HOME ENERGY USE, LIFESTYLE, AND BEHAVIOUR: A COMMUNITY ENERGY SAVING PROGRAMME (CESP) SURVEY IN ASPLEY, NOTTINGHAM

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To my late father....

Abstract

With increasing concern over national green house gas (GHG) emissions, combined with the widespread economic impact of global commodities such as coal, natural gas and oil and their effect on energy prices, improving household energy efficiency can be seen as a key vehicle against which both energy emissions can be reduced and domestic GHG emissions curtailed. It is argued that factors that form the basis of choices, habits and values of individuals dictate an individual's decision to either adopt environmentally sustainable behaviour or not. This research reflects on how this specific area of energy policy is being enacted through policy and regulation, notably through one of the Community Energy Saving Programme (CESP) schemes, rolled out by the UK government in 2009.

Although Government can play a pivotal role helping people foster more sustainable behaviour, it must do so in a manner that engages individuals and the public at large. As such, the aim is to adopt a more long term outlook towards encouraging sustainable energy use. The research reflects therefore on the results of a two-phase survey questionnaire administered to the residents of a CESP scheme in Aspley, Nottingham. The questionnaire sought to identify how tenants of energy-inefficient homes tend to behave with respect to domestic energy consumption and how their dwellings performed. This was augmented by quantitative data comprising utility bill figures gathered from the homes under investigation.

This study adopts a mixed method strategy where the researcher combines both quantitative and qualitative data in order to provide comprehensive analysis of the research problem. In this research, 'before-and-after design' survey design is set up to explore the associations between variables under study. The field work survey was performed in one of the pilot CESP schemes currently under delivery in the Aspley area of Nottingham. Designed and executed in two survey phases, the first phase sought to understand residents' attitudes and behaviour and explore how this related to home energy use and performance prior to extensive energy-related upgrades to their dwellings. The second

survey phase sought to examine changes - if any - in users' energy consumption behaviour and dwelling performance after their homes were upgraded to higher energy efficiency standards. This second phase also explored the possible reasons for any behavioural change depicted; whether it was due to policy uptake, information provided or means of communicating energy saving advice.

The Aspley area in Nottingham is identified as one of the most deprived areas in Nottingham, besides the number of inefficient solid wall houses that are 'hard to heat'. Thus, assessing the effectiveness of policy interventions requires a clear understanding of consumer behaviour and motivations across all income groups so that the most appropriate approaches are developed. As such, it is possible that government aspirations to reduce energy consumption will go unheeded if they are inconsistent with the social and physical context of real life. Financial costs, past behaviour, social values and physical infrastructure are considered some of the most difficult barriers to changing energy behaviours. Policies need not only inform people about technological improvements that can be installed in their homes, but should also strongly encourage and incentivise them to use them efficiently. The users' energy consumption behaviour and the policy interventions will make the difference between promising policy, and policy which in fact delivers on its aims for energy efficiency and sustainability.

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List of Acronyms and Abbreviations

ACE:	Association for the Conservation of Energy
ASWZ:	Aspley Super Warm Zone
BECC:	Behaviour, Energy and Climate Change
BRE:	Building Research Establishment
BREEAM:	Building Research Establishment Environmental Assessment Method
CB:	Curtailment behaviour
CERT:	Carbon Emissions Reduction Target
CESP:	Community Energy Saving Programme
CSH:	Code for Sustainable Homes
DCLG:	Department for Communities and Local Government
DEC:	Domestic Energy Consumption
DECC:	Department of Energy and Climate Change
DEFRA:	Department of the Environment, Food and Rural Affairs
DER:	Dwelling Emission Rate
DHS:	Decent Homes Standard
DTI:	Department of Trade and Industry
EC:	Energy Conservation
ECCP:	European Climate Change Programme
ECO:	Energy Company Obligation
EE:	Energy Efficiency
EEC:	Energy Efficiency Commitment
EPCs:	Energy Performance Certificates
EST:	Energy Saving Trust
EU:	European Union
FHM:	Frank Haslam Milan
FiTs:	Feed in Tariffs
GCH:	Gloucester City Homes
GHG:	Greenhouse gas
HESS:	Heat and Energy Saving Strategy
HIPs:	Home Information Packs - UK Government
HMG:	Her Majesty's Government - UK Parliament

LAs:	Local Authorities
LSOAs:	Lower Super Output Areas
$MtCO_2$:	Million ton Carbon Dioxide
NCH:	Nottingham City Homes
NEP:	Nottingham Energy Partnership
NOA:	Needs- Opportunities- Abilities
OECD:	Organisation for Economic Co-operation and Development
OPDM:	Office of the Deputy Prime Minister - UK Parliament
PAYS:	Pay As You Save
PIU:	Performance and Innovation Unit
PPS1:	Planning Policy Statement 1
PTEM:	Physical-Technical-Economic Model
RESOLVE:	Research Group on Lifestyles, Values and Environment
RHI:	Renewable Heat Incentive
RO:	Renewables Obligation
RSLs:	Registered Social Landlords
SAP:	Standard Assessment Procedure
SDC:	Sustainable Development Commission
SPSS:	Statistical Package for the Social Sciences, modified to Statistical Product and Service Solutions
SWM:	Secure, Warm, Modern
TEDIC:	Technological developments, economic growth, demographic factors, institutional factors and cultural developments
TER:	Target CO_2 Emissions Rate
TOE:	Tonne of oil equivalent
TRVs:	Thermostatic radiator valves
UNDP:	United Nations Development Programme
UNEP:	United Nations Environment Programme
WB:	World Bank
WHO:	World Health Organization

Glossary

Aspley Super Warm Zone (ASWZ):	one of the UK Government's 100 pilot Community Energy Saving Programmes (CESP) across Great Britain. It is a two year programme that delivers whole house energy makeovers with solid wall insulation and other energy upgrade measures in Aspley, Nottingham.
Code for Sustainable Homes (CSH):	is the national standard for the sustainable design and construction of new homes which aims to reduce carbon emissions and promote higher standards of sustainable design above the current minimum standards set out by the building regulations.
Carbon Emissions Reduction Target (CERT):	Carbon Emissions Reduction Target (CERT) came into effect in April 2008. CERT is an obligation on energy suppliers to achieve targets for promoting reductions in carbon emissions in the household sector. It is the principal driver of energy efficiency improvements in existing homes in Great Britain.
Community Energy Saving Programme (CESP):	has been created as part of the government's Home Energy Saving Programme in 2009, and requires gas and electricity suppliers and electricity generators to deliver energy saving measures to domestic consumers in specific low income areas of Great Britain. CESP has been designed to promote a 'whole house' approach and to treat as many properties as possible in defined areas in a house-by-house, street-by-street approach.
Decent Homes Standard (DHS):	was introduced in June 2004 to promote measurable improvements to housing in UK, and emerged from the UK Government's Housing Green Paper 'Quality and Choice: A Decent Home for All' and the standard was first published in England in April 2002. The Decent Homes Standard incorporates four main criteria: the statutory minimum fitness standard for housing; repair; modern facilities and services; and thermal comfort.
Energy Performance Certificate (EPC):	provides information at the point of sale or rent on the current energy efficiency of a property, its potential efficiency and the measures required to achieve that potential. The EPC rates properties on a scale of A to G, allowing potential buyers or tenants to compare the energy efficiency of properties.
Energy Company Obligation (ECO):	will focus energy companies on improving the ability of the vulnerable and those on lower incomes to heat their homes affordably, and on improving solid wall

	properties, which have not benefitted much from previous schemes.
Feed in Tariffs (FiTs):	introduced in April 2010 and replaced UK government grants as the main financial incentive to encourage uptake of renewable electricity-generating technologies.
Green Deal:	a framework established in 2012 by the Government to enable private firms to offer consumers energy efficiency improvements to their homes, community spaces and businesses at no upfront cost, and recoup payments through a charge in instalments on the energy bill.
Heat and Energy Saving Strategy (HESS):	The purpose of the HESS is to set out an aim of reducing emissions from buildings to as close to zero as possible by 2050 through a number of programmes.
Pay As You Save (PAYS):	led by the Department of Energy and Climate Change in partnership with the Department for Communities and Local Government, and administered by the Energy Saving Trust and announced in November 2009. The aim was to trial a range of financing repayment options to incentivise householders to install energy efficient and micro generation measures in their homes.
Renewable Heat Incentives (RHI):	is a UK Government scheme set up to encourage uptake of renewable heat technologies among householders, communities and businesses through the provision of financial incentives. There are two phases to the introduction of the RHI: Phase 1: the introduction of the RHI for non-domestic installations in the industrial, business, and public sectors. Phase 2: the domestic element of the RHI, is expected to be introduced in spring 2014.
Standard Assessment Procedure (SAP):	is the methodology used by the Department of Energy & Climate Change (DECC) to assess and compare the energy and environmental performance of dwellings. Its purpose is to provide accurate and reliable assessments of dwelling energy performances that are needed to underpin energy and environmental policy initiatives.
Secure, Warm, Modern (SWM):	funded from the Department for Communities and Local Government (under the national Decent Homes programme) and from Nottingham City Council the programme aims to bring Nottingham's 28,300 council homes up to the national Decent Homes standard in the housing stock between 2008-2015, delivered under the

following streams of work: Secure: Upgrading windows in 15,300 properties to 'Secure by Design' double-glazed units plus replacing old doors; Warm: Upgrading 19,700 heating systems to full central heating with A-rated boilers; Modern: Replacing 17,000 kitchens and 12,700 bathrooms, plus electrical rewires.

Warm Front (WF): This scheme was introduced in England (ended January 2013) aimed to make homes warmer, healthier and more energy-efficient for people on certain income-related benefits. The Scheme offered a package of heating and insulation measures of up to £3,500 (or £6,000 where oil central heating or other alternative technologies are recommended).

CHAPTER ONE

INTRODUCTION

Chapter Contents

1.1 SETTING THE SCENE

1.1.1 Energy consumption behaviour

With a growing world population characterised in part by an increasing number of people seeking to live in urban areas, achieving holistic sustainable behaviour poses numerous significant challenges. Among these is overcoming the barriers that society itself poses; those of behavioural and social patterns which in turn drive energy consumption and resource use. Although governments can play a pivotal role in helping people foster more sustainable behavioural patterns, they must do so in a manner that engages individuals and the public at large. Ultimately, the aim of the research is to understand residents' lifestyle and behaviour with a view to developing appropriately tailored approaches that support and maintain effective delivery of current and future policy initiatives.

The UK domestic sector accounts for approximately 30 per cent of the total national energy consumption (Utley & Shorrock, 2008). In 2010, of the 30 per cent total national energy consumption, 48 per cent was used for heating purposes; 58 per cent of which was consumed by the domestic sector (DECC, 2012b). Whilst major home improvements fuelled in part by various government initiatives[1] have in principal helped curtail overall energy use, which according to Eyre et al. (2011a) may have doubled without such improvements, overall energy consumption in the domestic sector is rising, with increasing numbers of new -build houses coming on stream.

One of the key determinants of energy consumption is the way that users behave and in particular the lifestyles they adopt. A major part of most individuals' lifestyles involves some form of energy consumption, whether it be for commuting, entertainment, cooking, personal hygiene, heating or cooling purposes. As such, habits develop through repeated and frequent patterns of behaviour; these in turn are often reinforced through the numerous

[1] Of those government initiatives: Warm Front, Decent Homes, Carbon Emissions Reduction Target (CERT), Community Energy Saving programme (CESP), Renewable Heat Incentive (RHI), Pay As You Save (PAYS)

unconscious decisions that take place in everyday life (Jackson, 2005). Thus, to 'unlock' the old habits and establish new ones, intervention strategies need to be tailored according to each and every problem or scenario identified.

People, however, often make daily decisions in response to their needs; but it can prove challenging to purchase sustainable products or uptake habits that may not provide the level of comfort required. It is argued that factors forming the basis of choices, habits and values of individuals dictate an individual's decision to either adopt environmentally sustainable behaviour, or not (McKenzie-Mohr, 2011; Abrahamse et al., 2005). Those factors include socio-demographic variables and psychological variables (Abrahamse, 2007).

Studies (Abrahamse & Steg, 2009; Biel, 2003) have shown that age, gender and income often dictate the amount of energy used in households. Additionally significant differences in energy consumption patterns can for example be correlated between different income groups among diverse ethnic groups and cultures (Gardner & Stern, 2002; Lutzenhiser & Hackett, 1993). Meanwhile, attitudes, norms and beliefs can also be considered very powerful energy consumption variables (McKenzie-Mohr, 2011). Stern et al. (1997) suggest that domestic energy use determinants are interdependent and act within a range of combinations rather than additively. Thus, to understand this complex phenomenon, it is essential that research transcends traditional disciplinary boundaries, therefore encouraging interdisciplinary collaboration between say sociologists, psychologists, economists, anthropoliogists, among others.

Another implication of energy consumption behaviour is Jevon's Paradox (otherwise known as the 'rebound effect' (Saunders, 2000)) which may happen with energy efficiency developments. With lowered energy consumption through, for example, energy efficiency measures, it has been mooted that any cost savings (and as a result availability of more disposable income) could be diverted to other, equally environmentally damaging means such as purchasing more power-hungry appliances, increasing frequency of travel (such as flying abroad), purchasing of cars and so on (Sorrell & Herring, 2009). Indeed, the UK Energy Research Centre predicts that the rebound effect could offset 10-30

per cent of energy savings (Swan et al., 2010). In line with the previous implications to energy consumption, Gardner and Stern (2002) propose four basic types of interventions to drive pro-social and pro-environmental individual behaviour; the use of government regulations and incentives is one of these. This method is examined and investigated in the present research as one of the potential instruments for driving sustainable energy-consumption behaviour.

1.1.2 Policy initiatives for reducing energy use in the domestic sector

Climate change policy planning has been closely connected to energy policy in the UK. In the UK, policy initiatives have been in place, and continuously developing, for the last 40 years. During the last decade, the UK has set a major priority to achieve low carbon and secure energy supplies (Ekins et al., 2011) driven by three core objectives; climate change, energy security and fuel poverty. Given its contribution to energy consumption and carbon emissions, the UK's domestic sector has been seen as a worthwhile vehicle against which the Government's 2050 carbon reduction targets can in part be met. Besides, energy consumed by lighting and appliances has increased by 123 per cent since 1970 (ACE, 2005). To meet the 2050 targets, domestic sector carbon dioxide emissions have to reduce by 17 MtC p.a. (million tonnes of carbon dioxide per annum) (McManus et al., 2010).

Recently, European governments have been setting more regulations and incentives to encourage the adoption of energy efficiency measures and behaviours in the domestic sector (Faiers et al., 2007). As part of the UK government's strategy to reduce carbon emissions and meet the climate change targets, the EU Energy Performance of Buildings Directive (EPBD) was introduced in the UK in 2006 with a three year implementation period ending 2009 (Concerted Action EPBD, 2012). The EPBD objective was to improve energy efficiency and introduced higher standards of energy conservation for new and refurbished buildings obliging energy performance certification for all buildings when sold or rented out. This resulted directly in numerous initiatives and policies to evolve in the UK and these have flowed down to national policy

and legislation. For instance, the EPBD has had a significant influence on some core building regulations such as Part L, Conservation of Fuel and Power, which was first introduced in 1965 for limiting energy loss through buildings (McManus et al., 2010), but further requirements have been introduced to reinforce it. A tool developed for this was the Standard Assessment Procedure (SAP) which was introduced in 1992 to provide a useful measure of potential energy performance. SAP feeds directly into Part L of the Building Regulations (DEFRA, 2005a).

Moreover, Building Regulations for new buildings set the target of zero carbon homes by 2016 and zero carbon buildings by 2019 (Eyre et al., 2011b). The Government suggests a stepped policy approach to zero carbon homes that includes three hierarchical steps: good fabric energy efficiency, on-site heat and power technologies, and allowable solutions for further carbon emissions reduction on site (Zero Carbon Hub, 2013). Thus, all new homes are required to have a mandatory Code for Sustainable Homes indicating whether they had been assessed, and the performance of the home against the Code. The Code builds on the Energy Performance Certificate (EPC), which has been mandatory since 2008 whenever a building has been built, sold or rented out.

Policies for new built housing stock, however, will not provide significant improvement to the existing stock. Existing housing stock constitutes around 99 per cent of total building stock at any one time (SDC, 2006). Thus, retrofitting existing domestic stock has been identified as a major priority by the UK, and the current vision is to upgrade seven million homes by 2020 (DECC, 2010). To help achieve this target, several strategies and programmes have been introduced recently. Primary among these is the Heat and Energy Saving Strategy (HESS), introduced in 2009 with a view to saving energy and decarbonising heating, and it incorporates several schemes such as Carbon Emissions Reduction Target (CERT), Community Energy Saving Programme (CESP)[2], and Feed in Tariffs (FiTs) among others. The CESP, under study in this research, has been created as part of the HESS, where whole-house energy

[2] At the time of writing the research, CESP is to be replaced by the Energy Company Obligation (ECO) in 2012, and the Green Deal will also come into effect later in 2012.

efficiency measures are installed in street-by-street approach in specific priority areas (Anandarajah et al., 2011).

Thus, policy instruments could possibly reinforce the importance of programmes that aim to change organisational, household and individual behaviour. Although policies could remove structural and institutional barriers to behavioural change to some extent, the residual energy consumption will always vary between households due to varying individual behavioural patterns. Emphasis on using economic instruments for delivering carbon reduction needs to shift towards crucial behavioural change to ensure successful policy delivery. This has been highlighted in the most recent Sustainable Development Strategy (Barr, 2008). Environmental policy need not only focus on the economic instruments, but needs to incorporate complementary informative instruments that would possibly develop politically skilled and engaged individuals (Soderholm, 2010b). A focus on the bottom-up approach in policy instruments, by actively engaging the public through more information dissemination and communication, could possibly improve policy uptake and delivery.

Implications for environmental policy have been stated as three propositions (Soderholm, 2010b). First, the probability for policy and legislation to control households is low when it comes to people's personal privacy and autonomy concerning their own lifestyle-choices and behaviour. Another implication is the evident lack of infrastructure planning that facilitates pro-environmental behaviour at the household level.

1.2 SIGNIFICANCE OF THE RESEARCH

> *"Domestic energy consumption has increased by 32 per cent since 1970 and by 19 per cent since 1990. Since 1990 the number of households has increased by 10 per cent, population has increased by 4 per cent and household disposable income has increased by 30 per cent."* (DECC, 2009d, p.23)

With the rapid development of policy strategies and programmes in the UK it is vital to investigate if such programmes perform as intended. As previously discussed, policy changes to the way homes are built or retrofitted will only reduce carbon emissions to a certain extent (Anandarajah et al., 2011); whereas

the bigger challenge of addressing behaviour patterns of consumption needs to be targeted if existing homes are to meet the UK carbon emissions reduction target. One of the key factors to address is personal choices people make in their everyday lives such as turning off lights and using heating controls, among others, which have the potential to significantly contribute to the UK's climate change targets (Eyre et al., 2011a). Jackson (2005) suggests that individuals often become 'locked-in to unsustainable patterns of consumption'; hence, inducing behavioural change could possibly prove to be a proficient means if significant carbon savings in the UK are to be achieved.

Tailoring the information required to reduce energy consumption according to the specific requirements and characteristics of target groups has proved worthwhile in other studies (e.g. Abrahamse et al. 2007). In its Warm Homes, Greener Homes Strategy, DECC (2010) states that in order to support the consumer in household energy management, web- and telephone-based information services should be provided to inform individuals of how to reduce energy by making changes to behaviour, providing more information regarding their eligibility of subsidies in policy programmes and alternative financing packages (DECC, 2010). This is particularly important at the time where the UK's flagging economy and the rising energy prices are affecting the most vulnerable sectors of the population.

Arguably, however economic and regulatory factors that seek to motivate environmental actions are not the only efficient tools in this regard. Developing and activating social norms concerning home energy conservation is a vital social psychological motivator that decision makers also need to consider (Cialdini, 2010). If agreed norms are internalised by the people of a community, this is more likely to have a positive impact on their energy-saving behaviour than only providing prompts and information.

As such, it is possible that government aspirations to reduce energy consumption will go unmet if they are inconsistent with the social and physical context of real life. Financial costs, past behaviour, social values, and physical infrastructure are considered as some of the most intractable barriers to changing energy behaviours. Energy consumption is habitual and an integral

part of people's everyday lives (Whitmarsh, 2009). Thus, assessing the effectiveness of policy interventions requires a clear understanding of consumer behaviour and motivations across all income groups so that the most appropriate approaches are developed (Elsharkawy et al., 2011; SDC, 2006). This has been supported by Parag and Darby (2009) they propose for the Government to take actions that 'encapsulate interest' in emissions reductions in order to meet demanding carbon reduction targets. In essence, users' energy consumption behaviour and the related policy interventions will inevitably make promising policies to delivers on its aims for energy efficiency and sustainability.

The present study attempts to identify key features from policy instruments that can improve the chances of reducing energy consumption within the UK domestic sector. The study implies the importance of adopting a comprehensive, interdisciplinary perspective in energy conservation policies, in order to examine current behavioural patterns and to use policy instruments appropriately to improve them. It seeks to identify gaps in knowledge about energy-efficient behaviour in households, and to identify measures that could motivate behaviour change through policy instruments.

1.2.1 Novelty of the present research

Some current and previous research has been undertaken to investigate how home energy improvement policy programmes affect home energy performance (Patterson, 2012; Poortinga et al., 2003; Lutzenhiser, 2002; Alembic Research, 2002). Other studies have explored how programmes influence people's energy consumption behaviour (Gatersleben, 2011; Gatersleben et al., 2010; Pett & Guertler, 2004). However, little work has been undertaken to compare both aspects - home energy performance and occupants' behaviour - before and after implementing a programme. Besides, in DECC's (2011a) evaluation synthesis of energy supplier obligation policies suggested that for further work planned to address evidence gaps, monitoring change in household energy consumption following installation of CESP measures was required.

In response, a two-phased survey targeted at the Aspley Super Warm Zone scheme (one of the CESP schemes in Nottingham) has been designed and conducted for the purposes of this research. A wealth of data has been collected and analysed, which seek to uncover significant correlations between energy consumption behaviour and how information is communicated and disseminated to support this (Elsharkawy et al., 2012). The aim of this study is to examine the likely impacts of one the CESP schemes both, on energy consumption behaviour and home energy performance, together with investigating means for enhancing the policy delivery and up take.

1.3 RESEARCH AIM, QUESTIONS AND HYPOTHESIS

The research examines and tests the implications of policy initiatives that might possibly influence people's energy consumption behaviour, lifestyles and values, and drive genuine policy up-take and delivery. The study seeks to provide top-down and bottom-up views of one of the UK government policy programmes, the Community Energy Saving Programme (CESP). It investigates whether householders of the case under study (the Aspley Warm Zone Scheme ASWZ) have changed any aspects of their original lifestyles, values, and environmental behaviour or even developed new trends in response to the new energy efficiency measures implemented in their homes.

1.3.1 Research Aim and Objectives

The aim of the research is to understand residents' energy consumption habits and behaviour to help develop appropriately tailored approaches that support and maintain effective delivery of current and future policy schemes. The study seeks to provide policy makers and decision takers with feasible recommendations when planning energy policies for the domestic sector.

The objectives are twofold; first, to provide policy makers with a thorough understanding of the implications of people's energy consumption behaviour on policy delivery; and second, to find feasible propositions that could be included in policy initiatives (or the way they are undertaken) that could result in the significant and plausible success of schemes and programmes.

1.3.2 Research Questions

The main research question is:

What are the implications of people's energy consumption behaviour and lifestyle on the success or failure of policy delivery in the UK domestic sector?

The secondary research questions are:

What are the factors that underlie household energy consumption and conservation?

How can the UK domestic sector be motivated to help make policy initiatives deliver the intended outcomes of energy and carbon emission reduction policies?

To what extent could informing and educating people support the outcome of Government initiatives in home energy upgrade?

1.3.3 Research Hypothesis

The research hypothesises that current government initiatives predominantly opt to gain carbon reduction compliance without in fact bringing about a change in the public's underlying values, lifestyle, and behaviour that could establish a new culture of low carbon lifestyles. There exists a wealth of strategies for more effective policy delivery that need to be methodically planned and carefully put into action.

1.4 RESEARCH METHODOLOGY AND DATA COLLECTION

The primary underlying basis of the research is to identify current knowledge and understanding of energy consumption behaviour and how lifestyles of individuals could, both negatively and positively, drive the delivery of policy initiatives. To ensure systematic analysis of the key aim and objectives, a mixed methods research design is employed. The study is driven by the pragmatist approach which advocates the use of different views, methods and assumptions as well as data collection and analysis in mixed methods research. This mixed methods approach has the benefit of combining qualitative and quantitative data in order to explore more fully the research problem. The study uses procedures drawn from concurrent forms of data collection, in which both

the quantitative and qualitative data are collected simultaneously by means of the survey undertaken (Creswell & Clark, 2011).

The research begins with a comprehensive and critical appraisal of the literature surrounding domestic energy consumption behaviour, and the energy policy and carbon reduction initiatives outlined by the UK government. ASWZ scheme is used to examine the hypothesis and research questions, where data has been generated through a series of questionnaire and interview techniques.

Two main research methods for data collection and analysis have been employed during the course of the research. First, a series of survey questionnaires have been generated and administered, these are designed to address the key research questions under study. Second, additional data collected from primary documents and secondary sources will be used to support the surveys and literature review. Questionnaires are used to bring in the bottom-up insights while desktop literature is used to introduce top-down policies.

The research uses the Aspley Super Warm Zone (ASWZ) scheme, one of the pilot CESP schemes in Nottingham, as the primary vehicle from which data is generated and analysed. The Aspley area is identified as a socially and economically deprived area in Nottingham (Nomad Plus, 2006) comprising inefficient solid-walled houses that are particularly 'hard to heat'. In addition, the area presents additional challenges to any successful policy implementation; these are founded in its unique demographic, economic and socio-cultural characteristics. For any energy reduction programme to be delivered successfully, it is essential that due consideration is given to these factors.

Thus, a two-phased survey questionnaire has been designed and planned to gauge households' energy performance and occupants' energy consumption behaviour and lifestyle both prior to and following the energy-saving measures implemented within their dwellings. It engaged a stratified sample of 122 households from eligible households within the ASWZ. Data collected was analysed to produce descriptive and frequency statistics and regression analyses tests were performed to compare levels and rationale for tenants'

energy consumption behaviour and home energy performance in the ASWZ. The data and results from both phases have then undergone comparative analysis to draw the overall picture for the performance of the ASWZ scheme. It was found that changing home energy use behaviour demands both a bottom-up approach which focuses on understanding individual energy consumption behaviours and parameters, as well as a top-down perspective which finds the most appropriate policy instruments that target home energy conservation. The lack of communication is very likely to result in losing valuable outcomes through disparate efforts and approaches between concerned parties.

