009). *The Climate Change Act and UK regulations / Committee on Climate Change*. [online] Theccc.org.uk. Available at: <http://www.theccc.org.uk/tackling-climate-change/the-legal-landscape/global-action-on-climate-change/> [Accessed 11 Jul. 2015].

- Community Power Cornwall (CPC), (2015). *Current Portfolio | Community Power Cornwall*. [online] Available at: <http://communitypowercornwall.coop/home/our-projects/portfolio/> [Accessed 5 Feb. 2015].
- Conrad, F. and Schober, M. (1999). Conversational interviewing and data quality. *Proceedings of the Federal Committee on Statistical Methodology Research Conference*.
- Cullen, J., Allwood, J. and Borgstein, E. (2011). Reducing Energy Demand: What Are the Practical Limits? *Environmental Science & Technology*, 45(4), pp.1711-1718.
- Department of Energy and Climate Change (DECC), (2011a). *Energy statistics - statistical press release*. London: Crown.
- Department of Energy and Climate Change (DECC), (2011b). Provisional UK figures: Data tables 1990-2011. *Department of Energy and Climate change*.
- Department of Energy and Climate Change (DECC), (2014). *UK Energy Statistics*. London: Crown. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296183/pn_march_14.pdf
- Department of Energy and Climate Change (DECC), (2015a). *2010 to 2015 government policy: energy demand reduction in industry, business and the public sector*. London: Crown.
- Department of Energy and Climate Change (DECC), (2015b). *A guide aimed at local groups who are interested in setting up a community energy project*. London: Crown.
- Devine-Wright, P. (2005). Local aspects of UK renewable energy development: exploring public beliefs and policy implications. *Local Environment*, 10(1), 57-69.
- Energy Information Administration (EIA), (2015). *How much electricity is lost in transmission and distribution in the United States? - FAQ - U.S. Energy Information Administration (EIA)*. [online] Eia.gov. Available at: <http://www.eia.gov/tools/faqs/faq.cfm?id=105&t=3> [Accessed 7 May 2014].
- Elias, R. J., and Victor, D. G. (2005). Energy transitions in developing countries: a review of concepts and literature. *Program on Energy and Sustainable Development, Working Paper*. Stanford: Stanford University.
- Eyre, N. (2011). Demand reduction and low carbon supply – friends or enemies? *Proceedings of 'People and Energy'*. University of Oxford. September 2011.
- Flick, U. (2009). *An introduction to qualitative research*. Sage.
- Ford, R., and Church, C. (2009). *Reducing Domestic Energy Consumption Through Behaviour Modification* (Doctoral dissertation, Oxford University).

- Fouquet, R. (2010). The slow search for solutions: Lessons from historical energy transitions by sector and service. *Energy Policy*, 38(11), pp.6586-6596.
- Fox, L. (2006). *Over a Barrel: The Challenge of Defence and Energy Security*. The Westminster Energy Forum. Available at: <http://www.westminsterenergy.org/pdf/overabarrel-thechallengeofdefenceandenergysecurity.pdf> [Accessed 9 May 2015].
- Greening, L., Greene, D. And Difiglio, C. (2000). Energy efficiency and consumption – the rebound effect – a survey. *Energy policy*. 28 (6-7), 389-401.
- Hain, J. J., Ault, G. W., Galloway, S. J., Cruden, A., and McDonald, J. R. (2005). Additional renewable energy growth through small-scale community orientated energy policies. *Energy Policy*, 33(9), 1199-1212.
- Higgins, J. (2012). Policy options to support the development of District Heating in the UK. MSc. Dissertation, University of Exeter.
- Hillebrand, R. (2013). Climate protection, energy security, and Germany's policy of ecological modernisation. *Environmental Politics*, 22(4), pp.664-682.
- Hinshelwood, E. (2001). Power to the People: community-led wind energy - obstacles and opportunities in a South Wales Valley. *Community Development Journal*, 36(2), pp.96-110.
- House of Lords (HL). (2005). Ageing: Scientific Aspects. House of Lords. HM Government, London.
- Hoffman, S. M., and High-Pippert, A. (2010). From private lives to collective action: Recruitment and participation incentives for a community energy program. *Energy Policy*, 38(12), 7567-7574.
- Hoffman, S. M., Fudge, S., Pawlisch, L., High-Pippert, A., Peters, M., and Haskard, J. (2013). Public values and community energy: lessons from the US and UK. *Sustainability*, 5(4), 1747-1763.
- Howard, R. (2015). *A new model for delivery of energy efficiency measures?*. [online] Policy Exchange. Available at: <http://www.policyexchange.org.uk/media-centre/blogs/category/item/a-new-model-for-delivery-of-energy-efficiency-measures> [Accessed 18 Aug. 2015].
- Howarth, R.B. and Andersson, B. (1993). Market barriers to energy efficiency. *Energy Economics*. 15 (4), 262-272.
- International Energy Agency (IEA), (2010). World Energy Outlook. Head of Communication and Information Office. France.
- Intergovernmental Panel on Climate Change (IPCC), (2013). *Long-term Climate Change: Projections, Commitments and Irreversibility*. IPCC Fifth Assessment Report. [online]