1.5 THESIS CONTENT

The thesis comprises eight interrelated chapters, each forming a coherent case for the research and providing a critical appraisal of the results that follow. Following this introductory chapter, therefore,

Chapter two reviews several aspects of energy consumption in the UK domestic sector. It illustrates fundamental facts and figures that set the context for the study. The chapter elucidates external and internal determinants of domestic energy consumption and strategies for energy conservation.

Chapter three discusses emissions reduction initiatives and energy policy development in the UK –specifically in the domestic sector. It draws out and critically appraises policies that target both new and existing homes. The chapter investigates how policy initiatives could effectively reduce energy consumption and encourage energy conservation behaviour. This is performed through a critical review of four projects that bring a comparable approach to the present study.

Chapter four presents the research methodology by explaining the rationale of the research hypotheses, and aim and objectives. It illustrates the case under study and explains the research design model adopted to approach the research problem. It fully explains the field work of the survey phases A and B before stating some limitations of the study.

Chapter five presents the key findings from the survey performed on households that did not have the energy upgrade works done. It tests the

survey hypotheses and draws significant correlations that consequently feed into phase B.

Chapter six illustrates the key findings from phase B of the survey performed on households that had the ASWZ scheme undertaken for more than a year. Once more, the hypothesis is tested, demonstrating correlations of high and medium significance at this research stage.

Chapter seven comprises the discussion of the two previous chapters, and draws meaningful comparisons between the findings from both phases. It discusses whether any change in lifestyle and energy consumption behaviour could be detected and, if so, reasons for this change before and after the energy upgrade in response to the new energy efficiency standards in their homes. It concludes with feasible recommendations for researchers and policy makers for future research and policy planning.

Chapter eight concludes the research, reflecting back on the research questions and survey analysis and finally points out directions for future research.

CHAPTER TWO

ENERGY CONSUMPTION IN THE UK DOMESTIC SECTOR

Chapter Contents

INTRODUCTION

> *Energy use in the UK, as in other developed countries, is central to our current way of life. It fuels our manufacturing processes and high levels of mobility, keeps warm (and sometimes cool) our buildings and powers a huge array of electrical appliances from lighting and refrigeration through to the proliferation of modern consumer electronics* (Eyre et al., 2011b, p.260).

Energy in the domestic sector is used to meet the needs of heating, lighting, cooking and the running of appliances, among others. Clearly, homes themselves do not use energy; but the people living within them do. As such, it is important to consider the interaction between the buildings and the systems and the people who consume energy when using them (Swan et al., 2010).

The UK domestic sector accounts for just under a third of the UK national energy consumption (DECC, 2012b). Thus, it is a major sector that needs to be examined and targeted if the UK is to achieve its carbon emissions reduction target by 2050. The domestic sector is one of the largest cost-effective potentials for emissions reduction and is considered important for economically-rational climate change mitigation (Hawkes et al., 2011).

This chapter reviews several aspects of energy consumption in the UK; particularly in the domestic sector. It illustrates essential facts and figures that set the context of the study. The chapter elucidates external and internal determinants of domestic energy consumption and suggests strategies for energy conservation.

2.1 ENERGY IN THE UK DOMESTIC SECTOR

The existing housing stock in UK is the oldest in Europe, with approximately 26 million houses - 8.5 million of those built more than 60 years ago (Energy Saving Trust, 2007). Much of the existing stock will still be in use in 2050, as old homes are being replaced at a rate of less than one per cent annually (Swan et al., 2010). Providing for energy in the domestic sector involves a complex interaction of systems, regulations, technology, and people. This complex

interaction needs to be fully appreciated for effective management and ultimate change of energy use by 2050.

The UK housing market is under pressure from the rising population and a move towards smaller household sizes. It has been noted that the UK population grew by 349,000 people in the year to mid 2006, representing a 0.6 per cent increase (Office for National Statistics, 2007). It is projected that between 2004 and 2016 there will also be an extra 1.85 million single person households in England alone, with these figures contributing to a total increase of 2.8 million new households by this date (Barker, 2004; DCLG, 2007). Addressing the issue of housing supply is crucial, as evidence indicates that too few homes have been built to meet demand over the last three decades of the twentieth century. As Barker's (2004) report into housing supply has made clear, additional housing provision is needed. If the houses needed are built, then by 2050, as much as one-third of the total housing stock will have been built between now and then. Thus, policy initiatives that target the domestic sector were essential, such as Part L of the Building Regulations, Standard Assessment Procedure (SAP), the Code for Sustainable Homes (CSH) amongst several other initiatives.

Notably, energy use in the UK domestic sector accounts for a large proportion of total national energy consumption. In the 1970s it accounted for 24-27 per cent of UK energy consumption but since 1980 it has risen to 28-31 per cent of UK energy consumption (Utley & Shorrock, 2008). The total amount of primary energy used for the domestic sector per year was 73.2 million tonnes of oil equivalent (TOE) in 2004. This constitutes a 26 per cent increase since 1970 and a 17 per cent increase since 1990 and also represents a 17 per cent increase per person since 1970 and 12 per cent since 1990 (ACE, 2005). The main trend in the domestic fuel mix since 1970 has been a rise in natural gas and a decline in solid fuels with a significant increase in the final energy used in homes from natural gas increasing from less than 25 per cent in 1970 to 70 percent in 2004 (ACE, 2005).

The DECC asserts that in 2010, 48 per cent of the total energy consumption was used for heating purposes. From figure 2.1, it is estimated that around 58 per cent of energy used in homes is consumed for space heating, followed by 25 per cent for water heating, and 14 per cent on appliances and lighting (DECC, 2012b).

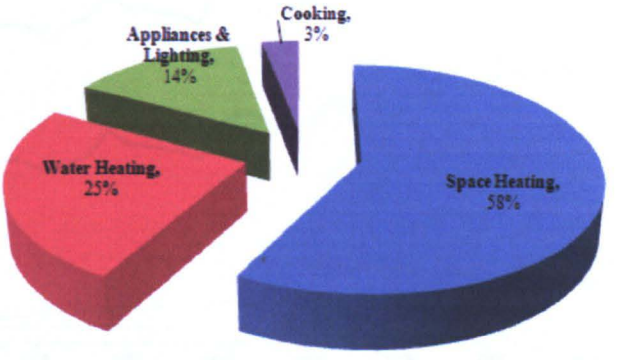

Figure 2.1: Approximate break down of energy use in homes (DECC, 2012b)

In 2007 the UK's total carbon dioxide emissions were 543 $MtCO_2$ (Million ton Carbon Dioxide). Emissions from the domestic housing sector represent less than 30 per cent of this figure (DECC, 2012b; Swan et al., 2010). The average UK household creates almost five and a half tonnes of carbon dioxide every year to heat and power their home (EST, 2009). Over a period of 17 years (since 1990 to 2007), residential CO_2 emissions reduced by nine per cent, in spite of a 13 per cent increase in the number of households during the same period (Swan et al., 2010). It is argued that this fall in CO_2 emissions might have been driven by the European Union Emissions Trading Scheme which sets regulations for energy supply and large scale industrial production (Swan et al., 2010).

As illustrated in Fig 2.1, much of the energy consumed in homes is for space heating (GCH 2010). DECC also reports that since 1970, a continued decrease in the levels of energy consumption for water heating and cooking, whereas a continued increase in energy used for lighting and appliances (DECC, 2012b). Energy consumed by lighting, appliances (particularly cold appliances i.e. freezers, refrigerators and fridge-freezers) was also reported to have increased

by 123 per cent since 1970 by the Association for the Conservation of Energy (ACE, 2005).

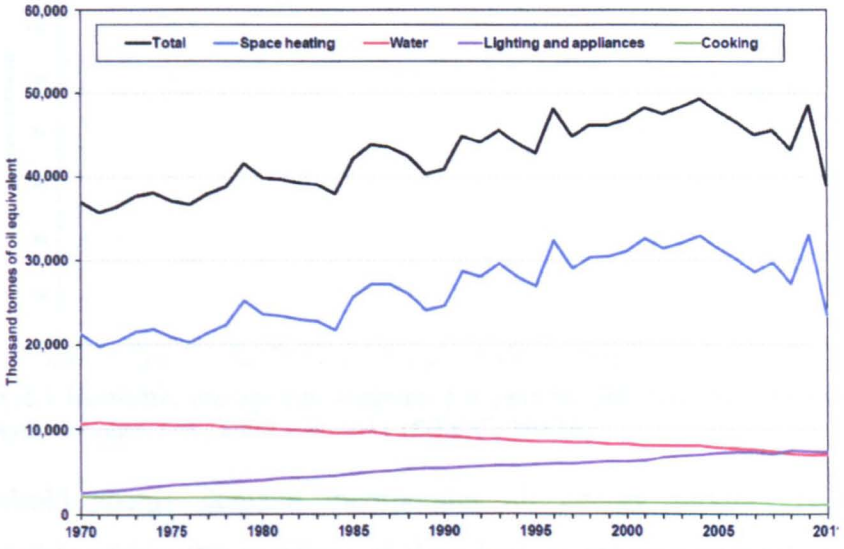

Figure 2.2 Domestic final energy consumption by end use, UK, 1970 to 2011 **(DECC, 2012b)**

The figure below illustrates that since 1990 the amount of energy consumed per household has decreased slightly whilst the amount of energy consumed per person has increased (DECC, 2012b). This could be explained by the increasing ownership of appliances which increases the energy consumed per person, besides the increase in household size. The following diagram (figure 2.3) illustrates that energy consumption per household has reduced by 20 per cent, whilst energy consumed per person has reduced by 13 per cent. On the other hand, energy consumption per unit household disposable income has reduced by 40 per cent since 1990 (DECC, 2012b). As household expenditure on energy is a percentage of household disposable income, a study has also found that the poorest 10 per cent of households surveyed spent nearly eight times the proportion of their disposable income as the richest 10 per cent (Druckman & Jackson, 2008).

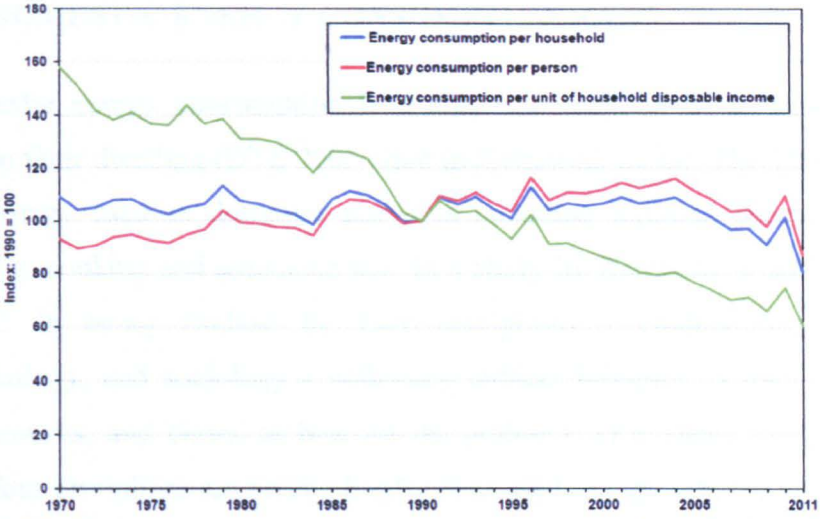

Figure 2.3 Domestic energy consumption per person, per household and per unit of household income, UK, 1970 and 2011 **(DECC, 2012b)**

Household energy demand incorporates all energy services required by households within the premises of their homes; most importantly is thermal comfort provided by space heating and constituting 58 per cent of household energy, followed by water heating, appliances and lighting, then cooking, as previously indicated (Utley & Shorrock, 2008). Space heating has remained the dominant component in household energy use.

As for demand in other end uses, very little change has occurred except for hot water use which has increased faster than heating system efficiency. Notably, energy use for lighting and appliances has risen fastest of all since 1970. Also, demand growth has been widely driven by consumer electronics, home information and communications technologies and entertainment systems. This has caused household electricity use to increase from 11 per cent to 32 per cent in just two decades (DECC, 2012a). It is estimated that the fast growth of home entertainment consumption will be responsible for 45 per cent of domestic electricity use by 2020 (Hamza & Gilroy, 2011; EST, 2007). Moreover, the fact that CO_2 emissions from electricity are around 2.5 times that of gas, the rising rates of electricity use would definitely have a significant impact on CO_2 emissions.

2.2 DOMESTIC ENERGY CONSUMPTION (DEC)

Domestic energy consumption is energy consumption of a household unit within their dwelling (DTI, 2003 cited in Keirstead, 2006). The DEC indicates the energy used in domestic activities including lighting, space and water heating, cooking and appliance use. In a study by Keirstead, it was noted that "DEC is being studied by four disciplines - engineering, economic, psychology, and sociology - with each subject bringing its own techniques, frameworks, and biases to bear on the problem" (Keirstead, 2006, p. 3066). The four disciplines are hereby briefly discussed to highlight the importance of multidisciplinary approaches in policy design.

The *engineering* discipline studies energy consumption of the domestic sector by considering the technologies and physical laws, such as heat transfer, (thermal transmittance) U-values, etc. Besides providing extensive analysis and numerical data, the *economic* discipline also deals with some aspects of human behaviour as a social science. The engineering and economic disciplines together form the physical-technical-economic model (PTEM) of DEC which significantly feeds into energy policy (Lutzenhiser & Hackett, 1993). Besides, *psychological* studies contribute to understanding DEC by studying motivations and drivers to energy consumption/conservation in individuals, based on behaviour models and theories. Finally, *sociological* studies have contributed in illustrating the significance of the social context in understanding DEC; reflecting concepts such as lifestyle analysis, cultural inertia of technological systems, and minimal levels of culturally accepted levels of consumption (Keirstead, 2006). An integrated and multidisciplinary framework has been suggested that studies DEC comprehensively and attempts to overcome the limitation of each disciplinary approach (Keirstead, 2006). This has been proposed as a meaningful and accessible approach that could be adopted by policy makers. The following sections discuss direct and indirect home energy use and factors and determinants of energy consumption in the domestic sector from the macro level to the micro level.

2.2.1 Direct and indirect household energy use

> *"A household not only uses direct energy in the form of gas, electricity and petrol, but it also uses indirect energy embodied in consumer goods such as food, furniture and services"* (Vringer, 1995, p. 893).

Energy use is a result of consumption decisions, both direct and indirect; energy used directly by consumers and indirectly in the production of goods and services (embedded energy). Direct energy consumption is determined by two factors; the demand for energy services, and the energy efficiency of the energy conversion devices that provide the services (Eyre et al., 2011b). Direct energy consumption could occur by consuming gas, electricity or fuel, and through indirect consumption; which incorporates extracting, producing, distributing and disposing of consumer goods. The share of direct energy requirements in different countries in the European Union ranges from 34 per cent to 64 per cent of the total energy requirement (Reinders et al., 2003). It has been implied (Reinders et al, 2003 cited in Abrahamse, 2007) that nearly half of the average household energy use in the Netherlands is comprised of indirect energy use. In the UK, direct consumption is increasingly driving UK national energy use; mainly in households and transport sectors (Eyre et al., 2011b).

Reinders et al. (2003) imply that to change consumer behaviour effectively, energy consumption patterns of households need to be understood to find the household consumption categories that could be possibly dealt with. Indirect energy use relates to variables that might differ from those related to direct energy use, thus implying that it is imperative to study both thoroughly in order to effectively encourage households to consume products of lower energy use (Abrahamse, 2007). It should be noted that most research on household energy focuses primarily on direct energy requirements. The reason for ignoring the indirect energy requirements lies in the difficulty of determining them (Abrahamse, 2007; Benders et al., 2006).

2.2.2 Factors affecting domestic energy consumption

Household energy consumption is affected by various societal factors; technological developments, economic growth, demographic factors,

institutional factors and cultural developments (known as TEDIC factors) (Opschoor, 1989 cited in Abrahamse, 2007; Gatersleben & Vlek, 1998). Technological factors refer to developments in technology available for the consumer to purchase and use such as microwave ovens and dishwashers, among others. Economic growth refers to to the general rise of welfare in developed countries where households have more spending power when it comes to direct and indirect energy-consuming activities. Demographic factors indicate population growth and its significant correlation with energy consumption. Institutional factors, such as government policies and programmes, also have a significant role in encouraging and discouraging household energy use by creating incentives and restricting energy use. Finally, cultural developments shape and support household decision-making processes in forming individuals' choices, strengthening social norms, and directing preferences towards energy-related activities (Abrahamse, 2007).

These five general macro-level factors (TEDIC) form the societal context that inevitably influences individual behaviour. Vlek et al. (1997) proposed a "Needs- Opportunities- Abilities" (NOA) model of consumer behaviour. In this model opportunities and abilities form stimulating and limiting factors respectively, which influence consumer motivation and behaviour (Gatersleben & Vlek, 1998). It is also believed that opportunities might further evoke motivation, whilst abilities and opportunities together provide behavioural control to perform a specific consumption action. Needs and opportunities together form the motivation for consumption actions while opportunities and abilities together form the behavioural control needed to consume (Gatersleben & Vlek, 1998). The degree of behavioural control people have is controlled by opportunities and abilities. If a specific consumption action is required, motivation and behavioural control are needed, as briefly illustrated in figure 2.4.

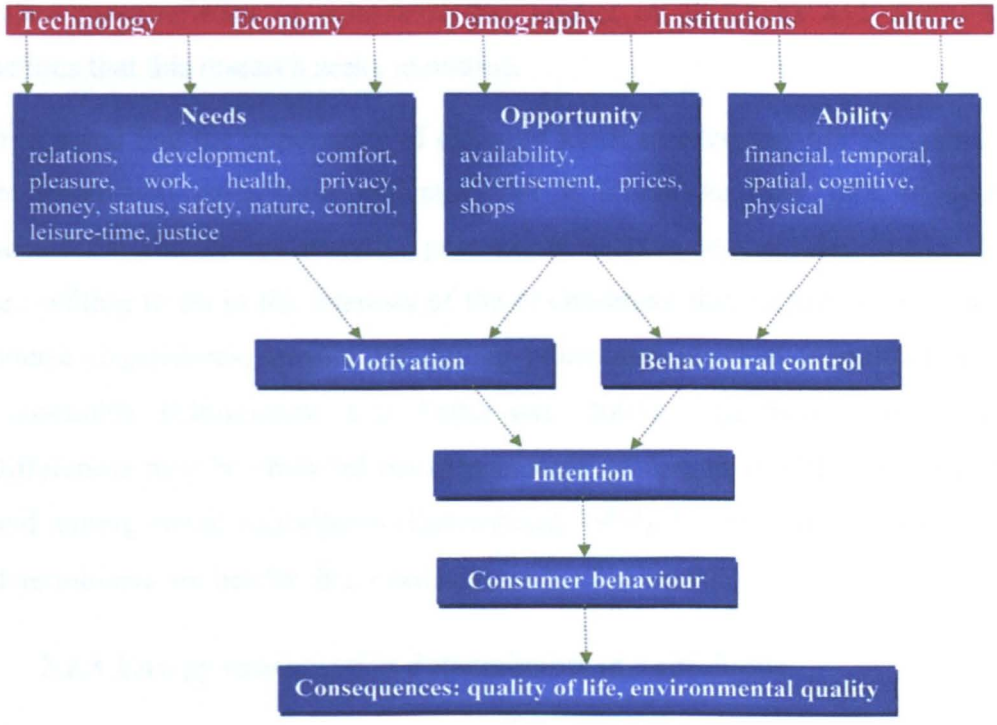

Figure 2.4 The Needs- Opportunity- Ability model of consumer behaviour (Gatersleben & Vlek, 1998, p.146)

Overall, the amount of energy used and its impact depends on many factors; these include the type of equipment, duration of use, fuel used, economic incentives, and psychosocial perception of energy use and services. Thus, TEDIC factors affecting domestic energy could also be described as external factors, and internal factors (Abrahamse, 2007).

The forces that cause or explain environmentally disruptive actions have been stated by Stern et al (1997) in a study of energy use in residences, which helps illustrate the general situation. In this study, it has been deduced that energy use depends on multiple factors within households, including the number of people in the household, and their age, gender and lifestyle. These are a few factors that affect the demand for heating, cooling, and the services that appliances provide. Energy use also depends on household income, and the size of a dwelling and therefore its energy demand, and also affects the household's ability to invest in energy-efficient home technology (Stern et al., 1997). Nonetheless, it is ultimately the choices of individuals that become a key factor in the process of changing behaviour. Consumption provides a reason as to why individuals behave in the way they do, but there are many

other characteristics of behaviour that impact on decisions and determine actions that this research seeks to outline.

It is noted that the importance of different kinds of everyday-life contexts for environmental orientation indicates that it is not an easy task to bring substantial changes in everyday practice. It is believed that what households are willing to do in the interests of the environment depend critically on life-course experiences, current life-course phase and physical infrastructure of households (Martensson and Pattersson, 2003). Significant energy use differences may be observed between income groups, across life cycle stages, and among ethnic subcultures (Lutzenhiser, 1997). Some of these energy use determinants are hereby discussed.

2.2.3 Energy consumption determinants in households

A study by Hitchcock implied that increasing incomes will act to increase energy use through larger dwellings and a greater use of appliances. Thus, if incomes continue to increase, there will be this increasing pressure on energy use. Several studies (Druckman & Jackson, 2008; Dresner & Ekins, 2004) reported a similar correlation between carbon dioxide emissions and household income and energy use and household income. Besides, household income has been found to be directly correlated to dwelling floor area / volume and homes with high annual incomes tend to have large floor areas and therefore require more heating (Kelly, 2011).

Another factor with the potential to push energy use up is the increasing age of the population and the greater number of elderly persons, with the associated demand for higher indoor temperatures (Hitchcock, 1992). People older than 65 tend to spend more than 85 per cent of their time at home and due to their more sedentary lives and metabolic process, they tend to be more sensitive to ambient temperatures (Hamza & Gilroy, 2011). Besides, the use of energy also depends on household members' desires for appliances; their attitudes, beliefs, and values concerning energy use, frugality, and various other matters; and even their cultural backgrounds. In addition, energy use depends on household technology and its relation to the physical environment. These factors include

the appliances being used and their designs, the home's construction, its exposure to wind and weather, and its surrounding micro- and macro-climates (Stern et al., 1997).

Household energy use is influenced by many additional factors as well, which create the context for key choices and actions in the household. An obvious one is the price of energy, which is affected, in turn, by public policies of energy taxation and utility regulation, the competitiveness of energy industries, advances in the technology of energy production and distribution (Lawrence, 2006). Energy use is also affected in indirect but important ways by the standard practices of the home construction and appliance manufacturing industries, and by local building codes. Also, energy use may also be affected by policies intended to influence it directly, such as regulations governing appliance manufacture and the information and financial incentives that governments and energy suppliers have sometimes offered to households to induce them to invest in energy efficiency. Another key determinant of energy consumption within households is users' behaviour.

Stern et al. (1997) suggest that the former long (but incomplete) list of determinants suggests several things; that an environmentally significant consumption activity like household energy use is multiply determined, and that the influences are numerous (both direct and indirect). The list also implies that the many influences are interdependent, acting in combinations rather than additively; and that it will take many disciplines working together to understand how they drive the phenomenon. Moreover, it suggests that the influences act on different time scales, with some - like the demand for heating and cooling - capable of changing in minutes, hours, and days, while others - like those affecting building construction - have effects that last for decades. In these respects, energy use is much like other environmentally-relevant human activities and choices where each of these choices and activities responds to multiple influences.

2.3 IMPLICATIONS OF USERS' BEHAVIOUR ON ENERGY CONSUMPTION AND CONSERVATION

A key determinant of energy consumption within households is users' behaviour. Policy changes to the way homes are built or retrofitted will only reduce carbon emissions to a certain extent; whereas the bigger challenge of addressing behaviour patterns of consumption needs to be targeted. Two of many implications of the effect of users' behaviour on energy consumption are discussed below; lifestyle and habits, and the rebound effect.

2.3.1 Sustainable behaviour and sustainable lifestyle

> *Sustainable lifestyles are patterns of action and consumption, used by people to affiliate and differentiate themselves from others, which: meet basic needs, provide a better quality of life, minimise the use of natural resources and emissions of waste and pollutants over the lifecycle, and do not jeopardise the needs of future generations. Sustainable lifestyles should reflect specific cultural, natural, economic, and social heritage of each society* (UNEP, 2007a, p.2).

Shifting people's lifestyles into more 'sustainable' directions has become generally accepted and has also become a focus of environmental policy. Eyre et al. (2011b) suggest a possible 'cultural shift' that could help to positively shift energy consumption behaviours and scales to 'lower impact, less energy intensive and potentially more community oriented society' (Eyre et al, 2011b; DEFRA, 2008). Shifting to sustainable lifestyles has to be developed at all levels for it to become part of individuals' everyday life. This requires social and technical systems and institutions to enable and encourage individuals and societies to shift to sustainable living (UNEP, 2010).

There, however appears to be little consensus in the field over the extent of encouraging government, business and individuals to shift to pro-environmental behaviour in the light of the current dominant lifestyles that people live (DEFRA, 2008). Thus, DEFRA (2008) suggests the need for encouraging and developing pro-environmental behaviours that are complementary with people's current lifestyles, even if this entails long-term fundamental shifts. The report highlights that to develop effective

interventions, thorough understanding of current lifestyles of socio-demographic groups is crucial. However, lifestyle change can - in effect - influence energy use in two opposite directions - as with greater wealth, the corresponding higher levels of consumption will tend to raise energy use (DECC, 2012c).

Although radical changes in lifestyles are unlikely to be achieved easily, there is scope for significant progress in sustainable behaviours. *Sustainable behaviour* often refers to individual actions that are favourable to the environment, whereas *sustainable lifestyle* implies a pattern of (consumption) behaviour that supports environmental values and attitudes –with minimal impact on the environment (Poortinga et al., 2003). The DEFRA (2008) confirms that influence of personal recommendations and one-to-one contact might encourage the adoption of new behaviours, such as better energy management, buying more sustainable products, recycling, and others. Motivators for pro-environmental behaviour have been found to include 'feel good factor', social norms, individual benefits (health, finance), ease, and being engaged in beneficial activity. Constraints on the other hand may encompass external factors such as cost, infrastructure, working patterns and internal factors such as habit and scepticism, disempowerment amongst other factors (DEFRA, 2008). The DEFRA (2008) also suggests that these could be for the broader audience; however, a segmented approach would make it more feasible for the government to effectively target specific groups with more tailored approaches.

2.3.2 Lifestyle and habits

> *Lifestyle is a way we live our lives that allows us to fulfil our needs and aspirations. They serve as social conversations, in which people signal their social position and psychological aspirations to others. Since many of the signals are mediated by goods, lifestyles are closely linked to material and resource flows in the society* (UNEP, 2007a, p.2).

The area of lifestyle choices has been said to be too subjective, too value-laden and too intractable for policy intervention (UNEP, 2010). Lifestyles are shaped by culture, politics, economics and social norms. Energy consumption is often

inconspicuous to individuals as it becomes part of an ordinary lifestyle - such as the trends of using household appliances, where Jackson asserts that individuals often become 'locked-in to unsustainable patterns of consumption by a combination of perverse incentives, institutional structures, social norms, and sheer habit' (Jackson, 2005). Household consumption itself has an element of culture, in which the use of appliances comes with 'standards of comfort, cleanliness and convenience to which people adhere and subscribe' (Wilhite et al., 2003; Spaargaren, 2000). Heiskanen et al. (2009) imply that consumption behaviour is not based on individualistic choices; rather 'shared conventions that evolve historically, creating common understandings of decency and appropriate behaviour'. These conventions are a result of a vast commercial system of technologies and media that provide collective standards signifying the scale of what creates consumption behaviour.

Nonetheless, it is ultimately the choices of individuals that become a key factor in the process of changing consumption behaviour (Heiskanen et al, 2009). This is clear in a study of social housing tenants in the UK (Pett & Guertler, 2004) where energy-efficiency measures had been installed; only 23 per cent per cent of tenants surveyed were using their heating systems 'efficiently', as designed. The majority were using them to suit their lifestyle, but not utilising the systems at optimum efficiency. This study underlines the fact that what appears best to the tenants in terms of delivering them the greatest perceived benefit, may well not equate to optimum usage of the systems from an efficiency point of view, and may not in turn deliver 'design level' carbon savings. This specific aspect of delivering the estimated savings from energy efficiency measures is further investigated in the current research.

This has also recently been recognised by the Sustainable Development Commission in the development of policies for behaviour change towards more environmentally sustainable behaviour (SDC 2006). Lifestyle change could impact energy use in both directions, positively and negatively, as greater wealth, higher levels of consumption and energy services would inevitably trigger energy use and demand (Eyre et al., 2011b).

Personal habits are also one of the main barriers to sustainable energy consumption. Habits come into existence when 'behaviours are frequently and consistently repeated' (Bechtel and Churchman 2002) and become a major factor in predicting the outcomes of a behaviour change as they are unique to individuals. Jackson highlights that habits occur against rational choice. He describes them as being part of lower cognitive processes that require little in the way of thinking or even unconscious decisions. As this is the case, they often tend to interfere with an individual's ability to make decisions in their own best interest (Jackson, 2005). Energy use is not considered price-sensitive and is often driven by habitual use. Even though an individual may intend to reduce household energy emissions for example, habit or routine may cause them to do otherwise.

To achieve successful behaviour change, old habits need to be broken and new ones established (Stern, 2002). Even if policies are in place to induce environmentally sustainable behaviour, the choice of short-term reward that originates from existing habits may override paying the consequences for the action.

2.3.3 The 'Rebound Effect'

'Rebound effect' is an umbrella term for a variety of mechanisms that reduce the potential energy savings from improved energy efficiency. It is argued that assuming a reduction in energy demand due to improving energy efficiency may not in fact be achieved as 'rebound effects' are assumed to mitigate the size of energy savings achieved. Some researchers imply that energy-efficiency improvements could even lead to increased energy demand over the long term; thus, encouraging energy efficiency aiming to reduce carbon emissions could prove useless (Sorrell & Herring, 2009).

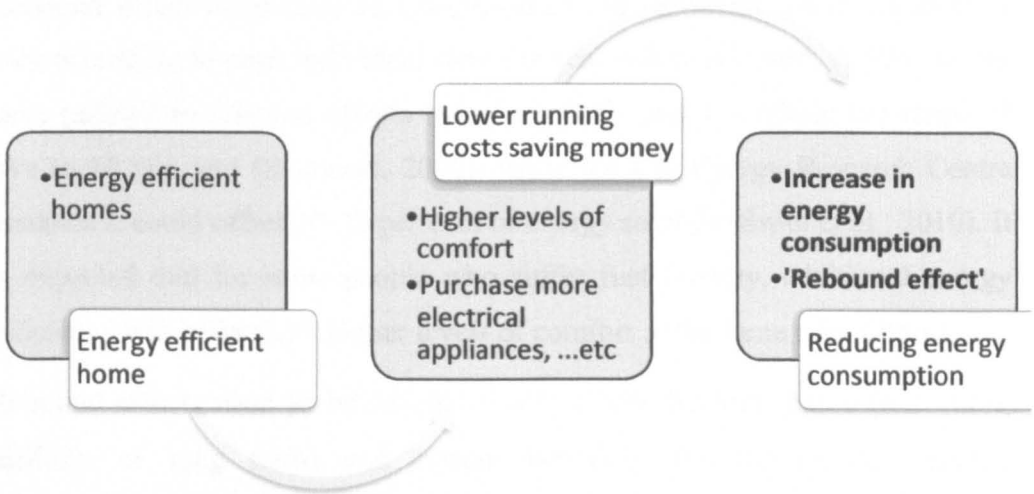

Figure 2.5 Illustration of the optimal scenario and the 'rebound effect' scenario in energy efficient homes (adapted from Sorrell, 2009)

It is argued that if rebound effects are significant, their implications could be considerable for energy policies. Moreover, while energy-efficiency improvements should improve welfare, they could also provide a counterproductive effect on mitigating climate change. However, it must be noted that even if rebound effects are common, this does not necessarily imply that all energy-efficiency improvements will increase overall energy consumption (Sorrell & Herring, 2009).

The 'rebound effect' may have important behavioural implications that might impact energy consumption negatively. In the context of housing, home-owners may be able to afford to heat their home to a higher standard, and may also use the cost savings from energy-efficiency improvements to purchase other goods and services that require energy in their provision, such as flights, consumer goods, and so on (Sorrell, 2009). Sorrell (2009) implied that at the micro-level, the question is whether improvements in the technical efficiency of energy use can be expected to reduce energy consumption by the amount predicted by simple engineering calculations. Simple economic theory suggests that it will not; since energy-efficiency improvements reduce the marginal cost of energy services such as travel, an increase may be expected in the consumption of those services, which in turn may be expected to offset some or all of the predicted reduction in energy consumption.

Rebound effect magnitude and significance are empirical questions as they vary according to each individual case and real-world evidence. A few studies have pointed to rebound effects being relatively small – within the range of five to 10 per cent (Saunders, 2000), while the UK Energy Research Centre assumes it could offset 10-30 per cent of energy savings (Swan et al., 2010). It is expected that for some people who suffer fuel poverty, additional energy efficiency will offer them higher levels of comfort at the same expenditure.

Rebound effects need to be defined within a specific time frame (e.g. short, medium or long term) and system boundary for the relevant energy consumption (e.g. household, firm, sector, national economy). Rebound effects may also be expected to increase in importance over time as markets, technology and behaviour adjust (Sorrell & Herring, 2009). This rebound will have a negative impact when examining the overall energy consumption of the dwelling. Energy-efficiency improvements are generally assumed to reduce energy consumption below where it would have been without those improvements (Sorrell & Herring, 2009).

In new-built homes, the rebound effect must be understood in the context of technologies likely to be installed. The major influencing factors will be the pattern of usage of these systems, and that tenants will need to be well informed about the appropriate methods of using energy efficient technologies provided in their homes to achieve the maximum savings (McManus et al., 2010).

2.4 ENERGY CONSERVATION IN THE DOMESTIC SECTOR

Most behavioural actions in everyday life require the use of energy – be it eating, commuting, using appliances, or other activities. As stated previously, households are acknowledged as a major contributor to energy-related problems and hence constitute a significant target group for energy conservation (Abrahamse, 2007; Benders et al., 2006). It is asserted that examining factors causing household energy consumption and means of encouraging effective energy conservation is crucial. Particularly, it is more important to study individual-level factors than societal- and contextual-level

factors related to energy use and conservation (Abrahamse, 2007). This has been explained in the proposal of governmental energy policies that encourage the use of renewable energy; some consumers will choose to switch to renewable energies while others will not. This indicates that consumers have the choice to act pro-environmentally or not, given the societal circumstances besides the upfront capital for investing in renewable energy technology and payback cost (Abrahamse, 2007).

Boardman (2004) has implied that the relationship between energy efficiency (EE) and energy conservation (EC) can be very confusing. However, the UK Performance and Innovation Unit suggested there should be a 20 per cent improvement in energy efficiency by 2010 which would result in a 10 per cent drop in energy consumption; thus clarifying the difference between both EE and EC (PIU, 2002 cited in Boardman, 2004). Energy conservation depends on fuel prices, capital investment, technology options and behavioural choices. Thus, to accurately predict energy conservation from energy-efficiency improvement , careful analysis is required (Boardman, 2004).

A major problem arises with the UK government plan to inform people on a mass scale with detailed, comprehensible information of the changes they would need to make in order to establish a zero carbon future. The Warm Homes, Greener Homes strategy (2010) highlights that in order to support the consumer in household energy management, national advice provision will be provided, informing individuals of how to reduce energy by making changes to behaviour, eligibility of subsidies and where to find more tailored advice (HM Government, 2010). Several ways have been suggested to encourage households towards more energy conservation. Information given to consumers is required to be appealing, personalised and user-friendly to be more effective (Abrahamse et al., 2007). The advantage of tailored feedback and information is to provide households with relevant information without overloading them with irrelevant advice (Benders et al, 2006). Another way suggested is to provide consumers with more informative energy bills on a more frequent basis, possibly comprised of a simplification of the energy bill, comparisons with previous bills and some energy-saving tips (Wilhite and Ling, 1995 cited in Benders et al. , 2006).

When measuring the effectiveness of interventions in energy savings, it is however important to examine the extent to which the intervention results in both energy savings and behavioural changes that support this saving (Abrahamse, 2007). Notably, users' energy consumption behaviour and policy interventions will make the difference between promising policy, and policy which in fact delivers on its aims for energy efficiency and sustainability.

2.4.1 Drivers of energy conservation

It has been increasingly recognised that environmental problems evolve from millions of choices that people make in their everyday lives (Soderholm, 2010a). Some research has suggested that general members of the public in the USA tend to think that energy conservation entails curtailment actions only, without considering energy-efficiency actions (Kempton et al., 1985 cited in Gardner and Stern, 1996). However, energy conservation is not a case of *either* curtailment *or* efficiency; it requires a mix of both; yet, a technical analysis of the energy system is required before the choice and mix of actions evolve based only on intuition or subjective observations (Gardner & Stern, 1996).

Over the centuries, there have been only a few basic methods for promoting pro-social individual behaviour that political philosophers have written about and societies have used. Gardner and Stern (1996) identified four basic solution types, or ways to encourage individual behaviour for the common good: the use of government laws, regulations and incentives to encourage pro-social behaviour; programmes of education which attempt to encourage pro-social behaviour by giving people information and trying to change their attitudes; the encouragement of pro-social behaviour via certain informal (nongovernmental) social processes that operate in small social groups and communities, and the use of moral, religious, and/or ethical appeals to encourage pro-social behaviour.

Although the laws/regulations method encourages individuals to behave in the public interest by making it in each individual's personal self-interest to do so, the other three basic solution approaches try to encourage pro-social individual behaviour in a fundamentally different way. These methods assume that under

the right conditions, people will want to behave in a public-spirited fashion, whether or not such behaviour is in their own personal interest (Gardner & Stern, 1996).

Moreover, two categories of interventions have been suggested to encourage energy conservation; structural and psychological interventions (Abrahamse, 2007; Steg, 2003). The aim of structural interventions is to change the context of behavioural decisions, by altering the conditions where behaviour takes place. Steg (2003) identifies three structural strategies; financial-economic measures, physical-technical alternatives and legal regulations. Financial-economic measures that are aimed at making energy consuming behaviours more expensive and other pro-environmental ones less expensive may encourage energy conservation. Besides, physical-technical alternatives may promote energy conservation through technological changes to existing equipment; such as introducing energy-efficient appliances. Legal regulations are the third structural strategy that encourages energy conservation by imposing government legislation along with strict monitoring and subsequent enforcement (Abrahamse, 2007; Steg, 2003). The second category suggested to encourage energy conservation is psychological interventions. Those interventions aim at changing individual-level variables such as people's current perceptions, attitudes, norms, and values. Notably, individual-level variables form important driving forces of energy consumption decisions. Abrahamse (2007) states that both structural and psychological interventions have been practiced to encourage energy conservation with varying levels of success. The success of an intervention is determined by examining the extent to which the intervention has resulted in energy savings and behavioural changes to help in effective intervention planning.

Although the economic aspects are most often emphasised in the problem of energy consumption, at present, users tend to request information about the relation between behaviour and energy use at their homes and more user-friendly technology, besides economic gratification programmes for lowering energy consumption (Gyberg & Palm, 2009; Linden et al., 2006). However,

technological solutions will only be helpful when building occupants are committed to using energy-efficient systems in an appropriate way.

An option suggested by Roberts (2008) is raising the accessibility of Smart Meters to households as a tool which both informs users of energy consumption and encourages shifts in power use to reduce peak demand. Besides, the SDC Report (2006) mentioned that direct and indirect measures including smart metering, informative billing and energy audit can reduce energy consumption by 10 per cent. The report also asserts that savings are likely to increase if coupled with efficiency advice and innovative energy tariffs, which can encourage more sustainable patterns of use. Moreover, another common method to stimulate consumers to adopt more energy-efficient behaviour is to measure all energy-related activities in households to identify those actions that give rise to the greatest consumption to help develop a management plan for mitigating their impact. The figures will help the consumers to concretise energy and take control over the energy flow, where the gauging of use can be a way to improve the control over energy in everyday life (Gyberg & Palm, 2009).

Due to the many factors that influence the energy consumption behaviour of individuals, educational and awareness-raising campaigns are therefore crucial in the process of ensuring the energy efficiency of buildings (UNEP, 2007a). However, providing a household with information tends to result in higher knowledge levels, but not necessarily in behavioural changes or energy savings (Abrahamse, 2007). At present, it is increasingly recognised that more integrated policies and programmes are necessary for achieving profound change in consumer attitude and behaviour.

Moreover, a programme introduced by the Energy Saving Trust, that aims to ensure the potential for household energy saving is maximised in climate change policy, is working on providing consistent advice to the Government on the policies necessary to ensure effective action by consumers. This occurs as they pass on their expertise in consumer behaviour and attitudes and, where appropriate, call for intervention through mandatory or fiscal measures (EST, 2009). This programme may be developed by policy makers to help with

possible amendments in building policies that might directly influence user behaviour in energy consumption.

2.4.2 Energy-saving behaviours: Energy efficiency and curtailment behaviours

From a study that examines measures that influence household preferences for energy-saving measures in the Netherlands (Poortinga et al., 2003), three distinguished energy-saving strategies were identified. These are improving energy efficiency of products, different use of products, and shifts in consumption. The first two strategies imply reducing direct energy use by technical improvements of the energy efficiency of products, and by choosing less intensive use of products –aiming to reduce direct energy use. The third strategy implies reducing indirect energy use through shifts in consumption of goods which involves behavioural change (Poortinga et al., 2003). Energy-saving behaviour in households could vary from sophisticated energy-efficiency measures to straightforward habitual actions. A distinction is made between these two types of energy-saving activities; energy-efficiency behaviours (EE) and curtailment behaviours (CB) (Gardner & Stern, 2002; Abrahamse, 2007; Urban & Scasny, 2012).

Energy-efficiency behaviours incorporate one-off actions taken such as the purchase of energy-efficient equipment that would possibly increase consumers' levels of comfort (Abrahamse, 2007). This could entail home insulation, buying an energy-efficient refrigerator (or any other home appliance), installing energy-efficient heating systems, or even buying an energy-efficient car (Poortinga et al., 2005). It has been argued that EE behaviours are possibly not always driven by moral motivation, besides involving monetary costs, time and planning for implementation (Urban & Scasny, 2012).

As for curtailment behaviours; these involve developing energy-efficient behaviours (Abrahamse, 2007). If developed or changed, those behaviours could for example involve switching off unwanted lights, turning off appliance

stand-by mode, having shorter showers, walking or cycling short distances, car pooling, etc (Poortinga et al., 2005).

It has been argued by Gardner and Stern (2002) that EE behaviours entail greater energy-saving potential than that of CB. This is also supported by other research that suggests that energy-saving potential of energy efficiency is often underestimated by laymen in spite of it being higher than that of curtailment behaviours (Attari et al., 2010 cited in Urban & Scasny, 2012). However, it should be noted that depending on the frequency of using energy-efficient equipment, remarkable savings in energy might not be achieved. If the new equipment is being used more frequently than the previous energy-inefficient one, then this is where the rebound effect (Khazzoum Brookes postulates) evolves (Sorrell, 2009; Abrahamse, 2007).

2.4.3 Government laws, regulations, and incentives

The defining characteristic of the government laws/regulations/incentives approach is that the laws, regulations and incentives encourage people to behave in the public interest by making it in each individual's best interest – monetary or otherwise - to do so. Laws and regulations might either be enforced by the threat of fine and/or imprisonment or by using rewards (monetary and nonmonetary) to encourage people to perform behaviours that are in the public interest (Gardner & Stern, 1996). Moreover, it has been argued that only government laws, regulations, and incentives will ensure widespread pro-environmental behaviour on the part of the general public. Hardin (1968) assumed that humans are innately egoistic, inclined to act only in ways that advance their own interests. He thus concluded that the most effective solution approach is the one that channels human egoism into pro-environmental behaviour that is in each individual's best interests (Hardin, 1968).

The implementation of environmental policies often requires the active involvement of the householders. Besides, many existing and new environmental requirements are expressed in terms of household-related activities like recycling and choosing eco-labelled products and services. It has

been claimed that people who hold strong environmental attitudes and values, and people who say they are willing to undertake a number of household-related activities that promote a sustainable environment, do not actually reflect these sentiments in their daily behaviour (Hardin, 1968). Soderholm (2010b) asserts that for policy tools (i.e. information campaigns, fees, regulations and infrastructural measures) to be effective and legitimate, politicians and practitioners need an increased understanding of how policy interplays with household values, attitudes and the constraints that people face in their daily lives.

Public policy-making in general and environmental policy-making in particular, are two areas that are concerned with the identification of desirable goals and the selection of tools for moving development towards these goals (Lundmark et al., 2010). However, it has also been suggested that allowing one specific value to act as a guiding principle might imply that one or more values are sacrificed throughout the policy process. For instance, top-down governmental control might be chosen at the expense of public deliberation; and regulation at the expense of voluntariness (Lundmark et al., 2010).

At present, researchers and policy-makers agree that individual citizens within the household are responsible for both the causes of and solutions to environmental problems (Ibsen, 2010). Other researchers stress that in order to understand individual behaviour in a given time and context, understanding the political contexts is crucial; as opportunities for behaving in an environmentally-friendly manner are mostly structured by the government. Nordlund et al. (2010) conclude that individuals' pro-environmental behaviours in the private sphere are important targets for behavioural change, since they have a large impact on the environment at an aggregated level. Problem awareness, a positive perception of one's own personal capacity to affect environmental outcomes, social influence and reasonable sacrifices are factors that – in a variety of combinations - induce people to take active individual responsibility for the environment and thus undertake any related activities. These results apply equally well to recycling, purchasing eco-labelled products and choosing modes of transport. It is crucial to realise that

behaviours are more or less constrained by the context, and behavioural change might first and foremost require a contextual change. However, when this is not possible, powerful approaches are used that entail multiple influences on behaviour, presenting a 'carrot and stick' perspective on behavioural change in the environmental sphere (Matti, 2010).

CONCLUSION: POLICY INITIATIVES FOR BEHAVIOURAL CHANGE

Energy consumption and conservation have been main issues on the international political agenda for several decades now. The energy concern after the 1970s energy crisis raised concern about the depletion of fossil fuels, and extensive research evolved in attempts to develop an effective planning framework that targets the main contributors to the energy crisis and climate change. The domestic sector is the second biggest contributor to greenhouse gas emissions. From OECD figures, household contribution to energy use lies within the range of 15 to 20 per cent (Biesiot & Noorman, 1999 cited in Abrahamse, 2007).

Human activities that alter the environment respond to a mixture of social, economic, technological, political, and psychological forces; however, the example of energy use in residences illustrates the general situation (Stern et al., 1997). To assess the ways in which durable change can be accomplished in relation to greater environmentally-sustainable behaviour in households, understanding behaviour is imperative. The DEFRA believes that if sustainable development is to be achieved, changes need to be made in behaviours of individuals, communities, firms and the public sector (DEFRA, 2005a). If the concept of zero carbon is to be achieved, and if 'almost every action that individuals carry out has an impact on the environment'; changes in behaviour are deemed necessary to achieve such targets (Bell et al., 2004). The key point to address is that policy changes to the way homes are built or retrofitted will only reduce carbon emissions to a certain extent. There is a bigger challenge of addressing habitual household consumption that needs to be targeted if new homes are to be addressed as zero carbon.

Current thinking suggests that it would be infeasible for government to change individual consumer behaviours. Research does not support this presumption. Government plays a vital role in shaping the cultural context within which individual choice is negotiated through its influence on technology, market design, institutional structures, the media, and the moral framing of social goods (Jackson & Michaelis, 2003).Yet, current legislation does little to tackle underlying values and address the issue of habits -which as discussed previously- exist as a result of routine behaviour and recurring events (Verplanken & Wood, 2006). It can be said then, that if habits are developed over time, a zero carbon society may be achievable in the future, but effectively changing behaviour to more energy efficient behaviour may not be possible as soon as regulation sets in. Clearly then, the Government needs to bring about a change in underlying values, to establish a new culture of low carbon lifestyles.

Due to the many factors that influence the energy consumption behaviour of individuals, educational and awareness-raising campaigns are therefore crucial in the process of ensuring the energy efficiency of buildings (UNEP, 2007b). However, as discussed in this chapter, providing a household with information tends to result in higher knowledge levels, but not necessarily in behavioural changes or energy savings. This chapter has highlighted the complexity of energy consumption behaviour in the domestic sector from both directions; top down and bottom up. The options for pushing behaviour change can be either at the macro-level, through policy instruments, economic benefits etc., or at the micro-level, involving education and information disseminated to individual households. Both approaches are required, and both will entail benefits and drawbacks. The following chapter further discusses significant policy initiatives in the UK domestic sector that target energy efficiency both, in existing and new-built homes.

Chapter Three: Energy policy as an instrument to reduce household energy consumption

Chapter Contents

INTRODUCTION

The previous chapter elucidated some significant factors that affect energy use in the domestic sector, focusing on implications of users' behaviour. It demonstrated how the literature to date has affirmed that policy initiatives could be considered potential instruments for driving pro-environmental and sustainable behaviour (McKenzie-Mohr, 2011; Parag & Darby, 2009; Stern, 2002; Lutzenhiser, 1997; Gardner & Stern, 1996; Stern et al., 1985). This has been discussed in previous studies concerning the feasibility of achieving the target of zero-carbon homes in the near future due to policy implications and unsustainable behaviour (Elsharkawy et al., 2011; McManus et al., 2010; Osmani & O'Reilly, 2009).

Notably, by 2050 an expected six per cent increase in carbon emission levels from the 2000 level could evolve if new policies and measures are not enacted (Anandarajah et al., 2011); currently, with the existing policies and technologies, it is anticipated that a 15 per cent reduction from 1990 emission levels will be achieved by 2020. However, this is much less than the 34 per cent reduction target proposed by the legislated carbon budget.

This chapter discusses energy policy development in the UK in general and the domestic sector in particular. It identifies and discusses the impacts of specific policies that target both new and existing homes. The chapter investigates how policy initiatives could effectively reduce energy consumption and encourage energy conservation behaviour through a review of four relatively recent projects that have taken on a similar approach to the present study.

3.1 CARBON EMISSION REDUCTION POLICIES IN THE UK

At present, there exists an overwhelming body of scientific evidence that indicates that anthropogenic climate change is a serious and urgent issue (Leary & Kulkarni, 2007). There is sufficient evidence to give clear and strong guidance to policy makers about the urgent need for action. Emissions of greenhouse gases, particularly carbon dioxide, are the main cause of

climate change. Thus, the UK government signed up to the United Nations Framework Convention on Climate Change in 1992; and further developed its climate change policy and legislation through the Kyoto Protocol in 1998. This Convention requires countries to commit to the measurement and management of carbon emissions through a variety of policy mechanisms which include emissions trading, energy efficiency and management of carbon sinks, among others. However, despite the broad scope of the protocol, it emphasises the need for the development of more specific national commitments (Ekins et al., 2011).

The European Union Directives have also established a number of initiatives that aim to reduce emissions through the European Climate Change Programme (ECCP) initiated in 2000. One of the directives that the UK committed to is the Directive on Energy Performance of Buildings in 2003. This Directive required calculating the energy performance of buildings, applying the minimum energy standards for buildings, energy certification of buildings, and inspection regimes of boilers and ventilation equipment (Swan et al., 2010). The UK domestic policy has since been brought in line with the EU Directive, subsequently developing its Energy White Papers and the Climate Change Act (2008) which set the target of 80 per cent reduction in CO_2 from the 1990 level by 2050. The Department of Energy and Climate Change (DECC) also published a National Strategy for Low Carbon Transition in 2008 which, besides addressing how to mitigate climate change, also addresses how the UK population could live with some level of climate change (DECC, 2009b).

The 2007 Stern Review suggested a policy framework for carbon reduction, to include three elements: *carbon pricing* - through taxes or emissions trading; *technology policy* - promotes the development of low-carbon energy sources and high-efficiency appliances or buildings; and the *removal of barriers to behaviour change* - that is, encouraging low-energy technology take-up and behaviours. The Climate Change Act 2008 which set a target that UK GHG emissions must be 80 per cent below the 1990's level by 2050, and a 34 per cent reduction by 2020, sets the current context of the UK climate

change policy. The Act also proposed a carbon budgeting system that caps emissions over five-year periods, with three budgets set at a time, to help in tracking the UK 2050 target. The first three Carbon budgets run from 2008-12, 2013-17 and 2018-22 (HMG, 2012). Improving household energy efficiency can help meet both challenges, which are to reduce GHG emissions and reduce energy bills (DTI, 2007). Figure 3.1 illustrates the current policies that are designed to achieve a 24 Mt CO_2e carbon goal in a Household Carbon Map that aims to deliver 29 per cent of the household carbon goal for 2020 (DECC, 2010).