Cambridge: Cambridge University Press. Available at: https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter12_FINAL.pdf [Accessed 14 Jul. 2015].

- Jaccard, M., Failing, L., and Berry, T. (1997). From equipment to infrastructure: community energy management and greenhouse gas emission reduction. *Energy Policy*, 25(13), 1065-1074.
- Jackson, T. (2005). Motivating sustainable consumption. Report for the Sustainable Development Research Network, available at: http://www.sd-research.org.uk/wpcontent/uploads/motivatingfinal_000.pdf.
- Keepin, B., and Kats, G. (1988). Greenhouse warming: comparative analysis of nuclear and efficiency abatement strategies. *Energy Policy*, 16(6), 538-561.
- Koopmans, C.C., Te-Velde, D.W. (2001). Bridging the energy efficiency gap. *Energy Economics*. 23 (1), 57-75.
- Kronenberg, T. (2009). The impact of demographic change on energy use and greenhouse gas emissions in Germany. *Ecological Economics*. 68, 2637-2645.
- Kuzemko, C. (2013). Understanding the Politics of Low Carbon Transition: Context, Paradigms and Power.
- Langevin, J., Gurian, P.L. and Wen, J. (2012). Reducing energy consumption in low income public housing: Interviewing residents about energy behaviours. *Applied Energy*. In Press, Corrected Proof.
- Leadership for Energy Action and Planning, (LEAP). (2013). *Cornwall community energy case study*. Cornwall Council.
- Lomborg, B. (2007). *Cool it: the skeptical environmentalist's guide to global warming*. Vintage Books.
- Longhurst, R. (2003). Semi-structured interviews and focus groups. *Key methods in geography*, 117-132.
- Lorenzoni, I., Nicholson-Cole, S. and Whitmarsh, L. (2007). Barriers perceived to engagement with climate change among the UK public and their policy implications. *Global Environmental Change*. 17 (3-4), 445-459.
- Marshall, C., and Rossman, G. B. (2010). *Designing qualitative research*. Sage publications.
- Michael-Roberts, M. (2012). Can the Green Deal overcome the barriers to energy-efficiency whilst being a good deal for business, consumers and the climate? MSc. Dissertation, university of Exeter.
- Meehl, G. A., Stocker, T. F., Collins, W. D., Friedlingstein, P., Gaye, A. T., Gregory, J. M., and Zhao, Z. C. (2007). Global climate projections. *Climate change*, 283.