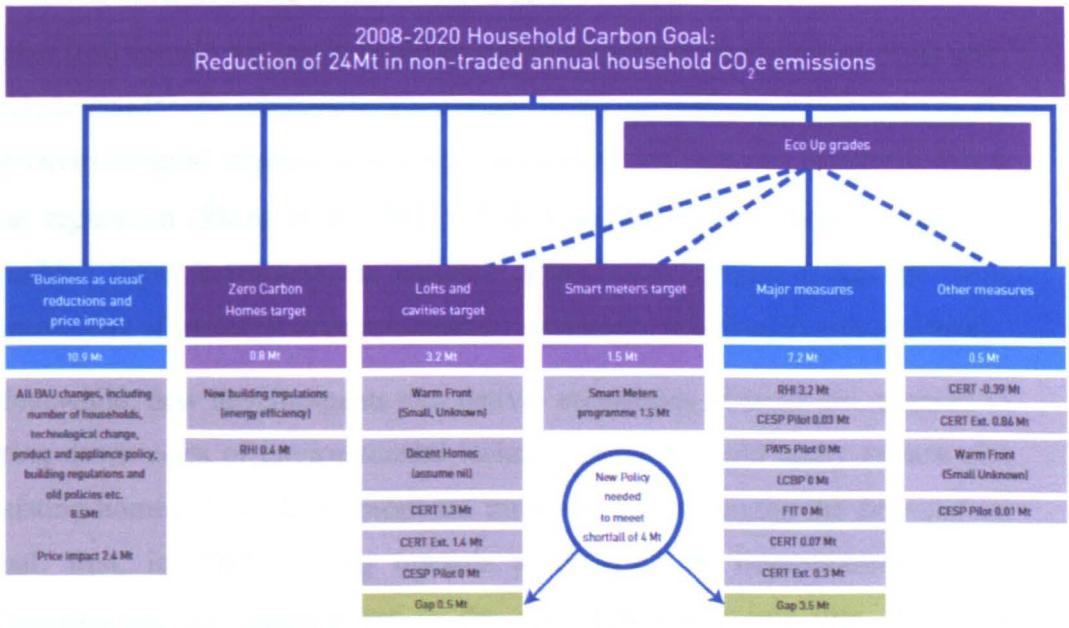

Figure 3.1 Household Carbon Map: Targets for meeting carbon goal (DECC, 2010, p.7)

In terms of existing and future policy instruments planned to meet such targets, a typology that groups instruments under four generic headings has been suggested (Jordan et al., 2003 cited in Ekins et al., 2011).It has however been asserted that in practice, a policy instrument may be hybrid in that it may incorporate the aspects of several instruments. The typology suggested includes market/incentive-based instruments, classic regulation instruments, voluntary agreements, and information and/or education-based instruments (Ekins et al., 2011).

Market/incentive-based instruments include emissions trading, environmental taxes and charges, subsidies and green purchasing among others. These instruments change the relative prices according to processes that have a lower environmental impact. Classic regulation instruments are those policies that define legal standards in relation to technologies and environmental performance such as the renewable and energy-efficiency obligations that have been imposed on energy suppliers in the UK. As for voluntary or negotiated agreements between governments and producing organisations; they develop agreed self-regulation that may in turn lead to increased profitability and improved environmental performance. Finally, the information- and education-based instruments suggested could be either mandatory or voluntary. Examples include eco-labels, advertising campaigns (such as 'Act on CO_2'), and reports on environmental impacts which raise awareness and improve corporate image and reputation (Ekins et al., 2011). Policy packages have recently opted to combine these instruments to enhance policy effectiveness across the three dimensions of sustainable development – economic, social and environmental.

Meanwhile, new developments that deliver economies of scale are required to bring down costs of environmental technologies that could apply to new and existing homes. The DCLG proposed three steps to achieving the zero-carbon goal: first, in 2010 moving towards a 25 per cent improvement in the energy/carbon performance set in the approved documents (the Building Regulations); second, in 2013, moving to a 44 per cent improvement; and finally, in 2016, moving to a zero-carbon target. Zero carbon means that, over a twelve-month period, the net carbon emissions from all energy use in the home would be zero (DCLG, 2007).

On the other hand, the Carbon Trust (2009) suggests that the focus for carbon reduction should be on two levels; the first level, up to 2020, is to implement almost all cost-effective energy efficiency potential in non-domestic buildings. This will require the vast majority of buildings to undergo some level of improvement, with the implementation rate for cost-effective measures increasing from less than 40 per cent today to at least 90 per cent (Carbon Trust, 2009). Most of this could be achieved through simple, low-cost

measures such as lighting and heating controls, or better energy management and building-user behaviours. For the second level, beyond 2020, currently expensive energy-efficiency measures will need to be implemented alongside low/zero-carbon energy generation, with a more integrated approach taken at each stage in a building's development. A similar strategy may well be planned for the domestic sector by making the appropriate adjustments.

It is important to note that sustainability policy in the UK has progressively shifted from a centralised 'top-down' approach towards a distributed 'bottom-up' approach towards implementing sustainable development policy (DEFRA, 2005b). Notably, the initial conceptions of public involvement in sustainability have centred on consultations. However, the placement of the behaviour change agenda at the centre of the most recent Sustainable Development Strategy has highlighted the important role of the individual in sustainable development (Barr, 2008). The following section discusses how the UK energy policy has developed inter-related initiatives that aim to deliver its carbon emissions reduction target.

3.2 ENERGY POLICY IN THE UK DOMESTIC SECTOR

For more than a decade, climate change policy-making in the UK has been closely linked to energy policy. This is reflected in extensive policy documents from central governments, including two energy reviews, two Energy White Papers (Our Energy Future, 2003 and Meeting the Energy Challenge, 2007) (DTI, 2007), and a Nuclear White Paper, besides numerous consultations and detailed policy strategies (Eyre et al., 2011a). The two main UK energy policy challenges set in the 2007 Energy White Paper were to reduce carbon dioxide emissions both in the UK and abroad, and to ensure secure, clean and affordable energy (DTI, 2007).

Energy policy is driven by three core objectives; climate change, energy security and fuel poverty. Regarding climate change; 85 per cent of the total UK greenhouse gas emissions come from CO_2 (Swan et al., 2010). Concerning energy security; the UK is currently a net importer of energy, relying on other countries for its supply. In terms of fuel poverty, this has significantly increased in the last five years or so due to the rising cost of

energy; thus mostly affecting those who can least afford it, such as social housing residents and elderly people (Swan et al., 2010).

Energy policies may relate to energy supply, energy demand or energy security. The 2007 and 2011 Energy White Papers have set out the long-term energy challenges which ensure that the UK's future electricity supply is low-carbon and affordable (DECC, 2011b). In addition, the Renewable Energy Strategy is one of the most comprehensive strategies that deals with energy supply (DECC, 2009a). The main proposal set in this strategy is that by 2020 the UK will be able to generate 30 per cent of its electricity, 12 per cent of its heat, and 10 per cent of its transport energy from renewables. The Renewables Obligation (RO) is the main regulatory instrument introduced to decarbonise energy supply. It obligates the main electricity generators to buy a specific proportion of their supplied energy from renewable generators in return for Renewables Obligation Certificates presented to OFGEM (The Office of Gas and Electricity Markets). Failure to do so attracts a penalty (Ekins et al., 2011).

It is evident that in the last decade European governments have been setting incentives and regulations to encourage the adoption of energy-efficiency measures and behaviours in the domestic sector (Faiers et al., 2007). In the UK, policy initiatives have been developing for almost 40 years, with the standards for limiting energy loss through buildings introduced in the 1965 Building Regulations (McManus et al., 2010). This was then incorporated in the Approved Document L1 of the current Building Regulations, 'Conservation of Fuel and Power'. These sets of documents propose a thermally comfortable environment for occupants and in so doing minimise the amount of energy required to achieve this. This also involves careful control of the mechanisms that affect heat loss from and heat gains to buildings (ODPM, 2006).

The Standard Assessment Procedure (SAP) rating, introduced and developed since 1992, also provides a useful measure of potential energy performance that feeds directly into Part L of the Building Regulations (DEFRA, 2005b). Notably, several other closely related government initiatives have been

introduced to target the different sectors within the domestic housing sector. These include the Stamp Duty Land Tax, exemption for zero-carbon homes, the criteria for meeting the energy components of the Code for Sustainable Homes, the details of the amendments to be made to the energy-efficiency and carbon requirements of the Building Regulations in 2010 and 2013, and numerous other initiatives. Ongoing consultations take into account lessons learnt to date in the development of current and future initiatives (CLG, 2008). Moreover, the Green Deal offers a radical approach towards financing energy efficiency in the domestic sector. The upfront cost of efficiency measures will be spread over a number of years to be offset by a reduction in household energy bills (Pearson & Watson, 2012). The following sections explain several policy initiatives that have evolved in the existing and newly built domestic sectors.

3.2.1 Planning policies and codes for new homes in the UK

Researchers (e.g. McManus et al., 2010) assert that new housing presents an opportunity for best-practice energy solutions to be installed at the present time, with a view to the situation in the future. Policy and standards implemented at present are effectively locked into the building on completion - if not for its entire lifetime then at least until potentially costly renovation is carried out. Therefore, it is vital to ensure that these standards and policy instruments enable new housing not just to meet current 'minimum' standards, but that there is a clear path towards achieving significantly higher levels of performance. Thus, the Code for Sustainable Homes, introduced in 2008, promotes higher environmental standards in housing ahead of the implementation of regulatory standards.

Under this Code, all new publicly funded homes are required to have a mandatory Code rating, indicating whether they had been assessed, and assessing the performance of the home against the Code. A mandatory rating against the Code is expected to build on Energy Performance Certificates (EPCs), which became compulsory in October 2008 whenever a building has been built, sold or rented out. The DCLG has also stated that, to further support the aim of zero-carbon homes, the Government is to develop planning policy to

set a framework for development, in order to achieve zero-carbon outcomes (DCLG, 2007).

3.2.2 Policies for existing homes in the UK

The age of the housing stock directly reflects on its energy efficiency, as the older the stock, the more likely it is to have been built to lower energy-efficiency standards (Swan et al., 2010). Thus, policies for newly-built stock, such as the CSH, could not possibly contribute to improving the UK's current domestic energy situation to meet the environmental standards in the short and medium terms. A major priority for the UK in this regard has been identified as the retrofitting of existing domestic stock in order to provide energy upgrades to seven million homes by 2020 (DECC, 2010).

Thus, several programmes and schemes addressing existing buildings have been rolled out in the last few years. The Community Energy Saving Programme (CESP) has been created as part of the government's Home Energy Saving Strategy (HESS) and was initiated in September 2009. It requires gas and electricity suppliers and electricity generators to deliver energy-saving measures to domestic consumers in specific low-income areas of Great Britain. The programme has been designed to promote a 'whole house' approach and to treat as many properties as possible in defined low-income areas, as well as 'hard to treat homes' (DECC, 2009c). It includes several measures applied in homes meeting the eligibility criteria; the installation of loft insulation and solid wall insulation, replacing g-rated boilers, and fitting modern kitchens and bathrooms. In December 2011, OFGEM reported that 58,931 carbon-saving measures have been successfully installed in 30,588 properties across the UK, resulting in an estimated 2.9 $MtCO_2$ (lifetime, including adjustments) emissions reduction, which comprises 15 per cent of the overall CESP target (Ofgem, 2012). It has also been noted that an estimated 41.2 million tonnes of oil equivalent have been achieved from combined savings of insulation and heating efficiency improvements in the UK domestic sector (figure 3.2) (DECC, 2012b).

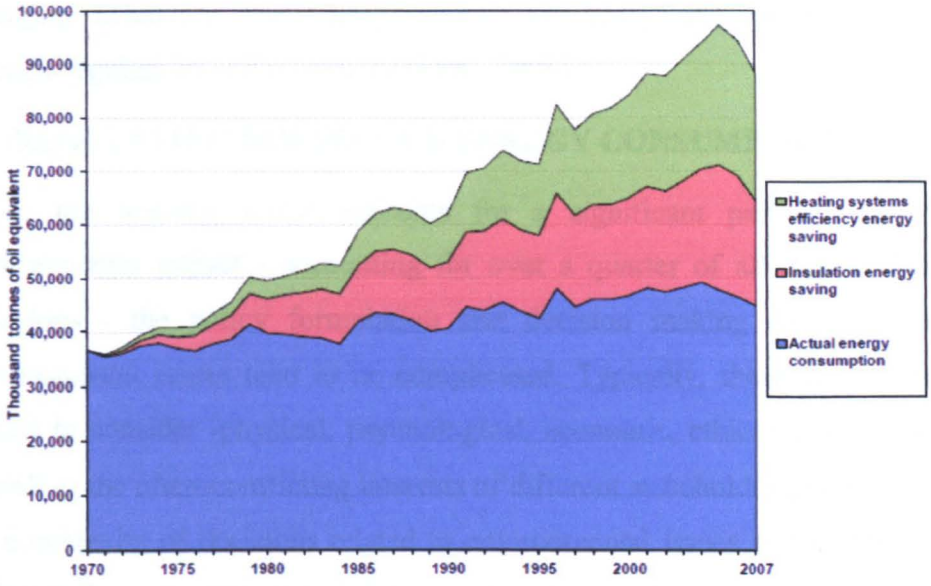

Figure 3.2 Savings due to better insulation and heating efficiency: UK figures 1970 to 2007 (DECC, 2012b)

Regulatory climate policy instruments include the Carbon Emissions Reduction Target (CERT), formerly the Energy Efficiency Commitment (EEC). It was introduced in 2008 and due to run until the end of 2012, after which it would be replaced by the Green Deal underpinned by the Energy Company Obligation (ECO). The ECO requires energy suppliers to install energy-efficiency measures in their customers' homes to reduce household CO_2 emissions. Notably, CERT does not involve public expenditure; thus it is not visible to the public and does not generate awareness of its objectives. This specific aspect needs to be considered for future policies in terms of generating public awareness and support to achieve greater carbon reductions. Two other regulatory climate policy instruments for installing subsidised energy-efficiency measures aiming to reduce fuel poverty are Warm Front and Warm Zones introduced in 2000.

The Sustainable Development Commission (2006) considers the Building Regulations an appropriate means of encouraging householders to improve energy performance in existing homes. However, other steps to reduce carbon emissions from existing housing stock also need to be taken and facilitated through legislations, such as changing overall energy behaviour through audits, feedback and communication, raising awareness of the energy consumption of lights and appliances through standards and industry agreements, and finally

changing behaviour concerning thermal efficiency and micro generation through regulations and incentives (SDC, 2006).

3.3 REGULATING HOUSEHOLD ENERGY CONSUMPTION

While the housing sector accounts for a significant part of the UK's environmental impact - accounting for over a quarter of all carbon dioxide emissions - the policy formulation and decision making with respect to environmental issues tend to be complicated. Typically, there are numerous factors to consider -physical, psychological, economic, ethical, and political - as well as the often-conflicting interests of different stakeholder groups. In fact, the complexity of decisions related to environmental issues and problems are such that they may appear to defy rational analysis; subsequently, any efforts to establish environmental policies, particularly in the domestic sector, often court controversy (Nickerson, 2003).

Swan and colleagues (2010) suggest that energy consumption of new and existing buildings is regulated by four key elements; the planning system, Approved Document L of the Building Regulations, the Code for Sustainable Homes, and Energy Performance Certificates. These key elements are not enacted individually, but are closely linked and in most cases overlap.

3.3.1 The planning system

The planning system is designed to control and coordinate developments that respond to the national policy objectives and local needs. The system is a layered one; it starts at the national level, followed by the regional level through to decision making at the local level, thus ensuring that all planning decisions respond to priorities at the local level first (HM Government, 2007). At the national level, 'Planning Policy Statements' inform 'Regional Spatial Strategies' and 'Local Development Frameworks'. These development frameworks aim to ensure that UK policy objectives are systematically delivered. In 2005, the Planning Policy Statement 1 (PPS1) outlined the general principles of the planning system. This was followed in 2008 by the document 'Planning and Climate Change', a supplement to the PPS1 to

specifically tackle the issue of climate change and emissions reduction (Swan et al., 2010; CLG, 2008; ODPM, 2005).

The Regional Spatial Strategies are designed for each region to cover a 15-20 year period to provide frameworks for plans that address issues at the local level, such as housing, transport, communities and economic development (CLG, 2010). The Local Development Frameworks comprise documents that cover a range of developmental issues for each specific local authority. The 'core strategy' is the most important document that addresses the national policy objectives of housing and energy by outlining each individual local approach taken in tackling this issue (CLG, 2008). This may lead to different approaches at the local level as planning bodies align national policy with local needs (Swan et al., 2010).

3.3.2 Approved Document L of the Building Regulations

The UK Government has announced that from 2016 all new homes, and from 2019 all new non-domestic buildings in England will be built to zero-carbon standards (CLG, 2012). The Building Regulations in the UK set standards for design and construction for new and existing buildings. They comprise 14 sections, and each section is supported by an 'approved document' which outlines the required standards under the regulations. Approved Document L of the Building Regulations, 'Conservation of Fuel and Power', was reviewed and updated in 2006 to tackle climate change by making buildings more energy-efficient (CLG, 2012; Swan et al., 2010).

Approved Document L covers all building types; L1A covers requirements for new homes and L1B covers requirements for existing homes. One of the criteria of the design standards of L1A is to achieve the Target CO_2 Emissions Rate (TER) which is "the minimum energy performance requirement for a new dwelling approved by the Secretary of State" (HM Government, 2010). To comply with the regulation, the calculated Dwelling Emission Rate (DER) should not exceed the TER. The DER calculation incorporates several elements such as building design, materials, building performance, and fittings and fixtures (Swan et al., 2010). The difference between the DER and TER is

classed as improvement; the higher the improvement over the TER the better the score.

In L1B for existing homes, other minimum requirements are introduced that must be complied with where improvement or renovation work is carried out in an existing dwelling (Swan et al., 2010). The requirements include guidance relating to building work such as extension of a dwelling, material change use and change of energy status, and work on controlled fittings and services, as well as guidance on thermal elements including provision, renovation and retaining of thermal elements (HM Government, 2010).

3.3.3 The Code for Sustainable Homes (CSH)

> "*Energy policy for homes is being taken forward through a number of routes and the Code for Sustainable Homes is a major driver for achieving low and zero carbon homes*" (ZeroCarbonHub, 2009).

The Code for Sustainable Homes (CSH) has been developed in conjunction with the Building Research Establishment (BRE) and is effectively a bespoke version of BREEAM for the domestic sector in England. To support the Code, the Communities and Local Government (CLG) has worked with the BRE to put in place an assessment and certification system. The Code is part of a wider package of measures that are aimed at reducing UK carbon emissions from buildings and mitigating climate change (CLG, 2007). The CSH adopts a whole-house approach and measures the sustainability of a dwelling against nine performance requirements; energy/carbon, water, waste, materials, surface water run-off, and health and well being, where some of these performance requirements are mandatory whilst the remaining are flexible. The CSH is a fundamental driver that takes on a more holistic view over environmental sustainability while placing energy at the core of the agenda in helping reduce emissions.

Central to the CSH are the energy efficiency and CO_2 emissions of new homes; these are embedded in a mandatory section of the CSH in which minimum standards must be met in order to become accredited (linked to SAP and Approved Document L) (DCLG, 2007). Depending on the number of points achieved, a star rating is then awarded (one star being the lowest achievable

level and six stars denoting a zero-carbon home, see Table 3.1). From April 2008, all new social housing stock must be built to a minimum of Code level 3, and Code level 4 from 2010 (Swan et al., 2010). It is notable that the CSH intends to promote higher environmental standards in housing ahead of the implementation of regulatory standards; as all new homes funded by the Homes and Communities Agency (HCA), all new housing supported by the Welsh Assembly and all new self-contained social housing in Northern Ireland are required to meet CSH level 3 (BREEAM, 2012). However, it is not guaranteed that 'zero-carbon' housing as currently defined within the Code will actually deliver the UK zero carbon target, if new approaches for policy design and interventions are not taken on board.

3.3.4 Energy Performance Certificates (EPCs)

Introducing the CSH as a legislation, along with the implementation of Energy Performance Certificates (EPCs) - in line with the European Energy Performance of Buildings Directive - might prove highly successful in terms of reductions in CO_2 emissions and cost effectiveness, to the point that these measures could be major drivers for zero-carbon housing (Elsharkawy et al., 2011; Osmani & O'Reilly, 2009). However, the case of retrofitting existing housing stock is far more complex than incorporating best practice into new stock (Swan et al., 2010).

Energy Performance Certificates were introduced in 2007 by the UK Government as part of the Home Information Packs (HIPs) and one of the measures to help reduce CO_2 emissions. These certificates are required every time a building is sold, constructed or rented out. The building energy performance is rated from 'A', most efficient to 'G', least efficient, where the calculations are based on the Standard Assessment Procedure (SAP) for domestic buildings (DECC, 2010). F- or G-rated properties require the Energy Saving Trust to contact the occupiers to provide them with information on how to improve the energy efficiency of their property. Although the main goal of the EPC is to lower CO_2 emissions, several studies show the limitations in determining whether EPCs have effectively delivered this (Amecke, 2012). Some (e.g. Beerepoot, 2007) argue that the housing market is structurally

different from other markets such as household appliance markets, where information programmes might potentially affect people's purchasing decisions

Government policies convey important signals to consumers about institutional goals and national priorities. They indicate in sometimes subtle but nonetheless very powerful ways the kinds of behaviours that are rewarded in society, the kinds of attitudes that are valued, the goals and aspirations that are regarded as appropriate, what success means and the worldview under which consumers are expected to act. Policy signals have a major influence on social norms, ethical codes and cultural expectations (Jackson, 2005). It is clear, therefore, that delivering a sustainable energy strategy for the UK housing sector will entail a full and thorough examination of the barriers and implications discussed. It is not guaranteed that 'zero-carbon' housing as currently defined within the Code will in practice deliver on this promise. The following section explores some of the previous initiatives in light of several projects that have influenced the approach adopted in this study.

3.4 A REVIEW OF STUDIES ON THE EFFECT OF POLICIES AND INITIATIVES ON ENERGY CONSUMPTION BEHAVIOUR

The following review is undertaken of relevant studies that have been implemented in the UK and have been referred to in this research. Revisiting Easthall, User Behaviour, and 21st Century Living Project are all initiatives by housing associations, research council funds and government schemes, while the Arbed 1 scheme is one of the Warm Wales Retrofit Programmes funded by the Welsh Government. All four projects have influenced the approach adopted in the present study; they have been applied to existing homes, some of which have undergone a significant energy upgrade. The projects also examined people's behaviour within their homes; particularly in using their heating systems. Questionnaire surveys were administered in all the studies, and different approaches were taken to analyse the data collected. This provided significant results that have been considered in the present research. Thus, it is crucial to present an overview of these studies and conclude with helpful aspects that have been adopted by the current study and identify negative

aspects that have been considered. Studies are hereby critically reviewed and important aspects discussed.

3.4.1 Revisiting Easthall 2002

Scottish Power funded Alembic Research to undertake this project in Easthall, a project that was commissioned by Energy Action Scotland after 10 years of completing the project. This refurbishment project targeted damp, cold, and hard- and expensive-to-heat homes in Easthall, Glasgow, completed in 1992. A total of 42 dwellings were refurbished co-financed by the EU Thermie programme and Glasgow District Council. The refurbishment project represented four years of community activism, impetus and design. Thus, the residents' group set a precedent for being the first community group to receive an EU Thermie grant. Notably, the insulation standards considerably exceeded the regulations for new dwellings, and the achievements of the project attracted remarkable publicity (Alembic Research, 2002).

The project included modifications to the design of enclosed balconies and conservatories, and solar 'air-to-water collectors' in the roofs to provide solar-heated hot water and pre-heated air into the blocks of flats. Whole-house heating systems were installed in all 42 dwellings - either gas central heating systems or an electric storage-based heating system.

A physical survey and a social survey, combined in one questionnaire, were sent to 42 households, where only 26 fully participated. The aim of the physical survey was to assess the validity of some technical and maintenance concerns after 10 years of wear and tear (the heating systems, ventilation features, cavity wall insulation, window glazing, etc). The main purpose of the social survey was to create a dialogue with the householders to investigate the level of warmth and comfort they experienced after moving in to their refurbished homes, their fuel bills and affordability before and after they moved, as well as the method of payment, health issues and the impact of any energy advice they received.

Only the most significant results are hereby discussed. Most households highlighted that damp, mould and cold were their major problems before

refurbishment, but that their heating use was restricted by what they could financially afford. Most of them either heated the living room only, or the living room and other rooms as they occupied them. When asked about the level of comfort and warmth after refurbishment, 70 per cent found their homes to be comfortable or very comfortable and the same percentage reported their homes are easy or very easy to heat. Most households reported they only heated rooms when occupied. However, the householders' approach in controlling their gas systems was almost the same; minimum use of the installed time clocks and thermostatic controls was reported. Householders reported they have been provided with some energy advice regarding how to operate their heating systems but not on how to reduce their fuel bills, how to read their meters, or what tariff they were on (Alembic Research, 2002).

Regarding fuel cost savings, an annual saving of £371 for gas-heated dwellings and £464 for the electrically-heated dwellings was calculated as a result of the refurbishments. This is a significantly high level of savings compared to household average annual income. It was also confirmed that this project effectively delivered affordable warmth according to Glasgow Action for Warm Homes' policy definition of affordable warmth.

The aim of this research was to examine how well the Easthall refurbishment project had performed 10 years after completion. The survey results indicated that most householders were happier with their warmer and easier-to-heat homes. However, the heating systems were not successful, as many households were not using their central heating or electric storage systems. Instead, many were using the focal-point fires and other forms of room heater. Generally, the physical survey indicated that all new systems fitted – including solar collectors, solar water heating, double glazing, passive ventilation systems, and balcony and conservatory extensions - mostly performed as intended. This project proved that low-income households can live in warm, dry and affordable-to-heat homes providing the insulation and heating standards are appropriate.

3.4.2 User Behaviour in Energy-Efficient homes

This research was undertaken by the Association for the Conservation of Energy (ACE) funded by the Housing Corporation and the Energy Saving Trust. This project aimed to understand how effectively people used energy-efficient systems installed in their homes and to identify the policy benefits of the government programmes under which they were installed (such as the amount of CO_2 emission reductions). Based on abundant evidence on the lack of understanding of the role of thermostats and programmers, and combinations of heating, ventilation, and insulation, the survey focused more on how people reacted to and used their heating systems than on how they used energy advice. A number of housing associations that carried out energy efficiency improvements to a sizeable groups of homes for more than 15 months were contacted for participation in the survey (Pett & Guertler, 2004).

The energy-efficiency measures taken included (but were not limited to) change/upgrade of heating systems relating to communal gas heating, replacing electric systems with oil central heating systems, gas central heating installation, central heating replacement/modernisation programmes, and wood-fired central heating systems. The measures also included insulating the fabric and window glazing, including cavity wall and loft insulation, internal insulation of solid-walled homes, insulation improvements, external cladding, hot water tank insulation, and low-e double glazing.

The survey was performed on seven case studies, and 118 interviews were carried out. The survey analysis and results highlight the relationship between people's behaviour in using their systems and various factors that could improve the way energy efficiency is achieved through installing measures (Pett & Guertler, 2004). Regarding the heating patterns, nearly half the people replied they set heating hours with or without manual intervention, while one third would keep the heating on all day – assuming efficiency - or would switch the boiler or thermostat on and off - and the rest would rely on other sources of heating (such as storage radiators or community heating). With energy-saving actions, less than half the sample seemed to be energy-aware in that they did not leave appliances on standby mode, and dried their laundry

outside. Nearly half the sample also tended to always wash full loads, let food cool before placing it in the fridge, boiled only water needed in the kettle and placed the lids on pans when cooking.

Concerning the overall impact of their homes on their lives, responses to questions about overall perception including comfort, ease of heating, draughtiness/stuffiness and how easy it is to control the heating were generally positive, except for the problem of draught. Regarding fuel bills, results indicated that most people either paid less than or the same as they had before their energy upgrade, whereas nearly a quarter of the respondents reported they paid more and much more than before, which raises the need for further investigation.

The section dealing with behaviour styles in terms of energy efficiency identified three categories of behaviour - efficient, reasonable and inefficient. Efficient behaviour is behaviour that should produce the expected results from an energy-efficiency policy in terms of carbon savings, energy efficiency and domestic energy use. Reasonable behaviour is cost-effective but is adjusted to suit people's lifestyles and does not follow the recommended practice. Inefficient behaviour is characterised by not being cost-effective (Pett & Guertler, 2004). Nearly half the sample appeared to display reasonable behaviour in relation to the reported ease with which they heated their homes, whereas the rest of the sample was equally divided between efficient and inefficient behaviour. Also, two thirds of those with efficient behaviour have remained in their homes during the process of their home energy upgrade. This indicated that those who lived through the process might have had the chance to ask the installer about how their systems worked. Moreover, 90 per cent of those who lived through installation reported that they get the desired results from their heating, and most of them display reasonable behaviour.

One of the main limitations of this research project was the relatively low numbers of respondents from the seven case studies; thus the researchers stated that it was not possible for them to draw reliable conclusions. However, further recommendations for research were made to correlate behaviour style in using the system and obtaining desired results, as well as investigating the following

variables; demographics (age, children, employment status), having previous experience with gas central heating, receiving advice from the installer, provided with support for using the systems after installation, the location of the thermostats for the central heating systems, being provided with booklets or instructions, and general awareness of energy issues.

One of the significant recommendations emerging from this project is that a clearer picture of the extent to which domestic energy use could be reduced could be drawn if compared with households that have not had any energy-efficiency work done.

3.4.3 Twenty First Century Living Project

This research project aimed to understand UK householders' behaviour and lifestyles by monitoring consumption patterns. It also investigated ways householders could increase home energy efficiency, and thus reduce their environmental footprint. The Project was funded by the UK's Economic and Social Research Council and was undertaken by the Research Group on Lifestyles, Values and Environment (RESOLVE) at the University of Surrey (Gatersleben, 2011). The study examined how several interventions affected consumer behaviour with regards to energy use, water consumption and waste reduction, and investigated the level of change in participants' attitudes, values and behaviours over the course of the year-long study.

One hundred households were selected to be nationally representative of the UK in terms of social groups, house types and demographics. Each household underwent an environmental audit and an attitudinal survey at the start of the project to understand their opinions concerning environmental matters. Each household was given an information pack, 'green' start-up kit and £500 to spend on environmental improvements in their homes. Throughout the year householders were contacted by email, the Project website and several themed interventions, and many received an infrared thermograph (thermal image) of their properties. After 12 months, the environmental audits and attitudinal surveys were repeated to detect any changes. A total of 84 households fully participated and the data were collected and analysed. A general trend in the findings was that people acted on energy saving most enthusiastically,

followed by waste reduction and water conservation, while hardly acting on travel decisions. This directly reflects the important role of education and information programmes in raising people's awareness and helping drive their lifestyle trends and decisions discussed in the previous chapter.

The most significant findings of that study are as follows: 58 per cent increased their use of low-energy light bulbs, 55 per cent increased or installed loft insulation, 23 per cent replaced white goods with more efficient models, 12 per cent replaced their boiler or upgraded the heating system, 11 per cent installed cavity wall insulation, 10 per cent improved or installed double glazing, and 21 per cent installed a water butt. Average recycling rates rose from 58 per cent at the start of the project to 63 per cent by the end (Gatersleben et al., 2010). Overall, 81 per cent of the participating households took up at least one energy-saving measure. The £500 grant given to each participating household at the start of the project led to additional expenditure by 61 per cent of homes, some of which spent more than £500 of their own money on energy-efficiency products; however, no perceived changes in attitudes were detected through the Project year and no correlation was found between households with the strongest pro-environmental values and those who made the most acknowledged improvements. By the end of the Project, though, many householders noticed some behavioural changes in their lifestyles that they would not have expected to relate with buying eco-products. Besides, householders who received thermal imaging of their homes showed noticeable interest in draught-proofing and cavity wall insulation works. It has been noted that the sample in this study should not be considered a representative one as the people interested in environmental issues were found to be over-represented (Gatersleben, 2011).

The study concluded that cash investment encouraged most people to in turn invest some of their own money in energy-efficiency improvements. Other incentive-style interventions such as thermal imaging, goody bags and energy monitoring also had big impacts on people's awareness and behaviour. The Project also highlighted that tailored personal advice, and authoritative and detailed recommendations are major drivers to changing behaviour. Policy makers need to facilitate such schemes that provide specific advice, not just

generic energy awareness, within both the private and the public sectors. Another important recommendation was the need for regulating current billing and meter-reading arrangements, where utility providers would be obliged to provide detailed and comprehensive information of clients' energy consumption. The Project's average energy saving was found to be 10 per cent with a maximum of 25 per cent but this should be considered in light of the UK reduction target for GHG emissions of 80 per cent by 2050.

3.4.4 Arbed 1 Scheme evaluation

The Arbed 1 Scheme, led by the Welsh Government, aims to increase the energy performance and reduce the impact of fuel poverty on existing energy-inefficient homes in Wales (Patterson, 2012). The Scheme also aims to promote the installation of domestic energy efficiency and renewable energy measures to improve the overall energy efficiency of the housing stock, thus cutting carbon emissions and promoting economic investment. This Scheme was funded by Registered Social Landlords (RSLs) and Local Authorities (LAs); and additional funds came from the Carbon Emission Reduction Target (CERT) and Community Energy Savings Programme (CESP) schemes. Warm Wales (WW) was commissioned to deliver the project. The research report aims to assist in understanding barriers to and drivers of retrofitting dwellings and the possible outcomes of the scheme. It identifies the problems experienced in this scheme in order to assist such initiatives in the future.

The Arbed 1 Scheme is part of the Welsh Government's Strategic Energy Performance Investment Programme. It takes a 'whole house' approach to install energy-efficiency measures and renewables across Wales, with the aim to reduce fuel poverty and carbon emissions, and support the energy efficiency and renewable supply chain in more than 6,000 homes (Patterson, 2012). The Scheme targets solid and cavity wall, off-gas properties in low-income areas by providing them with External Wall Insulation (EWI), fuel switching, solar PV, or solar thermal and air-source heat pumps (ASHP), depending on the most appropriate options.

To evaluate the impact of the Warm Wales Programme, this study was undertaken through desk-top data collection, questionnaires to householders

and interviews with WW staff. The average SAP rating before works was 60; after the works this rose to 69, which is higher than the WHQS-recommended SAP of 65. The calculated CO_2 savings for the programme is 3,025 tonnes per year and the expected total financial savings from all households in the programme is estimated to be £285,000 per year. This has been calculated based on an average annual saving of £216 per household on energy bills. However, it was asserted that part of the saving might be used for increased indoor temperatures for higher comfort levels instead of financial savings.

With the questionnaire data collection and analysis, more than a third of the respondents agreed that their homes are more comfortable after the measures were installed; 60 per cent feel warmer than before, and 27 per cent feel better since the measures were installed. However, over three quarters of the sample found it was too expensive to heat their homes as they would have wanted, in spite of not having experienced a full winter season against which to evaluate the savings. One third of the respondents felt they have become more aware of their energy use and carbon emissions and need to reduce them, while more than half agreed they became more energy-aware of their home energy consumption after being involved in the Scheme. Regarding the installation of measures, over 70 per cent reported they were satisfied with the quality of work, and most of the dissatisfaction reported was associated with technical problems with the external wall insulation.

It has been noted that the works resulted in visual improvements to the properties. The Scheme also proved to have encouraged economic regeneration, and most importantly created employment opportunities in the local areas. By estimating CO_2 savings for each of the measures undertaken in the properties, fuel-switching proved to generate the best CO_2 savings per pound sterling (Patterson, 2012).

The report provided an evaluation of the environmental, social and economic aspects of the Arbed 1 Scheme in order to assist similar schemes in the near future. It has been suggested that monitoring the works before and after installation would possibly provide a clearer evaluation of the benefits and outcomes of such a scheme. It would help identify whether the Scheme is

performing as anticipated or whether it requires further development and modification. Also, the social impacts of the Scheme could be further explored in terms of householders' behavioural changes before and after the improvements. This would provide better understanding of the impact of the Scheme on the broader community.

Furthermore, the report suggested that the approach to the delivery of improvement measures needs to be carefully considered either as a 'whole house' or a 'blanket' approach. As each approach has particular advantages and disadvantages, careful planning and consultation of the appropriate approach needs to take place beforehand (Patterson, 2012). There is great potential in government funding to retrofit schemes of existing housing stock; thus considerable levels of planning and funding allocations are essential.

DISCUSSION AND CONCLUSION

During the last decade, a major policy priority for the UK has been to achieve low carbon and secure energy supplies (Ekins et al., 2011). This chapter has illustrated that sustainability policy in the United Kingdom has progressively shifted, to a certain extent, from a centralised 'top-down' approach towards a distributed 'bottom-up' approach to implementing sustainable development policy. Emphasis has moved from using economic instruments or a reliance on market forces to deliver sustainability, towards a realisation that behaviour change is necessary among the wider population if the goals of sustainable development are to be achieved.

Accordingly, Barr (2008) highlights that the locating of the behaviour change agenda at the heart of the most recent Sustainable Development Strategy has reinforced the significance of individuals' contributions to sustainable development. Thus, policy instruments are considered essential for ensuring the effectiveness of efforts to change individual, household, and organisational behaviour. They are seen as a means to influence processes in a way that leads to more careful use of resources, and may even lead to more environmentally friendly behaviour or decisions where environmental impacts are reduced. Policies can make inconvenient behaviours convenient, they can make

expensive behaviours less expensive, and they can remove structural, institutional, and legal barriers to behavioural change.

It has been stated that every form of policy instrument used to promote a behavioural change establishes a relation between at least two ends. The content of a defined measure serves as a communication message from the sender to the receiver (Linden et al., 2006). The receiver, whether an industry, a household or a person is seen as an extremely important decision maker. On the other hand, the sender, the authority, must do their best to argue for efficiency measures, and in turn inspire and motivate the receiver to accept the course of action and develop a strategy to improve efficiency in technology and/or behaviour within their organisation (Linden et al., 2006).

Due to the range in occupant behaviour patterns, residual energy consumption will always vary between households, despite measures to influence and even standardise behaviour. Thus, it is wise to make the right choices and pick the right combinations of policy tools by identifying and considering the full range of available options, and then formulate the right selections for each case, which may possibly make a difference in the effectiveness of a programme. Such possibilities may be establishing partnerships between Government and voluntary actions, setting benchmarks and measuring performance, labelling buildings according to energy performance, and the use of state-of-the-art communication modes for influencing people's behaviour, among a range of others (Wilbanks & Stern, 2002).

From the Revisiting Easthall Project, it could be concluded that surveying people's energy-related behaviour after a major home-energy upgrade provides valuable information to policy makers. It proves whether the intervention outcomes were as expected and how approaches could be further developed and modified based on previous surveys and results.

One of the limitations of the Users' Behaviour project was that it was conducted on samples selected from seven case studies with different energy-efficiency measures installed. Thus, conclusions from the survey did not provide reliable enough information, but could possibly be considered

indicators of progress. Also, recommendations for correlations in future research have also been considered in the present research.

A common recommendation provided by the Users' Behaviour and Arbed Scheme reports for future research is to pursue a comparison between people's behaviour and home performance, both before and after the energy upgrade works are done. This, if done, is expected to provide a more comprehensive picture and pinpoint where the problems lie, thus offering possible solutions and clarifying implications. This recommendation has been implemented in the present study, where a two-phased survey has been undertaken before and after the energy upgrade scheme.

The 21st Century Living Project provided two valuable lessons. The first is that some interventions used, such as thermal imaging, goody bags, and energy monitoring, have helped in pro-environmental behaviour and energy conservation. The second is the urgent need for tailored and personal advice to households concerning reducing bills and energy consumption. This has been deemed fundamental along with proposing a major government intervention towards requiring energy providers to provide simple, comprehensive arrangements for meter-reading and billing, so that consumers are able to understand exactly where they could be potentially saving energy and money.

This chapter proposes the identification of critical requirements within policy instruments that may possibly lead to the maximum reduction of energy consumption in the UK domestic sector. It implies the importance of adopting a broad perspective in energy conservation policies, of evaluating current behavioural patterns and of using policy instruments in a timely manner to improve them. It seeks to identify gaps of knowledge about energy-efficient behaviour in households, and measures that could develop further knowledge and motivate awareness and change of behaviour relating to such issues. The current and previous chapters helped develop the research methodology which is discussed in the following chapter.

CHAPTER FOUR

RESEARCH METHODOLOGY

Chapter Contents

INTRODUCTION

The previous chapters have demonstrated that policy initiatives and interventions could be considered effective instruments for reducing energy use and demand. It is also clear that people's energy consumption behaviour, lifestyle and habits may have the effect of bringing policy delivery to a failure. Policy makers and decision takers need to understand the significance of these implications for policy uptake and delivery. They need to work closely with interdisciplinary professionals (psychologists, sociologists, social scientists among others), but most importantly, they need to engage more with the public for whom the schemes and programmes are designed. Thus, planning a tailored approach for each sector within the overall target group can offer higher probabilities of successful policy delivery.

To ensure systematic analysis of the key aim and objectives of the research, the methodology adopted is hereby explained. The research is based on a mixed methodology of qualitative and quantitative data analysis that examines the impact of one of the Community Energy Saving Programme (CESP) schemes in Nottingham, on home energy use and tenants' energy consumption behaviour. The purpose of this chapter is to present the research methodology by explaining the rationale for the research, the hypothesis, and the aim and objectives. Following this, the case study of the research is presented and discussed; the research design model adopted to address the research problem is then explained, and identified limitations of the study conclude the chapter.

4.1 RATIONALE FOR THE RESEARCH

The Energy White Paper (2007) has set out the long-term energy challenges which include tackling climate change by reducing greenhouse gas (GHG) emissions, and ensuring affordable energy. Improving household energy efficiency can help meet both challenges - to reduce GHG emissions and reduce energy bills (DTI, 2007).

There are, however, market failures and barriers with respect to the uptake of energy efficiency measures in homes, despite the Government interventions that aim to improve overall welfare. Policy instruments with standards for

limiting energy loss through buildings have succeeded in imposing building codes and standards that take account of energy efficient design and upgrade: yet patterns of consumption and user behaviour have proved to have the effect of negating some of the benefit expected from those policies, previously discussed in chapter 2. Many researchers have argued that several energy conservation programme approaches tended to overlook various barriers and limiting factors that led to irregular patterns of success (Gardner & Stern, 1996; Lutzenhiser, 2002).

The primary underlying basis of the research is to identify current knowledge and understanding of energy consumption behaviour and how lifestyles of individuals could, both negatively and positively, drive policy initiative delivery. The secondary underlying basis of the research is to investigate and explore the UK carbon emission reduction initiatives and energy policies that relate to the domestic sector. The research aims to explore people's causal attitudes towards energy consumption and identify the gaps between their expectations of government schemes and aspirations of policy makers. The purpose is to provide some feasible propositions that could enhance policy delivery and uptake.

4.2 CONCEPTUAL FRAMEWORK

As indicated previously in chapter one, the main research question is: What are the implications of people's energy consumption behaviour and lifestyle for the success or failure of policy delivery in the UK domestic sector? The conceptual model of the research is based on the hypothesis that government initiatives in the domestic sector require stakeholders' complete understanding and support for successful delivery. The methods used to approach the research questions include a 'before-and-after' survey questionnaire designed to investigate tenants' home energy use and energy consumption behaviour before and after employing home energy upgrade through one of the CESP schemes.

The decision-making process has largely been informed by a top-down approach, often ignoring the needs and aspirations of community stakeholders. It is argued that simple survey techniques in isolation would not capture the diversity of opinions, and that the methodology required the drawing out of the

perceptions of individual stakeholders in a way that allowed for more freedom of expression (Moon, 2001). Thus, the study combines the use of qualitative and quantitative research methods by using a 'pragmatic' approach. This mixed methods approach has the benefit of combining different techniques, in order to explore more fully the context of the case under study. The combination of methods provides a basis for exploring how people's behaviour plays a vital role in the success (or failure) of the delivery of a government intervention. Questionnaires are used to bring in the bottom-up insights while desktop literature is used to introduce top-down policies. The intention is that the analysed results will inform decision makers of how best to design policy schemes that are as successful as they are intended to be. Consequently, a two-phased survey has been designed, pre and post CESP intervention, to unravel the research problem. The first phase of the survey forms a benchmark against which the results of the second phase are compared.

4.3 RESEARCH DESIGN MODEL

A research design model is a plan or proposal to conduct research and comprises three components. The model involves the philosophical worldviews, strategy of inquiry and research methods (Creswell, 2008). The research design model in figure 4.1 is employed in this research and is further explained in the sub sections below.

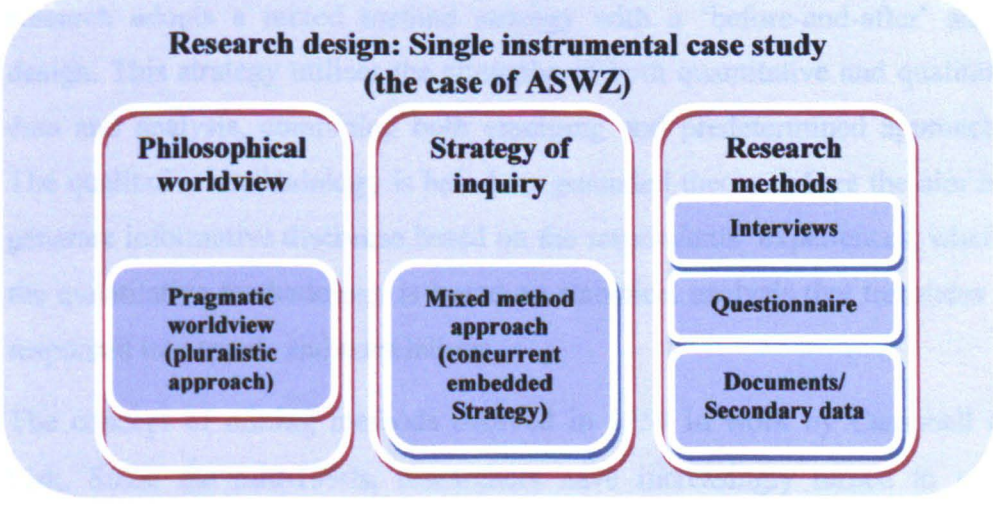

Figure 4.1 Research design model: The interconnection between three components (Adapted from Groat & Wang, 2002, p.13; Creswell, 2008, p.5)

4.3.1 Pragmatic worldview

This research employs pragmatic knowledge, generated from "actions, situations, and consequences" (Creswell, 2008). It is important to highlight the research problem and plan the use of all appropriate methods to understand the problem and produce effective solutions. Pragmatism is not devoted to a single philosophy, but relates to both qualitative and quantitative methods (mixed research methods). It also expresses its significance by focusing on the research problem and then using a "pluralistic approach" to create knowledge about the problem. Pragmatism enables the researcher to freely choose the proper methods, and procedures for the research (Creswell, 2008). Mixed methods researchers search for many approaches to collect and analyse data to understand and solve research problems. Thus, for mixed methods researchers, pragmatism encourages the use of different views, methods and assumptions as well as data collection and analysis.

4.3.2 Strategy of inquiry

As previously stated; the research hypothesises that current government initiatives predominantly opt to gain carbon reduction compliance without in fact bringing about a change in the public's underlying values, lifestyle, and behaviour that could establish a new culture of low carbon lifestyles. Thus, the research adopts a mixed method strategy with a 'before-and-after' survey design. This strategy utilises the strengths of both quantitative and qualitative data and analysis, combining both emerging and predetermined approaches. The qualitative methodology is based on grounded theory, where the aim is to generate informative discourse based on the respondents' experiences, whereas the quantitative methodology is based on statistical analysis that translates the responses into trends and correlations.

The concept of mixing methods evolved in 1959 in work by Campbell and Fisk. Since the mid-1990s, researchers have increasingly turned to mixed methods, on the grounds that collecting diverse types of data provides a more comprehensive understanding of the research problem (Groat & Wang, 2002; Ridenour & Newman, 2008; Creswell, 2008). Creswell (2008) stated that there

are three strategies of mixed methods; sequential, concurrent, and transformative mixed methods.

As a mixed model approach, a concurrent embedded strategy of mixed method was considered the most appropriate strategy to be employed in the research. The researcher combines both quantitative and qualitative data in order to provide a comprehensive analysis of the research problem. This approach has as its primary method a qualitative approach, while a quantitative database provides a secondary or supporting role. This concurrent mixed method is chosen to facilitate the use of different methods to study different groups and levels, thus gaining diverse perspectives from varied types of data. The researcher collects both forms of data simultaneously and the information is then combined to interpret the result. Thus, the mixing of the data from the two methods is often to integrate the information and not to compare one source of data with the other, but to set them alongside each other as two different sources of evidence. This then provides an overall comprehensive opinion about the problem, and offers broader perspectives as a result of using mixed methods than if only applying one method (Groat & Wang, 2002; Creswell, 2008).

4.3.3 Research methods

The data collection process needs to assimilate the mixed methods design of the study. This research uses procedures drawn from concurrent embedded forms of data collection, in which both the quantitative and qualitative data are collected concurrently (Creswell & Clark, 2011). The researcher has merged both types of data in order to present a thorough analysis of the research problem.

Data collection procedures differ according to the type of mixed methods design; and it is important to consider if data collection is occurring concurrently or sequentially. In concurrent data collection, the quantitative and qualitative data are independent of each other. The analysis and interpretation combines the two forms of data to show the similarities or inconsistencies in

the results (Creswell & Clark, 2011; Creswell, 2008). The following research methods have been extensively used for data collection and analysis.

4.3.3.1 Survey questionnaire

Social surveys are complex operations, requiring the development of an overall research design, as a poorly designed survey might fail to provide accurate answers to the questions under investigation; resulting in loopholes and wasting resources (Oppenheim, 1992). Designing a survey requires a significant amount of technical knowledge as it is often a prolonged intellectual exercise. As the research takes shape, the aims go through some subtle changes as a result of greater clarity of thinking (Oppenheim, 1992). Those changes would probably lead to a better specification for the instruments of measurement.

A survey might either be a descriptive, census-type survey or an analytical, relational type of survey. In the present research, an analytical, relational survey is set up to explore the associations between variables under study. In a survey, four types of variables could be possibly measured and tested; these are experimental, dependent, controlled and uncontrolled variables (Oppenheim, 1992). The design chosen for this research is a 'Before-and-after design' which, as the name implies, is a set of measurements taken from a group of respondents, who are then subjected to an experimental variable before being measured again. In this case, a two-phased questionnaire is performed (phase A and phase B) where phase A is used as a control group. The experimental variable is the energy upgrade work done in respondents' households under the CESP scheme. The samples of respondents are not the same; however, they are matched samples in that they both are within three LSOAs in Aspley ward, are social housing, have the same landlord (NCH), comprise similar-sized, solid-walled and energy-inefficient houses, and are all eligible for the scheme. The socio-demographic analysis undertaken later in the survey analysis ensures significantly comparable samples of respondents in both phases (see Appendix H).

The questionnaire has been employed as a research tool designed to collect information to be subsequently used as data for analysis (Denscombe, 2007). It allows for consistency and precision in terms of the question wording and processing of answers. The questionnaire has been used to access factual, straightforward information, and opinions, attitudes, preferences and other habitual information of respondents regarding their home energy use and energy consumption behaviour; issues that have been elaborated on in the previous chapters.

4.3.3.2 Documents/Secondary data

The research first undertakes a literature survey of people's energy consumption behaviour, and energy policy and carbon reduction initiatives of the UK government based on documentary resources. Documentary resources are an important source of data collection in the research. Documents are called 'secondary data' by some researchers, meaning the existing or available data or "what is already there" (Johnson & Turner, 2003, p.314). Documents include government publications and official statistics, censuses, journals, newspapers and magazines. The advantage lies in enabling the researcher to obtain the language and words of other authors and secondary sources represent and generate data that are thoughtful and have been compiled carefully (Creswell, 2008). However, limitations of this type of data collection lie in that information may be incomplete or may not be authentic or precise enough. Also, it may be protected information unavailable for public and private access and may require the researcher to search out the information in hard-to-access places.

To overcome the limitations of data documentation, the researcher collected the data from reliable sources including, for instance, government reports and census, besides international organisation reports. The researcher had to make an informed choice to filter data from several resources and to make a decision whether to employ the data or not, depending on its origin and creditability.

Data derived from magazines and other published sources have proved important in several instances during the course of this research. It provided

opinions and critiques by leading figures in the policy field that haves not been officially reported in other sources. Data documentation opens new and unfiltered perspectives in a study, and is considered a dynamic tool that enriches the integration within a study (Groat & Wang, 2002).

4.4 SURVEY OF USER BEHAVIOUR AND HOME ENERGY PERFORMANCE

4.4.1 Relevance of Aspley Super Warm Zone (ASWZ)

The CESP was created as part of the government's Home Energy Saving Strategy (HESS) and introduced in September 2009. The CESP has been designed to promote a 'whole house' approach and to treat as many properties as possible in the target areas with a combination of measures. CESP is designed to target income-deprived homes in defined areas through a community, street-by-street approach. The scheme was designed to upgrade hard-to-treat homes to higher energy efficiency levels through a number of measures (mainly solid wall insulation) (Hough, 2012). Those measures are delivered through partnerships between local authorities, energy companies, housing associations, and community groups. These partnerships have been designed to involve community-based organisations which are more engaged with their communities, whereas energy suppliers lack this level of engagement, thus facilitating the level of scheme uptake (Bradley & Smith, 2012).

The CESP is particularly focussed on barriers to the uptake of energy efficiency measures in low income areas and hard-to-treat homes. In these homes, there are barriers to implementing energy-efficiency measures for householders including lack of capital, awareness, hidden costs and landlord/tenant split incentives. Energy suppliers are incentivised to focus on delivering less costly measures in other areas through other existing obligations on suppliers in this programme.