- Mitchell, C. (2008). *The political economy of sustainable energy*. Palgrave Macmillan.
- Morris, C. (2015). *Power from fossil fuel drops to 35-year low in Germany*. [online] German Energy Transition. Available at: <http://energytransition.de/2015/01/fossil-fuel-power-at-35-year-low-in-germany/> [Accessed 27 Jun. 2015].
- Ofgem, (2001). *Electricity Distribution Loss Percentages by Distribution Network Operator (DNO) Area*. [online] Available at: <https://www.ofgem.gov.uk/ofgem-publications/43516/distribution-units-and-loss-percentages-summary.pdf> [Accessed 23 Feb. 2015].
- Office for National Statistics (ONS)/Department of Energy and Climate Change (DECC), (2012). Energy consumption in the United Kingdom: 2012 – Domestic energy consumption in the UK since 1970. *Office for National Statistics/Department of Energy and Climate Change*. 26 July 2012. 12D/291.
- Opdenakker, R. (2006). Advantages and disadvantages of four interview techniques in qualitative research. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (Vol. 7, No. 4).
- Palmer, J., Cooper, I., Cheng, V., CAR, A. T., Summerton, P., Shorrocks, L., and Econometrics, C. (2011a). Great Britain's housing energy fact file 2011. *DECC, London*. P 36.
- Palmer, J., Cooper, I., Cheng, V., CAR, A. T., Summerton, P., Shorrocks, L., and Econometrics, C. (2011b). Great Britain's housing energy fact file 2011. *DECC, London*.
- Palmer, J., Cooper, I., Cheng, V., CAR, A. T., Summerton, P., Shorrocks, L., and Econometrics, C. (2011c). Great Britain's housing energy fact file 2011. *DECC, London*. P. 46.
- Peters, M., Fudge, S. and Jackson, T., eds. (2010) *Low carbon communities: imaginative approaches to combating climate change locally*. Edward Elgar Ltd, Cheltenham
- Prindle, B. and Eldridge, M. (2007). *The Twin Pillars of Sustainable Energy: Synergies between Energy Efficiency and Renewable Energy Technology and Policy* [report].
- Reed, M. S. (2008). Stakeholder participation for environmental management: a literature review. *Biological conservation*, 141(10), 2417-2431.
- Schwanen, T., Banister, D. and Anable, J. (2011). Scientific research about climate change mitigation in transport: A critical review. *Transportation Research Part A: Policy and Practice*. 45 (10), 993-1006).
- Shove, E., Chappells, H., Lutzenhiser, L. and Hackett, B. (2008). Comfort in a lower carbon society. *Building Research and Information*, 36(4), pp.307-311.

- Shove, E., and Warde, A. (2002). Inconspicuous consumption: the sociology of consumption, lifestyles and the environment. *Sociological theory and the environment: classical foundations, contemporary insights*, 230, 51.
- Shove, E. (1998). Gaps, barriers and conceptual chasms: theories of technology transfer and energy in buildings. *Energy Policy*, 26(15), 1105-1112.
- Shove, E. (2010). Beyond the ABC: climate change policy and theories of social change. *Environment and planning. A*, 42(6), 1273.
- Slater, D. (1997). *Consumer Culture*. John Wiley and Sons, Ltd.
- Stake, R. E. (1995). *The art of case study research*. Sage.
- Solomon, S., Plattner, G. K., Knutti, R., and Friedlingstein, P. (2009). Irreversible climate change due to carbon dioxide emissions. *Proceedings of the national academy of sciences*, 106(6), 1704-1709.
- Stamford, M., (2004). Community ownership: the best way forward for UK wind power. MSc. Dissertation, University of East Anglia, Norwich.
- Stern, P. C. (1992). What psychology knows about energy conservation. *American Psychologist*, 47(10), 1224.
- Stern, N. (2007). *The economics of climate change: the Stern review*. Cambridge University press.
- Tipper, H. (2013). *Decentralised energy: powering a sustainable future - Carbon Trust*. [online] Carbon Trust. Available at: <http://www.carbontrust.com/news/2013/01/decentralised-energy-powering-a-sustainable-future> [Accessed 24 Feb. 2015].
- United Nations (UN), (2009). *Women, Gender Equality and Climate Change*. Women Watch. [online] Available at: http://www.un.org/womenwatch/feature/climate_change/downloads/Women_and_Climate_Change_Factsheet.pdf [Accessed 14 Jul. 2015].
- Utley, J.I. and Shorrocks, L.D. (2006). Domestic energy factfile 2006. *BRE/EST/DECC*.
- Valentine, G. (1997). Tell me about...: using interviews as a research methodology. *Methods in human geography*, 2, 27-54.
- Walker, G. (2008). What are the barriers and incentives for community-owned means of energy production and use? *Energy Policy*, 36(12), 4401-4405.
- Willis, R. and Eyre, N. (2011). Demanding less: why we need a new politics of energy. *Green alliance*

- World Energy Council (WEC), (2015). *World Energy Trilemma*. [online] Worldenergy.org. Available at: <https://www.worldenergy.org/work-programme/strategic-insight/assessment-of-energy-climate-change-policy/> [Accessed 12 Jul. 2015].
- Yu, s. and Zhu, K. (2012). A hybrid procedure for energy demand forecasting in China. *Energy*. 37 (1), 396-404.