In Nottingham, Aspley Super Warm Zone is one of a hundred Government pilot CESP schemes in the UK. It is a £2.8 million project, funded by Scottish

and Southern Electric and Nottingham City Council and covers a target area of around 1,800 social and private homes in three lower super-output areas (LSOAs) within Aspley Estate, Nottingham (Nottingham City Council, 2011). The social housing phase installs homes with internal wall insulation, modern kitchens and bathrooms and replacing G-rated boilers fitted alongside the Decent Homes work.

Nottingham City Homes (NCH) is a social housing landlord in Nottingham and is currently working to bring all its properties up to the government's Decent Homes standard by 2015. This standard specifies that properties should be free from serious hazards, in a reasonable state of repair and with modern facilities. NCH's programme is known as 'Secure, Warm, Modern' (SWM), replacing single glazed windows and warped doors, then heating, and then kitchens and bathrooms. NCH's 'Nottingham Plus' standard goes beyond the minimum Decent Homes standard in some areas. This is done by replacing every single glazed window with double glazing and installing additional energy efficiency measures.

In areas qualifying for funding under the CESP, the SWM work is carried out alongside the installation of internal insulation in each property, as this delivers the maximum cost efficiencies. Installing internal insulation requires that kitchen units be taken out, and it is therefore more efficient to install new kitchens where they are due at the same time as fitting the insulation. Therefore, all of the properties receiving internal insulation under CESP will also receive a new kitchen and bathroom, and may also have the heating system upgraded to a fully-programmable central heating system where this is not already in place. Every single glazed window has also been replaced with A-rated double glazing in properties receiving CESP work.

The private phase is for homeowners and private tenants. This phase started in the winter of 2011 and delivered a whole-house energy makeover to every home with solid wall insulation as its main measure, and with boiler upgrades and loft insulation as complimentary measures. For the private sector, tenants are offered a combination of internal and external solid wall where they are

required to financially contribute to the interventions. This is further discussed in a subsequent section.

The case of ASWZ has been chosen for the research due to its unique attributes as a CESP pilot scheme in the East Midlands. It has also been specifically chosen for the investigation as, until the date of writing, no comparable research has been undertaken on ASWZ or any other CESP scheme in England.

4.4.2 The case of Aspley, Nottingham

The city of Nottingham comprises about 28,500 council homes, and is ranked within the top cities in UK that contain social housing. Aspley is one of the Nottingham wards that formally comprised just local authority owned and managed houses, however, many houses have passed into private ownership since the 1980s. Aspley ward is located at 3 miles west of Nottingham City Centre (figure 4.2).

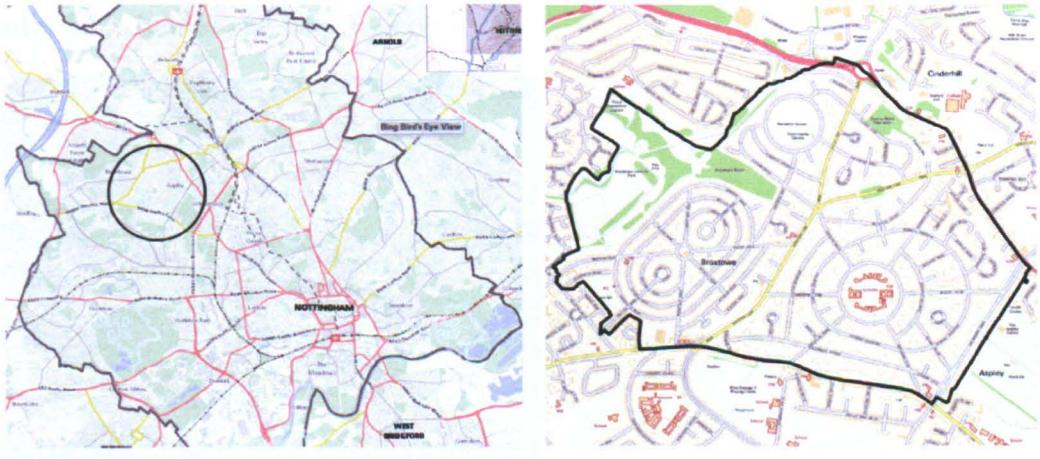

Figure 4.2 (left) Location of Aspley ward in Nottingham, (right) Aspley ward boundary (Source: Nottingham City Council, 2011)

The Aspley estate layout is radial with Ambleside Primary School in the centre of the estate. The building style is vernacular to the 1930's era, many with 'mansard' style roofs as can be seen in figure 4.3. All Aspley homes were built with solid brick walls, of nine inch thickness, characterised by similar thermal properties (external surface area, insulation and air-tightness). All houses are either semi detached or terraced, with an average of 3 bedrooms each. The

internal layout of most houses in Aspley includes the kitchen and the living room on the ground floor, and bedrooms and one bathroom on the first floor. According to NCH, almost all houses in Aspley have gas central heating as their main heating system but with varying heating efficiency owing to the boiler energy efficiency.

According to the 2001 census, it is estimated that approximately 16,470 residents live within Aspley (Nomad Plus, 2006). The ward of Aspley has the highest proportion of households with dependent children of all wards in Nottingham with a percentage of 45 per cent compared with the Nottingham average of 27 per cent. In addition it has a low proportion of student households as it is not within student catchment areas. The 2004 English indices of Multiple Deprivation rank Nottingham as the seventh most deprived city in the country. Notably, 13 out of 20 city wards are considered to comprise 10 per cent of the most deprived wards in the country (Nomad Plus, 2006). In the 2005 MORI residents' survey poll, 55 per cent of residents in and around Aspley prioritised improving safety in communities and combating crime over affordable homes and better schools.

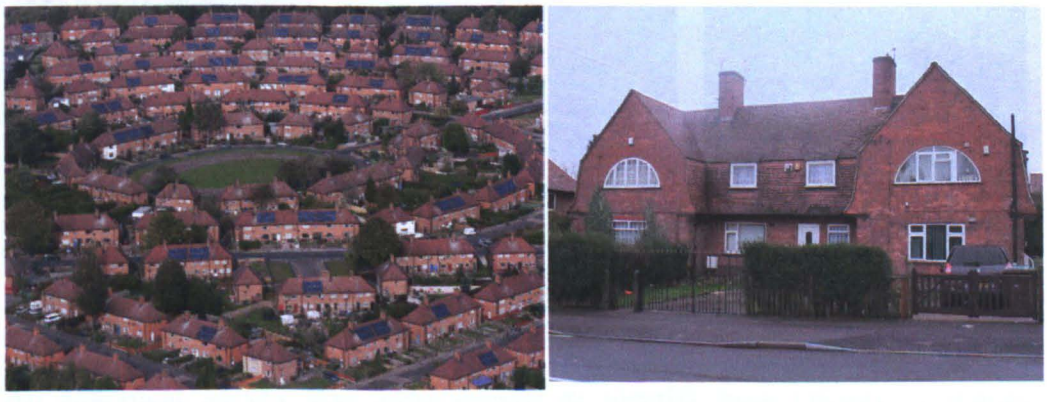

Figure 4.3 (left) Aspley estate with a significant number of solar panels, (right) A typical semi-detached house (Source: Nottingham City Homes, 2013; Nottingham Energy Partnership, 2013)

In the Mosaic[3] classification of Aspley, 78 per cent of the households are low-income families living in estate-based social housing. This percentage is 3.5

[3] Mosaic is a geodemographic dataset produced by Nottingham-based Experian describing the UK population in terms of their typical demographics and their social, economic, cultural and lifestyle behaviour.

times the Nottingham average (Nomad Plus, 2006). About 44 per cent of properties are semi-detached, with the same percentage for terraced properties; and 7.3 per cent of properties lack basic amenities[4].

About half the population in Aspley holds no qualifications. Moreover, Aspley is considered the third highest ward in unemployment rates with 14 per cent of economically active people aged 16 to 74 unemployed (Nottingham City Council, 2011). Thus, income levels are low with high levels of claims for Pension Credits and Disability Living Allowance (Nomad Plus, 2006). Most families in Aspley have priority concerns over their immediate physical environment and are less inclined in prioritising time or money on wider environmental issues (Nottingham City Council, 2011). Their primary contribution to the environment is through their usage of public transportation due to low car ownership (Nomad Plus, 2006). Only three LSOAs in Aspley ward are eligible for the ASWZ scheme according to the criteria set out in the CESP policy. These are shown in figure 4.3 below.

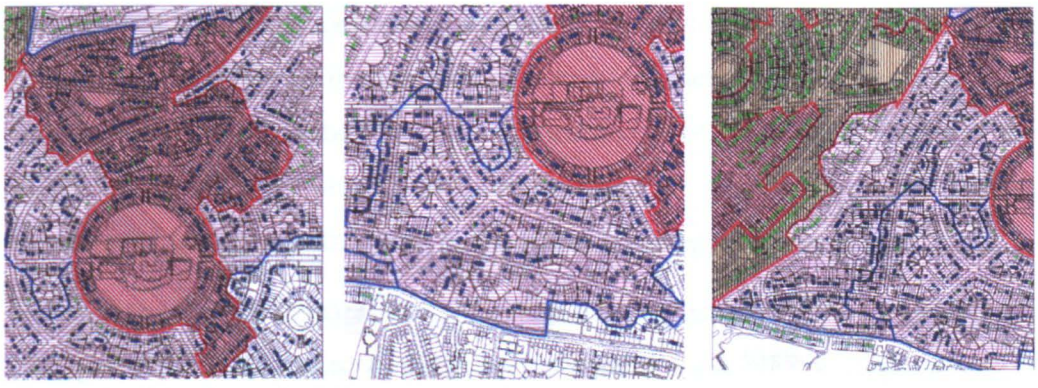

Figure 4. 4 The three eligible LSOAs in Aspley ward: E01013820, E01013824 and E01013821 (Source: Nottingham City Council, 2007)

An analytical survey was administered to identify how tenants of homes identified to be energy-inefficient react to and perceive the Aspley Super Warm Zone scheme. The survey was also conducted to develop an understanding of residents' attitudes and behaviour prior to and post-refurbishment. This will help develop appropriately tailored approaches that

[4] Not having all amenities" means lacking at least one of central heating, exclusive use of a bath or shower and an inside WC

support and maintain effective delivery of some of the current and future policy schemes.

The questionnaire therefore investigates tenants' experience with their home before and after the energy upgrade works are done by means of a two-phased survey questionnaire; A and B.

4.4.3 Questionnaire design

The survey design is based on four studies performed in the UK concerning users' behaviour in energy efficient homes; 21st Century Living Project, Revisiting Easthall (2002), Users' Behaviour (2004) and Arbed 1 Scheme in Wales. Notably, Revisiting Easthall placed a strong research emphasis on user behaviour (particularly in relation to heating controls) without considering the assessment of energy advice important. On the other hand, Users' Behaviour combined the energy advice assessment component with the emphasis on actual household behaviour in the UK social housing context. The present survey uses the Users' Behaviour approach, besides introducing a new aspect of gauging the effect of the upgrade of energy-efficiency standards on tenants' lifestyles and values concerning the environment. In addition, it explores the effect of introducing community commitment as a driver towards further lowering of energy consumption in the social housing sector in the UK.

Nottingham Energy Partnership (NEP) and Nottingham City Homes (NCH) are both partners in this research. As previously mentioned, NEP is responsible for the private sector and NCH is responsible for the social sector in the Aspley Super Warm Zone scheme. Thus, an analytical, relational survey is undertaken to explore the associations between particular variables. This is because an analytic survey is less orientated towards representativeness and more towards finding associations and explanations, and less towards description and more towards prediction, which is the overall expectation of this research (Oppenheim, 1992). The survey in this study was used primarily to sketch out household patterns of energy consumption and examine the effect of policy uptake on occupants' behaviour, lifestyles and values. It also sought to gauge the change –if any- in the behaviour, lifestyle and values before and after policy

up-take. Some precautions have been taken into account in designing the questionnaire as shown in table 4.1 below.

Table 4.1 Precautions in designing the questionnaire (Source: adapted from Brace, 2008; Le, 2007; Lehtonen and Pahkinen; 2004; Burgess; 2001; Keats, 2000; Foddy, 1993 Oppenheim, 1992; Moser and Kalton, 1971)

Precautions	Description
Clear and unambiguous	The terms used in the survey are clear and simple for the respondent to understand.
Concise	The form is as brief as possible.
Leading questions	The questions that may lead a respondent towards a certain answer.
Vague	Questions are specific in order not to create frustration and to increase the level of questionnaire completion..
Sensitive questions	Includes only those questions that the study needs.
Inappropriate order	Ask questions in a logical order, starting with easier questions, and moving to more difficult or time-consuming ones.
Time scale	Set an appropriate time in which to complete this task by reducing as much as possible the time of writing.

It is worth mentioning that the process of planning the questionnaire consumed more time than anticipated, and the questionnaires were modified several times. The questionnaire was prepared by the researcher and circulated between NEP and NCH representatives for feedback and suggestions on different aspects. The project team members were asked to advise on comprehensibility of language used, question wording and order, and the fluidity between sections and questions. The researcher also wanted to ensure that all questions incorporated would provide useful information to each partner. The researcher had to accumulate all comments, distil and refine questions accordingly, before finalising the questionnaire; while ensuring all the previously mentioned precautions had been considered and that the questions followed a logical and rational sequence (see Appendix A).

4.4.4 Sampling methodology

It is crucial to understand the methodology of the survey and data collection upon which the study findings and conclusions will be drawn. Thus, procedural details of the sample are described below. These details provide the researcher with the statistical representation, accuracy, and significance of results. Generalisation of survey findings from the sample to the total population is not

possible without understanding the details of the sampling methodology and design that have been used. The research sample design is based on the probability sampling technique which indicates that the researcher has chosen the sample with a prior knowledge that the sample will be a representative cross section of people in the population studied; in this case, ASWZ households.

4.4.4.1 The survey domain

The geographic domain of the survey is defined as the three Lower Super Output Areas (LSOAs) eligible for the Aspley Super Warm Zone (ASWZ) scheme within Aspley Ward in Nottingham, UK. In designing the sample, the aim is to collect a rich body of material comprising aspects of energy consumption behaviour, change in lifestyles and behaviour, suggestions to motivate high policy up-take and a broad range of other related information. The sample for the survey is provided by Nottingham City Homes (NCH) and Nottingham Energy Partnership (NEP), the main partners in the project. The stratified sample is selected for both phases A and B. The sample for phase A has been identified as households eligible for ASWZ that *have not yet* received any official information about it, and hence did not have the energy upgrade done. The sample for phase B has been identified as households that *have* had the refurbishment works done and have experienced the improvements for more than one year from the date of distributing the questionnaire. NCH was responsible for providing both samples for the survey.

4.4.4.2 Estimating the sample size

In planning a survey, a decision should be made about the size of the sample to use. The determination of the sample size involves balancing the demands for analysis with the feasibility of implementation and the constraints of timing. The decision on size is a significant one, as too large a sample implies a waste of resources and time, whereas too small a sample diminishes the viability of the results. The decision cannot always be made satisfactorily, for often researchers do not possess enough information to be assured that the best sample size is chosen (Oppenheim, 1992).

The use of surveys in social research does not necessarily have to involve samples of 1,000 or 2,000 people. In small-scale research, the surveys and sampling frequently range between 30 and 250 cases (Denscombe, 2007). Decisions on sample size are affected by how much variability is expected in the population from which the sample is drawn. In addition, the accuracy with which results need to be analysed, the level of confidence in the results, and the type of analysis that needs to be performed with the data, are all key factors to determine the appropriate sample size needed (Denscombe, 2007).

Thus, it is important to construct a sample frame as a list of populations from which the selection can be made. The availability of a suitable sampling frame is a major determinant of the feasibility of conducting population surveys. Having an area sample frame, of full-domain coverage and as up-to-date as possible, is a prerequisite for any sample selection process. This is either an existing sampling frame, an existing master sample, the sample of a previously implemented survey, or a list of randomly selected enumeration areas from a recently completed census.

According to the Aspley Ward Customer Profile (2004), Aspley comprises 6,264 households of which 1800 private and social houses eligible for the ASWZ scheme. The sample fraction initially aimed for was 10 per cent of the total ASWZ households; however, 122 households were successfully recruited for the study, constituting seven per cent of the total, which is still a relatively high fraction. This sample fraction was divided into both phases of the survey, A and B; 60 surveyed households prior to energy upgrade works, and 62 households surveyed post-energy upgrade works. The researcher decided to use a stratified sampling approach to select households from the NCH index of Aspley households eligible for the ASWZ. Stratified sampling ensures an equal opportunity of each unit being selected for the study in relation to their proportion within the total population (Denscombe, 2007), in this case ASWZ eligible households. In total, 224 households were approached for phase A, while 360 were approached for phase B. The researcher relied on the strength of the relationship between NCH with their tenants to achieve this relatively high response rate.

4.4.5 Questionnaire phase A

The questionnaire was self-administered; this method of data collection ensures a high response rate, accurate sampling and a minimum interviewer bias, while giving the benefit of a degree of self contact. The questionnaire was based on a scenario-building strategy and is used to map the personal constructs of a broad category of respondents. It explores gaps between tenants' expectations and aspirations, and decisions taken by policy makers that do or do not affect their energy consumption behaviour. The targeted sample for phase A was households eligible for the ASWZ scheme, but which had not received information about it yet. This was decided when choosing the stratified sample from the NCH register of Aspley.

The questionnaire includes background information about the respondents and the household, a set of questions about environmental attitudes and values, and questions about behaviour related to the functional areas: domestic heating and lighting, cleanliness, nutrition, entertainment and information. Some questions are based upon the amount of energy advice and information provided to households for more energy-efficient practices at home, indicated and provided by policy makers or electricity suppliers. The subsequent set of questions introduces community responsibility and involvement as a viable tool for raising awareness and motivations for further energy conservation in households. This set of questions offers respondents a series of options; seeking to acquire an overall sense of how community initiatives may be taken on board, along with policy initiatives, in a scenario-building approach (see Appendix A for the full questionnaire A form).

4.4.6 Questionnaire phase B

Data collected and analysed from phase A provided the basis for phase B of the questionnaire. The researcher organised a session where all the project team members (NCH, NEP, UoN) gathered to discuss the data analysis and findings from phase A to help inform phase B. Questions that provided significant correlations required further in depth investigation, and subsequently, more questions were added while others were deleted or modified.

Phase B of the questionnaire includes most of phase A; however, phase A comprised 40 questions while phase B comprised 60 questions. The section concerning ASWZ tenants' expectations from the scheme was replaced by a section that explored the tenants' experience during and after the energy upgrade work was completed. The phase B questionnaire focuses on comparing between tenants' previous experience with the heating systems, home conditions, energy bills, health conditions, and their recent experience following the upgrade. It also includes questions about any change between previous and current lifestyles, any altered values and any developed environmental actions.

The researcher was aware that the 60-question-long form would pose something of a challenge to achieve a good response rate (due to its length). Thus, this issue was discussed with project partners and an incentive for participation was introduced in the cover letter of the phase B questionnaire. This was a prize draw in which all households who successfully filled in the questionnaire would be entered for a chance to win a £25 shopping voucher provided by NCH (see Appendix B for the full questionnaire B form).

4.5 FIELDWORK PROCEDURES: PHASE A

4.5.1 Interviews

Prior to piloting the questionnaire, the researcher accompanied a marketing representative from NEP to interview two household tenants in Aspley who had the energy upgrade work done in 2010. The aim was to meet a sample of tenants who had already experienced a few months during the winter of 2010 with the energy upgrade in their homes, and perform a semi-structured interview with them regarding their experience and feedback concerning the scheme. A few questions were prepared, including:

- Before your home had solid wall insulation installed were you given a good explanation of how it would make a difference to your home?
- What was your house like before the solid wall insulation? Was it damp, draughty, etc?
- What changes have you experienced since having the insulation done?
- Have you been able to turn your heating down at all?

- Have you seen a difference in your fuel bills? i.e. if you are on a prepaid meter have you noticed you've had to top it up less?
- What does your family think about the work?
- Are you doing anything differently now you have the insulation?
- Would you recommend having the work done?

Generally, both tenants were very enthusiastic about relating their experiences, and unsurprisingly had the same worries and concerns before and during the work was done. However, they were much happier with the upgrade and believed their homes became much warmer than before. As a result, they hoped to maximise their savings. Both tenants agreed they would recommend their friends and neighbours to sign up to the scheme, provided they were eligible. The outcome of the interviews has been considered in the questionnaire design and has helped shape the questionnaire (brochures published by NEP from those case studies are in Appendix F).

The researcher also accompanied liaison officers from Frank Haslam Milan (FHM), the contractor, on two of their induction days with tenants of ASWZ, where they met 10 of the prospective clients. The induction visits were done as a routine, preliminary procedure in the scheme. FHM officers meet tenants, clarify how the scheme works, explain the work schedule, provide them with a comprehensive booklet of the work stages, and finally get them to sign a consent form and set a date for commencing the work.

By recording observations and thoughts gathered from visiting tenants who had the work done and other prospective ones, the researcher was able to build a comprehensive picture of people's overall experience. Those issues incorporated an interpretation of how tenants perceived the scheme, both positively and negatively, their worries, their attitudes, and a generic feel for their lifestyle. This helped develop the questionnaire into a more pragmatic and relevant version that is tailored to suit respondents of the ASWZ scheme.

4.5.2 Pilot questionnaire

The questionnaire had to be piloted to ensure it responds to the survey aim and objectives. In pilot studies respondents should be as comparable as possible to those of the main enquiry, as a judgemental sample (Oppenheim, 1992). Thus,

it was piloted on randomly selected households where five were interviewed by the researcher and the NCH representative while the other two forms were dropped off and collected two days later. The researcher requested the household representatives to complete the survey and provide feedback. The pilot allowed the questionnaire and the data transfer mechanism to be fully tested and was reedited to simplify the wording of several questions; also, a few vague questions were further clarified. Besides, a few questions were slightly modified to be more straightforward and to ensure the question serves its purpose.

At several instances, either the question wording or the suggested responses were adapted as follows. Question 3, concerning types and numbers of rooms in the dwelling has been modified to replace utility room with pantry and replace bathroom + wc, bath/shower w/o wc, and separate wc with bathroom according to NCH. Question 6, regarding the type of glazing was modified to exclude triple glazing, as NCH reported none of the eligible households for ASWZ had triple glazing. Moreover, the wording of question 7 has been clarified from 'what improvements have you made to your home' to 'what improvements have been made to your home' as most of the major improvements in Aspley have been undertaken by NCH. Question 11 in the pilot questionnaire proved too complicated as it included two questions in one 'what heating control(s) do you have? How often do you use them?' Thus, in the modified version of the form, the question was broken into two separate questions for more clarification. Besides, a question was added in the questionnaire concerning the general health of the respondent as this was recognised as an important aspect to compare between phases A and B. Other minor changes were made and could be referred to in Appendix G. A noteworthy benefit of the pilot questionnaire has been to demonstrate the importance of personal contact with respondents that enhances the response rate in a relatively short period of time.

4.5.3 Data collection and production

The survey team comprised the researcher, an NCH officer and, on a couple of occasions, an NEP officer. The phase A questionnaire was distributed and collected in May-June 2011. The hard copies of the questionnaire were distributed and collected from targeted households personally by the survey team. According to the stratified strategy of sampling, 300 selected addresses of households eligible for ASWZ who had not, to date, been contacted by NCH. The aim was to target as many of those as possible for phase A to be completed. A total of 224 households were approached, and the outcome was 60 successfully completed forms. The non-response and refusal rate for completing the questionnaire in this paper-based survey accounted for 70 per cent. On a number of occasions, the researcher had to go back more than once to collect the form, due to unanswered calls, or tenants' forgetfulness. The questionnaire was answered by the person representing the household in the majority of cases.

The data collected were entered to SPSS and the coding has included identifying valid responses to the closed, semi-closed and multiple response questions as well as to responses to the open-ended questions. Each coded response category was used as a variable in SPSS for subsequent statistical analyses. SPSS software was exploited to produce descriptive and frequency statistics and to perform regression analyses tests used to compare levels and rationale for tenants' energy consumption behaviour and home energy performance in ASWZ. Variables were grouped under three categories in SPSS; nominal questions (yes, no), ordinal questions (never, sometimes, often), and Likert scale questions (5-point scale questions). Consequently, the study investigated the correlations and significance of multiple variables and provided significant outcomes.

4.6 FIELDWORK PROCEDURES: PHASE B

4.6.1 Data collection and production

As previously explained, before designing and distributing questionnaire B, phase A had to be analysed and discussed among the project team members to construct a meaningful process. Thus, phase B questionnaire was designed to include more questions tailored to address, in further detail, respondents' home energy use, home performance, fuel bills before and after, experience with the scheme before and after, and also more socio-demographic information. Questionnaire B was distributed and collected from May to September 2012. The researcher required another stratified sample of a list of addresses of households which had ASWZ scheme completed for more than a year to date. The reason is to ensure tenants had the opportunity to experience a full year, particularly a whole winter season, in their more energy-efficient homes. A list of 427 properties was provided by NCH where, as in phase A, the researcher and NCH officer started approaching the properties on a door-to-door basis.

Thus, a sample of 160 households was initially targeted over a period of four weeks. In phase A, refusal and non-response rate accounted for 70 per cent, while in phase B, the non-response rate went up to 82 per cent. This higher rate was due mainly to the length of the questionnaire and partly because people had already had the works done, so they were probably not interested in participating – even with the prize draw incentive. In total, 28 responses were obtained in this first stage, answered by the person representing the household in the majority of cases.

As the door-to-door approach in phase B seemed less effective than that adopted in phase A, the project team members decided to seek another approach, and instead posted the forms to the addresses accompanied with a pre-paid envelope. The plan was to start with 100 forms posted, followed by a phone call from NCH to encourage people to participate and thus boost the response rate. Notably, this proved a successful approach, as 22 more forms were successfully completed and posted through to NCH over a period of three weeks thus proving more time-effective (although more costly). With 50 forms

collected, a minimum of 10 more were required to provide an appropriate sample equal to that of phase A, in order to ensure a balanced, comparative analysis between both phases. Thus, the process was repeated with another 100 forms posted to households of ASWZ. However, because the form was sent out during the school summer holidays, only 13 forms were successfully completed and posted back. Thus a total of 62 completed forms were input into SPSS and the previously explained method for analysis was used.

4.7 LIMITATIONS OF THE STUDY

Although the research attempts to introduce several implications of people's energy consumption behaviour on policy delivery, it does not explain the theoretical background of environmental psychology. This has not been the focus of the study, as this domain is very specific to the field of psychology. However, the researcher has touched on theories of behaviour during the desk top study to learn about the underlying basis of human behaviour.

A few challenges have evolved when applying the mixed methods approach; the need for extensive data collection, the time-consuming quantitative and qualitative data analysis, and the requirement for the researcher to probe into both research strategies of inquiry, qualitative and quantitative (Creswell, 2008). The researcher was also aware that the qualitative data collected from open-ended questions were not as evocative and meaningful as expected. The reason was that more than half the respondents chose not to answer those questions, probably due to the fact that open-ended questions can prove more time consuming for the respondent. Most of those who responded appeared to have some area of discontentment that they wished to complain about within the scheme, but some praise was also forthcoming.

Another limitation of the questionnaire as a data collection method is that questionnaires provide little opportunity to check the truthfulness of respondents as there is no direct interaction between the researcher and respondent. Furthermore, as is the case in most surveys, the challenge of raising people's interest often results in low response rates. The process of distributing and collecting the questionnaires also possibly consumes more

time than planned. Thus, the time factor needs to be carefully considered in similar research studies.

CONCLUSION

The rationale of the research has been described to provide grounds for the study. It has highlighted that incentives and knowledge could possibly drive energy conservation in the domestic sector (Lutzenhiser, 2002). The rationale of the research also illustrated that the UK Government's energy policy plans could possibly deliver on its aim by tailoring the schemes for each targeted sector, thus engaging the public and motivating policy uptake.

The research question is then posed, "What are the implications of people's energy consumption behaviour and lifestyle on the success or failure of policy delivery in the UK domestic sector?" The research sets out to trace the threads that may lead to the answer; thus the research conceptual framework is drawn to illustrate the mixed methods approach employed, with a single case study utilised for advanced investigation. The survey is undertaken in one of the pilot CESP schemes in Aspley, Nottingham. The scheme provides a whole-house retrofit in a house-by-house, street-by-street approach to improve the energy performance and thus reduce energy consumption.

Subsequently, the research design model is illustrated to explain how the research process was planned through to respond to the research question(s), in search for viable solutions. The research strategy of enquiry explained is a mixed methods strategy where the research methods were planned to collect qualitative and quantitative data concurrently. The questionnaire design, planning, sampling and data production procedures were then elucidated in detail to provide a clear account. Finally, several limitations encountered in the study have been stated to help future research attempts to possibly overcome them.

The following chapters will explore the survey findings of phase A and B, and will interpret those through correlations and further statistical analysis to map up the 'before ASWZ' and 'after ASWZ' phases.

CHAPTER FIVE

SURVEY ANALYSIS- PHASE A

Chapter Contents

INTRODUCTION

The research proposes the identification of critical requirements within policy instruments that might alleviate energy consumption in the domestic sector by means of a thorough survey. The study focuses on the potential effect of the CESP policy scheme on lowering energy consumption in the domestic sector by critically examining key findings from the Aspley Super Warm Zone (ASWZ) scheme. The aim of phase A of the survey is to understand home conditions, fuel bills, tenants' lifestyle and energy consumption behaviour and their anticipations from the upcoming ASWZ scheme. Thus, the survey designed for this phase is to map the experiences of this sample of tenants within the geographic domain of the ASWZ. Out of 224 households approached, 60 questionnaires were successfully completed. This chapter starts by illustrating general survey findings, and delves into interpretation through correlations and further statistical analysis to map the 'before ASWZ' phase. The findings are highlighted and discussed to feed into the next stage of the research; where the first part of the chapter paints a general picture of the survey findings whilst the second part critically analyses the findings using statistical analysis.

5.1 GENERAL SURVEY FINDINGS

Phase A of the questionnaire explores in detail a number of aspects that affect people's decisions and attitudes concerning energy-efficiency measures, i.e. demographics, current experience with home conditions and heating efficiency, general energy awareness, and method of advice and information preferred. Another important objective is to gauge participants' level of understanding and expectations from the Aspley Super Warm Zone scheme, and reasons for accepting or refusing to join it. The questionnaire design has been explained in chapter 4 (see appendix A for the full questionnaire).

5.1.1 Residents' socio-economic characteristics

This section comprises the analyses of questions 1-3 and 36-41 concerning households' socio-economic position, length of residency, tenancy situation, age, employment, and means of transport. A total number of 177 people were

covered by the survey; 68 infants and children between 3 and 12 years, 17 teenagers, 84 adults between 20 and 65 years and 8 adults over 65 years. Two-thirds of the sample lives in social/council housing (67 per cent). Concerning the length of residency, half the sample lived in the same households for less than five years while 45 per cent lived in their homes in Aspley for more than 10 years. This has been found to be due to health and mobility issues, proximity to family and friends, and the need to sustain their affordable homes.

The labour force demographically is defined as including all people that contribute with physical or mental efforts to the production of goods or services (in other words, those who are employed), as well as those who are capable of working and are searching for a job but have not found one yet (the unemployed) (Barth & Heffley, 2004). Employment status of occupants (age between 20 and 65) of sampled households is: 55 per cent are employed, 30 per cent unemployed, while 15 per cent are economically inactive. According to ONS (2012), the labour market statuses reports that nationally, 58 per cent are employed, 37 per cent economically inactive, whilst 5 per cent are unemployed. It is clear that in Aspley, the percentage of unemployed is much higher than the national average, which highlights one of the reasons that the area is characterised by being economically deprived.

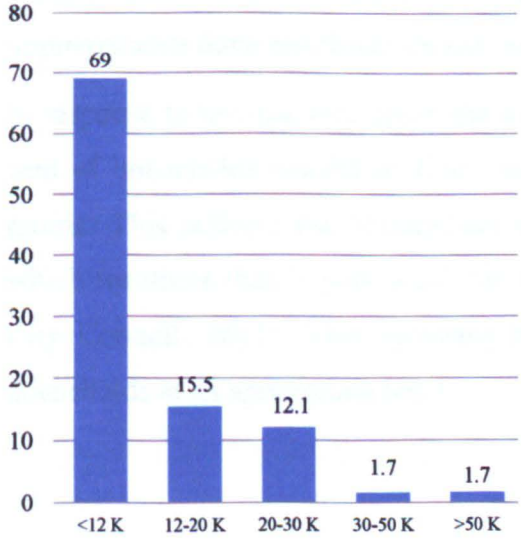

Figure 5.1 Total income of household

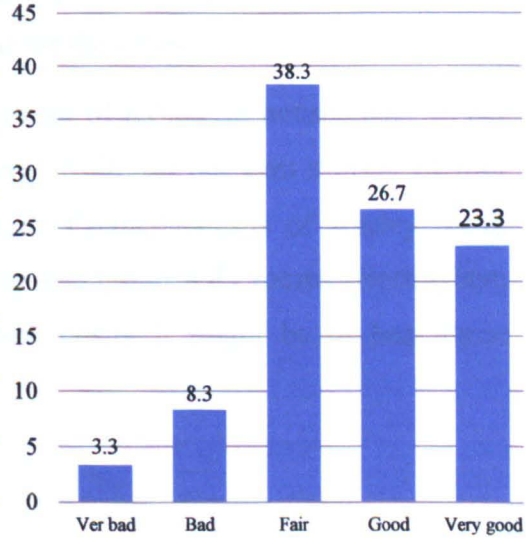

Figure 5.2 General health of respondents

The survey illustrated that there is one dominant group in Aspley, municipal dependency (low income families living in social/council housing). This group comprises 69 per cent of the sample, where the total annual income of the household is less than 12 thousand pounds, as illustrated in Fig 5.1. This group is on a low-income scale and mostly on benefits (Nomad Plus, 2006). Families within this group tend to spend what they have on the basics and on entertainment (Nomad Plus, 2006). From the questionnaire results, 62 per cent do not own a car, while 38 per cent own one or two cars.

The questionnaire also took into account the health conditions of respondents due to the direct impact of cold and damp home conditions on residents' health. The purpose is to gauge whether residents' health conditions have relatively improved or even degraded after their home improvement in the second phase of the project where the second questionnaire was administered (phase B). Thirty eight per cent reported a fair state of health, while 12 per cent reported it to be bad or very bad. The remaining 50 per cent reported their health as good or very good, as illustrated in Fig 5.2.

5.1.2 Home information

This section comprises the analyses of questions 3-8 concerning the number of rooms, main and secondary heating systems, type of glazing, home improvements done and those considered for the future.

In response to the question about the number of rooms[5] in households; 70 per cent of households consist of five rooms, while 30 per cent consist of four rooms. This reflects the Nottingham City Council census of Aspley ward, which mentions that Aspley ward has an average of 4.85 rooms (Nottingham City Council, 2011). This indicates how costly it might be to heat those households at an appropriate level.

[5] "Rooms" excludes bathrooms, toilets, halls and landings, and rooms which can be used only for storage are excluded. Kitchens are included.

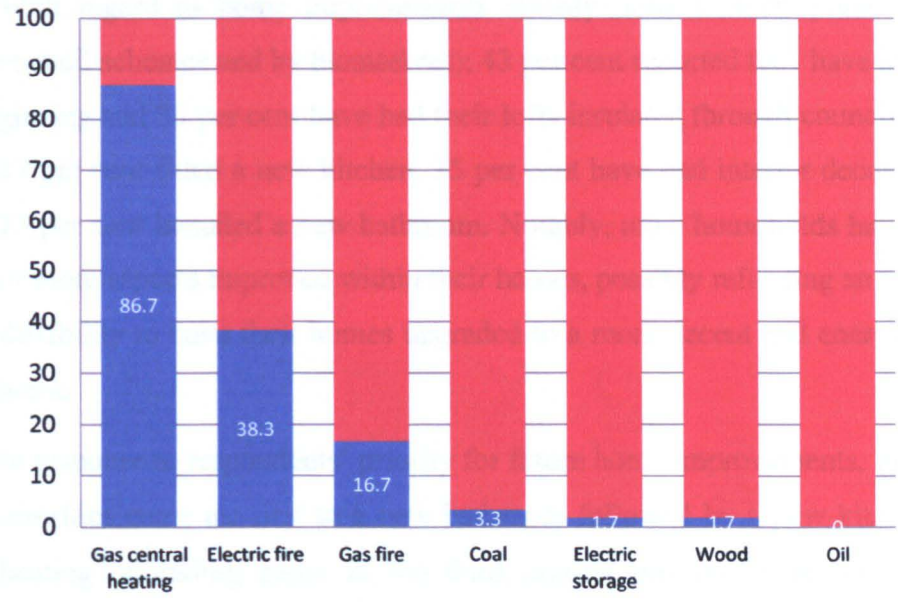

Figure 5.3 Main heating systems

Concerning the main heating system; 55 per cent reported gas central heating only as their primary heating system, 33 per cent of households reported having both, gas central and electric fire as their two main heating systems, while 7 per cent reported electric fire as the main heating system. The type of main heating systems reported in the questionnaires indicated considerable variation with the information provided by NCH. In fact, the majority of social housing in Aspley has gas central heating as the main heating system. A likely possibility for this variation is that some of the low-income households might believe that using their central heating systems could be too costly and thus would prefer to use their electric fire for heating mainly their living rooms.

As for the secondary heating system; the majority of households – 70 per cent - reported not having a secondary heating system, while 20 per cent use portable electric, and 10 per cent have gas wall heaters as a secondary heating system. In addition, 91 per cent of households have double glazed windows while the rest have single glazed or a mix of both. The high rate of households with double glazing goes back to the Decent Homes, and Secure, Warm and Modern schemes launched by Nottingham City Homes 2008 and 2011 respectively. Those schemes ensured that social housing should meet a minimum level of decent standards with specific home energy improvements, with double glazing as a priority.

With regard to home improvements already done to their homes (through council schemes and by themselves); 43 per cent reported they have had double glazing and 33 per cent have had their lofts insulated through council schemes, 37 per cent fitted a new kitchen, 35 per cent have had interior decoration, and 23 per cent installed a new bathroom. Notably, most households have had two or more aspects improved within their homes, possibly reflecting an anticipated flexibility to have their homes upgraded to a more decent and energy efficient home.

In response to respondents' priority for future home improvements, the order of priorities came as: first to a new bathroom followed by a new kitchen, while heating upgrading came as the third highest priority. This could possibly encourage people to sign up for the CESP intervention as it would provide those households with modern bathrooms and kitchens. Fifteen per cent of the respondents reported they would not consider any improvements in their homes due to ill health, age-related problems or they had already invested in some improvements (e.g. a new kitchen fitted, interior decoration, new bathroom), although they understood home improvements would be done for free. Seventy five per cent are not prepared to pay any contribution towards home insulation and energy-efficiency improvements in response to the fuel price rise. Financial constraints could be one major reason for this. Another reason might be that the majority of the sample do not own their houses and would not consider investing a significant proportion of their disposable incomes for measures they might not benefit from if they move or if they were to sell their owned properties.

5.1.3 Home use and performance

This section includes the analyses of questions 9-22 concerning problems in their homes, heating patterns, heating controls and trends in using them, monthly utility bills and method of payment, if they have changed the energy supplier and why, and whether they require energy advice and the format they would prefer it in.

In regard to problems in their homes, respondents were asked about how frequently they have experienced damp, mould, cold, draughts, condensation or any other problems. The bottom bar represents problem issues that have 'always' been experienced, while the top bar represents those which have never been experienced. These problems provide significant correlations with other variables in subsequent sections of this chapter.

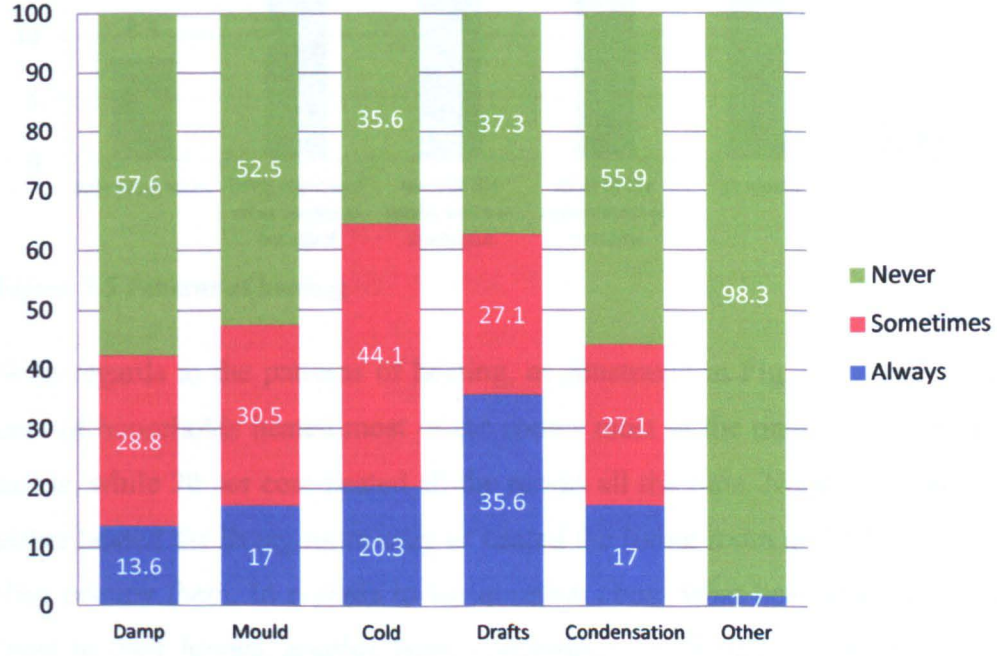

Figure 5.4 Problem issues experienced at home

It is illustrated in Figure 5.4 that respondents always and sometimes experienced cold 64 per cent and draughts 63 per cent, followed by mould 48 per cent and condensation 44 per cent, and finally problems of damp 42 per cent come at the end of the list. Most respondents reported the cold and draught were due to the worn out front and back doors that were not addressed within many of the home improvement schemes launched in Nottingham. Notably, the Secure, Warm and Modern scheme states that doors are only replaced if they are 'warped, rotten or beyond repair', which is not the case in most homes in Aspley.

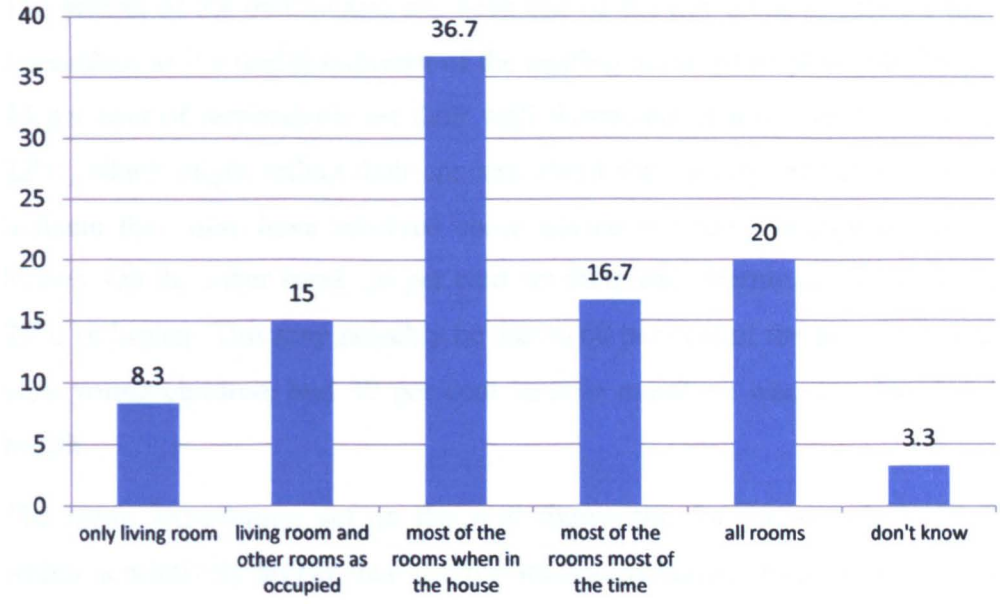

Figure 5.5 Patterns of heating

With regards to the patterns of heating, as illustrated in Fig 5.5, nearly 53 per cent of households heated most of the rooms most of the time and when in the house, while 20 per cent heated all the rooms all the time. Notably, 23 per cent either heated the living room only or heated the living room and other rooms as they occupy them. In regards to the question about what heating controls they have in their homes, another issue concerning conflicting information to that provided by NCH has evolved. This may reflect the lack of knowledge of respondents concerning their heating controls and how efficiently they use them. Also, it may reflect the little advice they get from utility providers concerning how to use their systems efficiently. Of the sample, 33 per cent reported they have all three heating controls mentioned in the question; thermostatic radiator valves (TRVs), wall thermostat, and boiler thermostat, while 38 per cent of households reported they have only one heating control (most of those had only a boiler thermostat), although nearly all homes in Aspley have TRVs and most of them have wall thermostats (NCH, 2011). Regarding the frequency of using the heating controls available, 42 per cent reported they sometimes use them, while 39 per cent always use them and 19 per cent never or do not know how to use them.

The setting of the thermostats has been one of the key areas of interest for the researcher, as it a useful indicator of the heating trends of respondents. Notably, 44 per cent of respondents set their wall thermostat at a temperature less than 22°C, which might reflect their concern about their utility bills and might also indicate they may have received some advice regarding energy use in their homes. On the other hand, 26 per cent set their wall thermostat temperature at 22°C or higher. This may possibly be due to 60 per cent of the sample including very young children, and 30 per cent include members who are disabled / ill health.

The mean temperature set on the wall thermostat for the sample is 22.5°C, which is relatively higher than the recommended temperature for user comfort and energy saving, which lies between 18 and 21°C. By examining the heating trends, we can posit that nearly 40 per cent of households in Aspley require comprehensive guidance on thermostat setting if the scheme is to deliver its aims of cutting down on energy bills and usage.

Another important aspect questioned has been the monthly utility bills for gas and electricity. Notably, based on the responses, the mean figures for monthly gas bills and monthly electric bills are £51 and £50 respectively. This means that an average household in Aspley spends £100 per month on utility bills, which comprises a significant proportion of the income of these households. This enforces fuel poverty, where households are defined as being in fuel poverty if they require 10 per cent or more of their income to attain the recommended minimum temperatures of 21°C in the living room and 18°C in all other rooms (WHO, n.d.).

With regards to methods of utility bills payment, 55 per cent use the prepayment meter method which directly relates to the low income of households in this area; 22 per cent of the sample pays by monthly direct debit, while 10 per cent use payment cards.

The attitude to supplier change may be an indicator of energy awareness; 35 per cent of the respondents report they have changed their electricity/gas supplier recently. The reasons most commonly reported by respondents for this were to find a better deal and to save money. The majority, 65 per cent, decided not to

change their supplier mainly because they did not want the hassle of changing, while others were satisfied with the services provided by their current suppliers.

When asked about receiving any energy advice, 28 per cent reported they have received some advice from their suppliers through booklets and fliers, door-to-door sales, and via online energy tracker. On the other hand, the majority of respondents 72 per cent mentioned they have never received any advice concerning saving energy. However, it is not clear whether those who have responded that they 'never' received any advice may in fact, have received some, as they may have been sent leaflets that they were not aware of. It is also not clear whether those who have received advice actually acted on it. Thus, the subsequent question was concerned with whether they would prefer to receive energy advice.

Notably, only 47 per cent would prefer to receive any advice concerning energy savings, while 53 per cent would not. The qualitative data analysis indicated that many people had problems and concerns they tended not to consider listening or reading any advice on energy that they believed was effective less. The majority of those who preferred to receive advice chose to receive it in written format such as leaflets and booklets, while some others preferred one-to-one support/visit to be provided with more comprehensive information.

Regarding household energy-saving appliances, 60 per cent of households have energy-saving lamps. It was reported that many households in the area have been given the lamps for free (NCH, 2012).

5.1.4 Lifestyle and behaviour

The following set of questions is split into two parts; lifestyle of respondents, and their energy consumption behaviour. It is worth mentioning that from the Office for National Statistics ONS (2011); 89 per cent of adults aged 16 and over watched television more than 3 hours a day, 59 per cent used their computers more than 2 hours a day for internet and mailing while 67 per cent spend their leisure time in reading (Seddon & Beaumont, 2011). The ONS statistical data has been found to be quite similar to the data collected from the study and hereby presented.

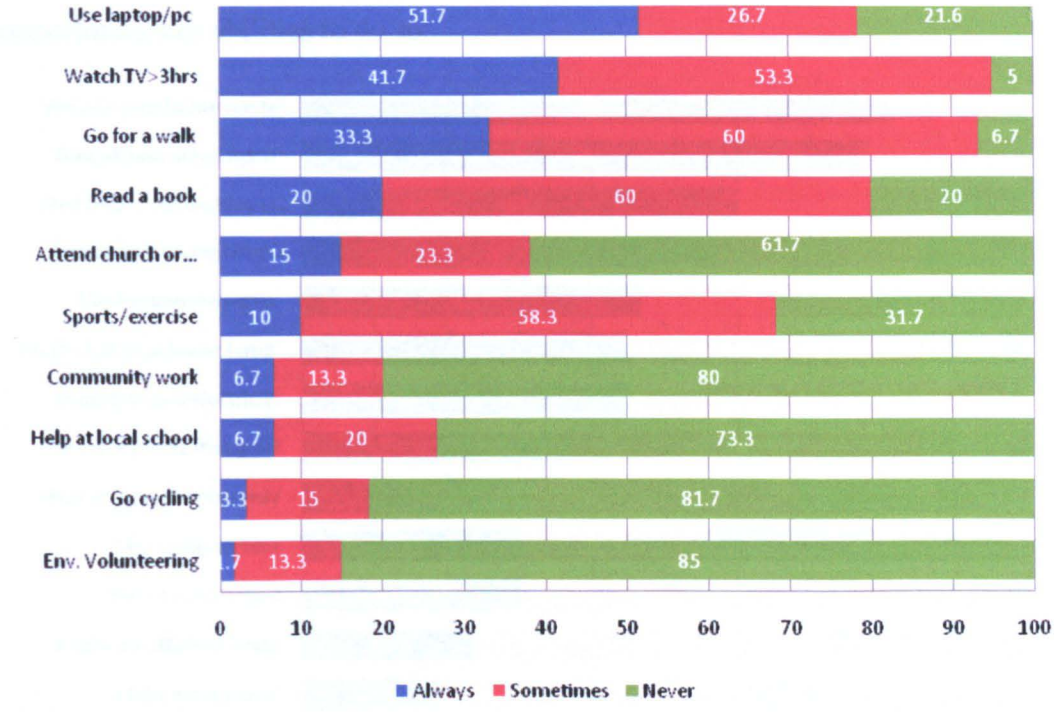

Figure 5.6 Lifestyle patterns

From Fig 5.6, it can be seen that more than half the sample always use their computers and laptops on a daily basis, while 42 per cent watch TV more than three hours a day. This may be due to the high numbers of unemployed and economically inactive respondents who might spend most of their time at home using their computers or watching TV; thus consuming more energy than households with employed members. One third of the sample always go walking, 10 per cent practice sports/exercise, while only 3 per cent go cycling. Twenty per cent often read books, while 15 per cent attend church (or other) frequently. Of the sample, 7 per cent reported that they help at the local school, 7 per cent volunteer in community work, and only 2 per cent volunteer for environmental work.

When asked if they are interested in volunteering to improve their local community, only 27 per cent agreed they would like to volunteer. Notably, Nomad Plus (2006) reports that many people in this area might be environmentally aware, but could not afford to support environmental activities or buy environmentally friendly products. Thus, people might have the

motivation for a more pro-environmental lifestyle, but they might not have the opportunities or abilities to do so.

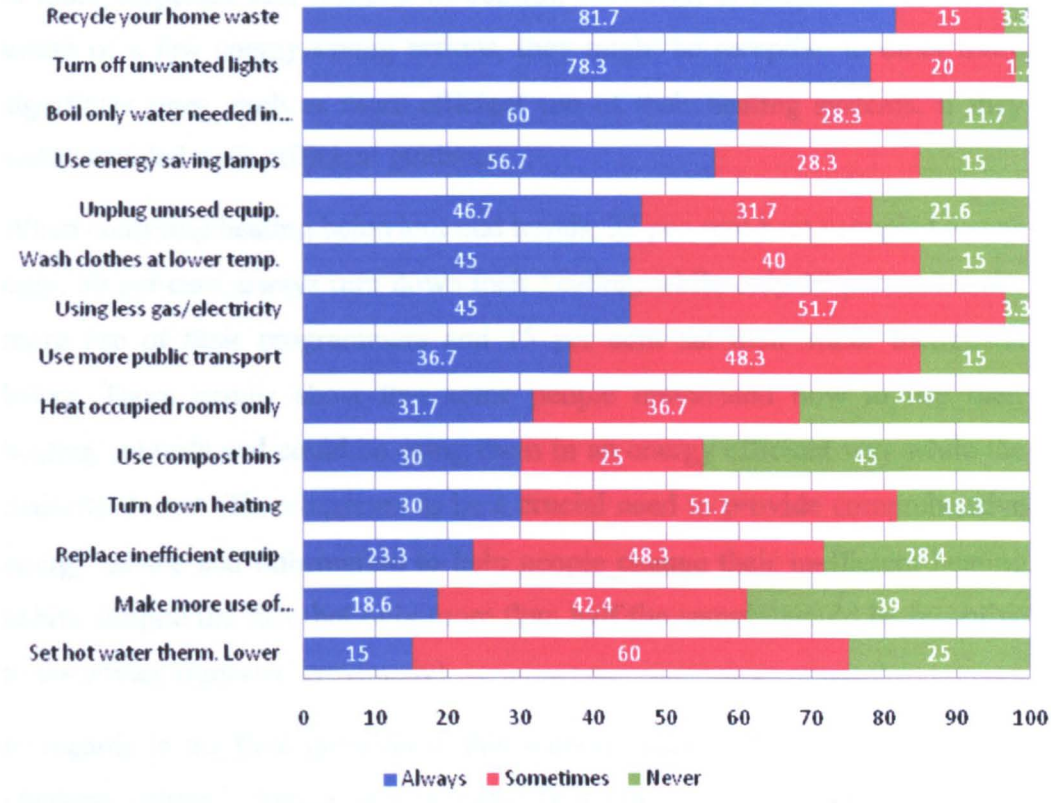

Figure 5.7 Energy consumption behaviour

In response to questions concerned with their energy awareness and behaviour 82 per cent always recycle their home waste while 30 per cent use their compost bins. This may be due to the consistent information campaigns communicated via media sources about recycling as opposed to composting, and also due to the accessible and available recycling facilities and points provided by Nottingham City Council across the city. Defra (2008) reported that recycling rates for households have risen approximately 40 per cent in England on the previous year rate, which indicates that recycling has become more of a habit than a one-off action.