(7.1) Figures

1. Sendai, P. (2014). *TOHOKU Indonesia - News TOHOKU University Indonesia*. [online] Tohoku-indonesia.com. Available at: <http://www.tohoku-indonesia.com/news/detail/7> [Accessed 12 Jul. 2015].
2. World Energy Council (WEC), (2014). *Energy Trilemma Index*. [online] Worldenergy.org. Available at: <https://www.worldenergy.org/data/trilemma-index/> [Accessed 12 Jul. 2015].
3. ARUP, (2011). *Decentralised Energy Master planning. A manual for local authorities*. [online] Available at: http://www.londonheatmap.org.uk/Content/uploaded/documents/EMP_Manual_lo.pdf [Accessed 25 Feb. 2015].
4. Energy Transition (2015). *Power from fossil fuel drops to 35-year low in Germany*. [online] German Energy Transition. Available at: <http://energytransition.de/2015/01/fossil-fuel-power-at-35-year-low-in-germany/> [Accessed 27 Jun. 2015].
5. Palmer, J., Cooper, I., Cheng, V., CAR, A. T., Summerton, P., Shorrocks, L., and Econometrics, C. (2011a). Great Britain's housing energy fact file 2011. *DECC, London*. P 36.
6. Palmer, J., Cooper, I., Cheng, V., CAR, A. T., Summerton, P., Shorrocks, L., and Econometrics, C. (2011c). Great Britain's housing energy fact file 2011. *DECC, London*. P 46.
7. World Bank, (2015). *Life expectancy at birth, total (years) | Data | Table*. [online] Data.worldbank.org. Available at: <http://data.worldbank.org/indicator/SP.DYN.LE00.IN> [Accessed 14 Jul. 2015].

(8)Appendices

(8.1)Appendix 1: Interview schedule

Interviewee	Organisation	Date
Jerry Clark	Wadebridge Renewable Energy Network	28 th May 2015
David Atfeild	Wadebridge Renewable Energy Network	28 th May 2015
Sam Angwin	Wadebridge Renewable Energy Network	28 th May 2015
Householder 1	Consumer	15 th June 2015
Householder 2	Consumer	15 th June 2015
Kate Royston	South West Devon Community Energy Partnership	3 rd July 2015
Nicola McCheyne	Community Energy Plus	30 th July 2015
Paul Martin	Community Power Cornwall	18 th August 2015
Neil Farrington	Community Energy Plus and Community Power Cornwall	24 th August 2015
Olly Frankland	Regen South West	24 th August 2015

(8.2) Appendix 2: Risk Assessment and Ethics



Form	Approval date
Risk Assessment	19 TH March 2015
E-Ethics form	12 th March 2015

Risk Assessment



FIELDWORK RISK ASSESSMENT PROCESS

Section 1: General Information about your fieldwork trip

SCHOOL/DEPARTMENT:	University of Exeter	COLLEGE:	College of Life and Environmental Sciences
DATE OF ASSESSMENT:	15/03/2015	CAMPUS	Penryn campus
SIGNATURE OF ASSESSOR:	James Ross	SIGNATURE OF SUPERVISOR:	Shane Fudge
PRINT NAME OF ASSESSOR		PRINT NAME OF SUPERVISOR	
DESCRIPTION OF YOUR FIELDWORK TRIP: Governing energy consumption at the local level: the potential of community energy initiatives to act as vehicles in demand management This project is looking at how effective community energy initiatives across Cornwall can be at energy demand management. Interviews will be conducted with stakeholders within community energy initiatives around Cornwall. The interviews will take place in company buildings and over the phone.			
ESTIMATED No OF STAFF AT RISK:	0	ESTIMATED No OF STUDENTS AT RISK:	0

Risk Assessment approved on: 19/03/2015

Ethics

Geography on line Ethics approval system -

James Ross

Your applications

2015/772 (rev2)	James Ross	Curbing demand: The potential of community energy in promoting sustainable energy consumption in Cornwall	accepted	12/03/2015	Track A
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