The following top actions taken by respondents are to turn off unwanted lights, use energy-saving lamps and unplug unused equipment, with 78, 57 and 47 per cent respectively. Besides, 60 per cent always boil only water needed in kettle, while 45 per cent wash clothes at lower temperatures. This might reflect their

basic awareness of the link between electricity use, electricity bills and actions that can be easily controlled. On the other hand, controlling the heating patterns is more dispersed and difficult to control. However, if people are relatively aware of a few energy-saving actions, they might be receptive to other more significant ones, such as more efficient use of their heating systems, if they were provided with sufficient guidance.

When analysing heating behaviour and trends, 32 per cent heat occupied rooms only, 30 per cent always turn down their heating, while only 19 per cent make more use of their programmers and 15 per cent set their water thermostat lower. These results show that some people understand how to use their heating controls and could be using them in an energy efficient way while the majority do not. There appears to be a crucial need to provide comprehensive energy advice and information to help people change their inefficient heating habits, despite the fact that only more than half the sample would be receptive to the advice (reported previously).

In regards to the final question in this section, 'reasons for taking any of the previous actions', saving money came first where 73 per cent chose 'save money' along with one or more of other reasons (save energy, habit, environmental concern). Twenty five per cent have chosen to take these actions to save money only as the dominant reason, 18 per cent take these actions both to save energy and due to environmental concern, while 15 per cent take these actions due to habit only. This shows that the priority for most of the people is to save money which, besides the low income that the majority of this area is on, it also implies a general concern for people at a time of flagging economy and rising fuel prices.

5.1.5 Attitudes and opinions towards the ASWZ scheme

The questionnaire forms were distributed among households eligible for the ASWZ scheme that had not officially received information about it yet. This section investigates whether they have heard about the scheme and, if so, how. This might help understand how people might access information about upcoming policy schemes and might help in providing means for disseminating

policy information. The section (comprising questions 27-34) provides some basic information about the scheme, then asks what people think of it, whether they would consider signing up for it, and what they expect the benefits would be.

Only 30 per cent of the sample had heard about the scheme, and 37 per cent of those knew about the scheme through information leaflets. Although they have not received information packs from NCH, they may have seen the leaflets at the community centre, or leaflets may have been dropped in to their homes through the contractor. Of the sample, 21 per cent had heard about the scheme from the contractor liaison officers who always work within the area, while 16 per cent knew about it from neighbours and 16 per cent visited the show home. When people who heard about the scheme were asked what they understood the scheme to be about, the majority replied its aim was to help households save money. Others thought it was to make homes warmer and to save energy. This indicates that some people were interested in learning about the scheme even before they receive official information packs. A couple of respondents, however, believed it to be a scheme that would 'cause a mess in their homes' and that 'providers aim to charge more for less'. This reflects that some people might not fully trust government schemes are launched for people's advantage.

A brief explanation of the ASWZ scheme is then provided in the question that followed. In response to what they thought about it, 40 per cent chose all three positive aspects of the scheme; good to improve their homes, good for the environment, and good to reduce their energy bills. This indicates that many respondents think they would benefit from the scheme and perceive it as an advantage. Only 5 per cent (two respondents) thought the scheme is intrusive and serves no purpose.

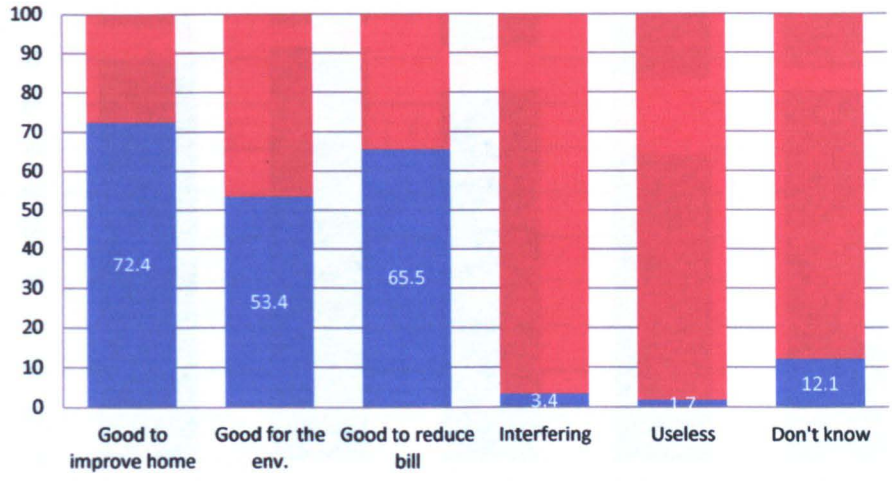

Figure 5.8 Residents' opinions of the ASWZ

In response to the question asking whether they would consider signing up for the scheme, 68 per cent reported they would, 29 per cent would not, while only 3 per cent were undecided. Further, 53 per cent of those who would consider signing up for the scheme did not know about it beforehand, while 47 per cent of them would sign up, now that they had learnt about the scheme. Respondents who would sign up to the scheme expected a warmer home and to pay less on energy bills as the benefits of the scheme, followed by improving home conditions then doing something good for the environment. The benefit cited the lowest (but was still surprisingly relatively high), was to add value to the property. A reason for this, discussed previously, may be that two thirds of the sample lives in social housing, thus adding value to the property did not seem to be their concern, unless they considered buying the property.

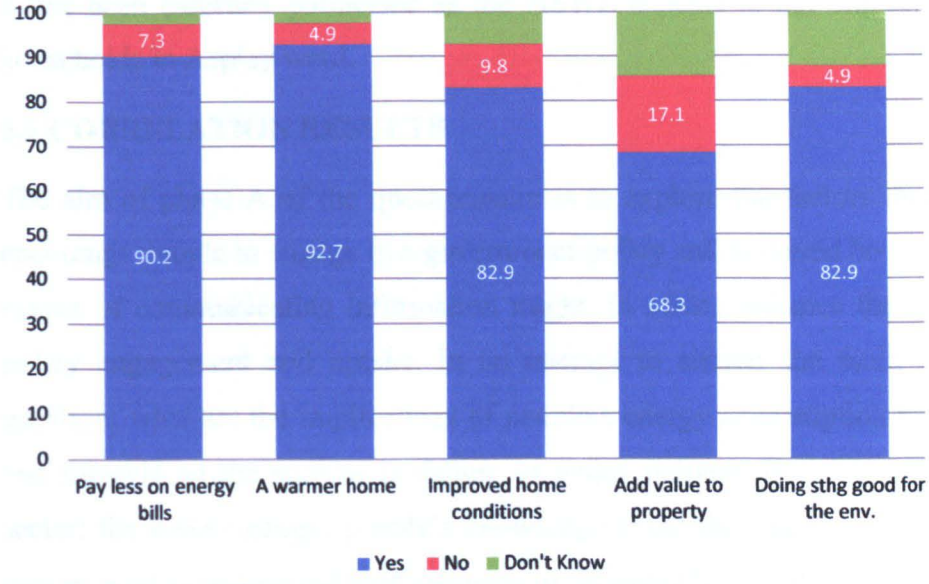

Figure 5.9 Anticipations from ASWZ

For the 29 per cent who would not sign up for the scheme, they were asked what the reasons were for not doing so. The majority of them responded that they would not want the disruption and hassle in their homes, a third of those reported they had already had home renovations, while a quarter reported that their ill-health prevents them from signing up. The following question concerning what would help them change their mind and sign up helped highlight a few important issues that could be taken into consideration by policy makers. Of those who would not sign up, 24 per cent needed more technical information about how the scheme works and how work will proceed in their homes. The same percentage agreed that more hands-on information may help them change their mind, while 12 per cent opted for more physical help, and 18 per cent needed a guarantee of workmanship to convince them. The rest, 22 per cent did not choose any response, which might indicate that their decision was final, and thus other means of persuasion may be required. They might be more receptive to hearing from people who had already had the work done, and thus find out through others' experience how effective the scheme is. This has already been done on a small scale through NEP with five case studies that have been interviewed and their complete experience of ASWZ publicised to encourage other residents in Aspley to sign up. However,

it has been carefully publicised as the ASWZ scheme is not eligible for all households in Aspley ward.

5.2 CORRELATION RESULTS

The aim of phase A of the questionnaire is to explore the factors that would encourage people to engage in a government policy and explored how different means of communicating information might, in effect, enhance the levels of policy engagement and uptake. In an attempt to answer the main research question: what are the implications of people's energy consumption behaviour and lifestyle on the success or failure of policy delivery in the UK domestic sector; the survey gauges people's knowledge about their heating systems the survey tried to understand how residents of households identified to be energy-inefficient use their heating systems, their lifestyle and behaviour, and how they react to and perceive the upcoming scheme of ASWZ. Thus, as described in the previous chapter, SPSS software was exploited to produce descriptive and frequency statistics and to perform regression analyses tests used to compare levels and rationale for tenants' energy consumption behaviour and home energy performance in ASWZ.

5.2.1 Correlation between tenancy situation and other variables

As mentioned in the general survey findings section, 67 per cent of the sampled households live in social housing; thus exploring correlations between social housing tenancy and other variables have been given priority. The reason is that ASWZ scheme was launched for the social housing sector in spring 2010, while it was launched for the private ownership housing sector in winter 2011. Thus, in finding meaningful correlations it is possible to detect patterns of behaviour and attitudes that might help predict behaviour and attitude in private tenancy. Notably, the disparity between the scheme for the social housing and the same scheme for the private housing is that it is completely free for the former. Concerning the private tenants, 40 per cent of the work will be funded by NCH and Scottish and Southern Electric (SSE), while the remaining amount should be met by tenants through interest-free loans made feasible by Nottingham Credit Union. To find the best financial arrangements

for tenants, NEP has been responsible for ensuring a set of appropriate financing agreements have been provided in due course for the launching of ASWZ for the private sector.

By exploring correlations between social tenancy and other variables, some moderate and other weak correlations have been found. A negative (moderate) relation appears between social tenancy and total income of household ($r = -0.376$, $p < 0.001$), while a positive (moderate) relation appears with the number of unemployed members per household ($r = 0.356$, $p < 0.001$). This indicates that more social housing households have considerably low annual income (less than £20,000). However, the problem of fuel poverty in Aspley is highlighted, as the mean of average monthly gas bills of the sample is £51, and the same for electricity bills. A positive relation appears between social tenancy and average monthly gas bill ($r = 0.465$, $p < 0.005$). Another positive (moderate) relation appears between social housing and paying utility bills by prepayment meter ($r = 0.465$, $p < 0.001$).

A remarkably high relation appears between social housing and electric fire main heating system ($r = 0.537$, $p < 0.001$). Although most households in Aspley have gas central heating as their main heating system, many consider electric fire as the main heating system where they use if for heating living rooms. Social tenancy is strongly related to problems with draughts ($r = 0.45$, $p < 0.01$). Significant negative relations appear between social tenancy and people who have had loft insulation for home improvement ($r = -0.431$, $p < 0.01$). This might imply that some households in the social sector have not had loft insulation or that they might have had it before they moved in to their homes. It has been reported by NCH that lofts needed to be cleared away from clutter to be possibly insulated through ASWZ scheme, which is not the case in many household lofts in the area.

Table 5.1 Means, standard deviations and correlations between social tenancy (M= 1.78, Sd= 0.47), socio-demographic variables and home use determinants

Independent variable: Tenancy (Social housing)	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Number of unemployed members in household	0.37	0.522	0.006	0.356**
2. Total income of household	1.78	0.47	0.004	-0.376**
3. Average monthly gas bill	50.7	21.731	0.041	0.279*
4. Payment method: prepayment meter	0.55	0.502	0.001	0.465**
5. Main heating system: electric fire	0.4	0.49	0.001	0.537**
6. Problems at home: draught	0.98	0.86	0.001	0.45**
7. Improvements made to home: loft insulation	0.33	0.475	0.001	-0.431**

Tenancy type: 1 'private ownership and 2 'social housing'. Years lived in house scale runs from 1 'less than 12 months' to 5 'more than 20 years'.
Total income scale runs from 1 'less than 12K' to 5 'more than 50 k'. Payment method 1 is prepayment meter. Main heating system: electric fire; 0 'No' and 1 'Yes'.
** $p < .001$, two-tailed
* $p < .05$, two-tailed

5.2.2 Correlation between home heating trend and other variables

From the general findings of the survey, 37 per cent of respondents reported they heat most of the rooms when in the house. This proved to relate to a number of aspects in their home use and performance. A positive relation appears between electric fire as a main heating system and the dominant trend of heating (heating most of the rooms when in the house) ($r=0.44$, $p<0.001$). Although this system is only used to heat living rooms, the fact that it came second in main heating systems indicates that because most of the respondents do not have full understanding of the heating systems in their households, they believe electric fire to be their main heating system. Another positive relation is detected between respondents who reported they have thermostats and those who heated most of the rooms when in the house ($r=0.3$, $p<0.05$).

On the other hand, households with this heating trend seem to report inadequate loft insulation in their homes ($r= -0.3$, $p<0.05$). This could either be due to not having any loft insulation done during their occupancy or due to

their not knowing whether their lofts are appropriately insulated or not. As for people's energy consumption behaviour, there are both high and moderate negative correlations between households with the dominant trend of heating, and those who wash clothes at lower temperature ($r=-0.335$, $p<0.001$), those who set their hot water thermostats lower ($r=-0.291$, $p<0.05$), and those who boil only water needed in kettle ($r=-0.247$, $p<0.05$). This indicates their unawareness of energy-saving actions and tips for cutting down on energy bills. However, households with this dominant heating trend seem to prefer receiving advice on cutting energy use and bills ($r=0.272$, $p<0.05$).

Regarding households' anticipations from the ASWZ scheme, a negative correlation is perceived between the dominant heating trend and those who anticipate improved home conditions from the ASWZ scheme ($r=-0.318$, $p<0.05$). Households with the dominant trend of heating most of the rooms when in the house would consider signing up for the ASWZ if provided with more technical information ($r=0.726$, $p<0.05$).

Table 5.2 Means, standard deviations and correlations between the highest determinant in heating trends; 'heating most of the rooms when in the house' (M= 3.35, Sd= 1.28), socio-demographic variables and home use determinants

Independent variable: heating trend (most of the rooms when in the house)	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Main heating system: Electric fire	0.38	0.49	0.001	0.44**
2. Heating controls you have: thermostat	0.55	0.502	0.02	0.301*
3. Improvements made: Loft insulation	0.33	0.475	0.018	-0.305*
4. Energy-saving actions: wash clothes at lower temp	1.3	0.72	0.009	-0.335**
5. Energy-saving actions: set hot water thermostat lower	0.9	0.63	0.024	-0.291*
6. Energy-saving actions: boil only water needed in kettle	1.48	0.7	0.05	-0.247*
7. Would like advice on cutting energy	0.53	0.503	0.039	0.272*
8. Anticipations from ASWZ: Improved home conditions	0.98	0.418	0.043	-0.318*
9. To sign up for the scheme: more technical information	0.4	0.516	0.017	0.726

Main heating system, heating controls, improvements made, anticipations from ASWZ, and more technical information are represented by either 0 for 'No' or 1 for 'Yes'. In energy-saving actions the scale runs from 0 'No' to 2 'Always'.
** $p < .001$, two-tailed
* $p < .05$, two-tailed

5.2.3 Correlation between temperature set for wall thermostats and other variables

As previously indicated in the general survey results, the mean temperature set on the wall thermostat was determined to be 22.5°C for the sample, which is relatively higher than the recommended temperature for user comfort and energy saving, which lies between 18 and 21°C. This independent variable has provided several significant correlations with other variables. Households with members aged 25-35 years seem to lower the thermostat temperature, which might indicate that people of this age are more resilient to lower temperatures

or they might be aware of their energy use, amongst other reasons that would require further research.

A strong positive relation appears between households with the problem of condensation, and their tendency to set their thermostats to higher temperatures ($r=0.376$, $p<0.001$). People might be unaware that condensation might be the counter effect of a higher temperature, along with other factors such as cooking, drying clothes inside, inappropriate ventilation among other factors. They might also believe that setting thermostats to higher temperatures might reduce the problem of condensation. As expected, the higher people tend to set their wall thermostats, the higher electricity bills they pay ($r=0.362$, $p<0.001$).

Table 5. 3 Means, standard deviations and correlations between the temperature set for wall thermostats (M= 6.67 where the scale runs from 1 '<18°C' to 10 'NA', Sd= 2.39), socio-demographic variables, home use determinants and energy awareness.

Independent variable: temperature set on wall thermostat	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Members of households: age 25-35	0.5	0.622	0.008	-0.346**
2. Problems in home: condensation	0.61	0.766	0.004	0.376**
3. Average monthly electricity bills	49.83	21.55	0.009	0.362**

Problems in home run on a scale from0 'Never' to 2 'Always'. Priority for home improvement and received energy advice or not are represented by either 0 for 'No' or 1 for 'Yes'
** p < .001, two-tailed
* p < .05, two-tailed

5.2.4 Correlation between average gas bills and other variables

The mean number of members per household in the sample is approximately three. Logically, the more members per household the more the average gas bills tend to be ($r=0.4$, $p<0.001$). Households with children seem to be paying more on gas bills ($r=0.318$, $p<0.05$). This relates to a general energy-consuming lifestyle for families with children that might well be different from that of single couples, or families with teenagers.

Concerning the problem of damp, a positive (moderate) correlation with higher gas bills is detected ($r=0.273$, $p<0.05$). As with the correlation between higher thermostat temperatures and problems of condensation, many people have a

misconception that by overheating their homes, problems of damp would diminish. Besides, average electricity bills rise alongside the rise in gas bills in a positive (strong) correlation ($r=0.537$, $p<0.001$).

Households with high gas bills anticipate a warmer home from the ASWZ scheme ($r=0.374$, $p<0.05$). Households with high gas bills and who would not consider signing up for the scheme might reconsider if provided with more technical information about the scheme ($r=0.709$, $p<0.05$). This might inform policy makers with viable means for increasing the policy scheme uptake by providing more comprehensive technical information about an upcoming home energy efficiency scheme.

Table 5.4 Means, standard deviations and correlations between gas bills (M= 50.65, Sd= 21.73), socio-demographic variables and home use determinants

Independent variable: average gas bills	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Number of persons per household	2.95	1.23	0.003	0.4**
2. Members of household: children	1	1.089	0.019	0.318*
3. Problems in home: damp	0.6	0.72	0.048	0.273*
4. Average monthly electricity bills	49.83	21.551	0.001	0.537**
5. Anticipations from ASWZ: warmer home	1	0.273	0.025	0.374*
6. To sign up for ASWZ: more technical information	0.4	0.516	0.032	0.709**

General health scale runs from 1 'very good' to 5 'very bad'.Problems in home run on a scale from 0 'Never' to 4 'Always'. Anticipations from ASWZ, and to sign up for ASWZ are represented by either 0 for 'No' or 1 for 'Yes' ** $p < .001$, two-tailed
* $p < .05$, two-tailed

5.2.5 Correlation between average electric bills and other variables

As with the previous correlation between gas bills and other variables, the more members per household the higher the average electric bills tend to be ($r=0.36$, $p<0.01$). Also, households with children seem to be paying more on gas bills ($r=0.273$, $p<0.05$). Another positive relation associates adults of age 25-35 years with higher electricity bills ($r=0.281$, $p<0.05$). This might reflect

their general energy-consuming lifestyle and unawareness of energy-saving behaviour. Moreover, problems of damp ($r=0.515$, $p<0.001$) and cold ($r=0.277$, $p<0.05$) seem to be consistent in spite of the high electricity bills, in particular problems of damp which are strongly related to high electric bills where houses lose heat at high rates due to cold bridging.

Table 5.5 Means, standard deviations and correlations between electric bills (M= 49.83, Sd= 21.55), socio-demographic variables and home performance determinants

Independent variable: average electricity bills	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Number of persons per household	2.95	1.23	0.008	0.36**
2. Members of household: children	1	1.089	0.046	0.273*
3. Members of household: adults (25-35)	0.5	0.622	0.039	0.281*
4. Problems in home: damp	0.6	0.72	0.001	0.515**
5. Problems in home: cold	0.85	0.738	0.045	0.277*

Problems in home run on a scale from 0 'Never' to 4 'Always'
** $p < .001$, two-tailed
* $p < .05$, two-tailed

5.2.6 Correlation between receiving energy advice and other variables

In the general survey findings, it has appeared that only 28 per cent of the sample has received energy advice, mostly from their energy suppliers and NCH fliers. However, this is associated with a moderate positive correlation with people who try to use less gas and electricity ($r=0.26$, $p<0.05$). A reason for this could be their awareness that reducing energy use directly relates to reducing their energy bills.

However, a positive and high correlation associates those who have not received energy advice and believing that ASWZ is good for the environment ($r=0.344$, $p<0.001$). This indicates that although only a third of the sample has received energy advice, most of the respondents believe that the ASWZ scheme would benefit the environment by making their homes more energy-efficient.

Table 5.6 Means, standard deviations and correlations between received energy advice (M= 0.28, Sd= 0.454), energy-saving actions and attitude towards the ASWZ scheme

Independent variable: received energy advice	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Energy-saving actions: Use less gas and electricity	1.42	0.56	0.045	0.26*
2. What do you think of ASWZ? Good for the environment	0.53	0.5	0.008	0.344**

In energy-saving actions the scale runs from 0 'No' to 4 'Always'. Good for the environment is represented by either 0 for 'No' or 1 for 'Yes'
** $p < .001$, two-tailed
* $p < .05$, two-tailed

5.2.7 Correlation between 'preference to receive energy advice' and other variables

Although only 53 per cent of the sample would like to receive energy advice, only one third would consider heating upgrade as a priority for home improvement. However, a positive and strong correlation associates not receiving energy advice and not considering heating upgrade ($r=0.414$, $p<0.001$). Also, a positive moderate correlation appears between preferring to receive energy advice and considering signing up for the ASWZ scheme ($r=0.287$, $p<0.05$).

Consequences of not receiving any energy advice and wanting to receive some information appear among the energy-saving actions that are not taken. People who would welcome receiving energy advice do not use less gas and electricity ($r=-0.269$, $p<0.05$), do not use energy-saving lamps ($r=-0.282$, $p< 0.05$), and most significantly do not heat occupied rooms only ($r=-0.413$, $p<0.001$). This may well indicate that a reason for not taking any of these actions could be the lack of knowledge and information with regards to energy-saving tips and effective ways of reducing energy consumption.

The preferred format for receiving advice has been reported in the general survey results; 84 per cent would prefer the written format and 25 per cent would prefer one-to-one support, while 9 per cent would prefer it to be sent

electronically (a number of households chose more than one format; thus the total is not equal to 100 per cent). It is important that Nottingham City Council in Aspley and in other city wards where people might not be energy-aware provide comprehensive information regarding energy-saving tips. Other research has proven the positive impact of effective information and communication on considerable reductions in energy consumption (Abrahamse, 2007; Relish, 2009).

Table 5.7 Means, standard deviations and correlations between 'would you like to receive energy advice?' (M= 0.53, Sd= 0.5), home performance, energy-saving actions and attitude towards the ASWZ scheme

Independent variable: would you like energy advice?	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Future home improvement: heating upgrade	0.35	0.418	0.001	0.415**
2. Heating controls: boiler	0.7	0.48	0.031	-0.283*
3. Energy saving actions: Use less gas and electricity	1.42	0.561	0.041	-0.269*
4. Energy-saving actions: Heat occupied rooms only	1	0.8	0.001	-0.413**
5. Energy-saving actions: Use energy saving lamps	1.42	0.743	0.032	-0.282*
6. Considering signing up for ASWZ	0.7	0.47	0.03	0.287*

Future home improvement and consider signing up are represented by either 0 for 'No' or 1 for 'Yes'. In energy saving actions the scale runs from 0 for 'No' to 2 for 'Always'.
** $p < .001$, two-tailed
* $p < .05$, two-tailed

5.2.8 Correlation between reasons for taking some energy-saving actions: 'save money' and other variables

As the research hypothesis tests factors that affect people's energy consumption behaviour, a statistical test had to be performed between reasons for taking energy-saving actions and other variables in the questionnaire. It appears from the general survey findings that about 80 per cent of respondents have reported that saving money is the main reason for taking some of these actions (turn off unwanted lights, boil only water needed in kettle, etc). A

positive and strong correlation associates the reason to save money with the reason to save energy ($r=0.45$, $p<0.001$).

Other positive and moderate correlations associate taking energy-saving actions to save money with anticipating improved home conditions ($r=0.325$, $p<0.05$), and doing something good for the environment ($r=0.403$, $p<0.05$) by signing up for ASWZ. However, those who take energy-saving actions to save money would require more hands-on information to be convinced to join the ASWZ scheme ($r=0.8$, $p<0.001$).

Table 5.8 Means, standard deviations and correlations between 'reason for taking energy-saving actions: save money' (M= 0.79, Sd= 0.414), home performance, energy-saving actions and opinion of the ASWZ scheme

Independent variable: reason for energy saving action: save money	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Reasons for energy-saving actions: save energy	0.43	0.5	0.001	0.45**
2. Anticipations from ASWZ: improve home conditions	0.98	0.418	0.047	0.325*
3. Anticipations from ASWZ: doing something good for the environment	1.07	0.412	0.012	0.403*
4. To sign up for ASWZ: more hands-on information	0.4	0.516	0.005	0.8**

Reasons for energy-saving actions, anticipations from ASWZ, and to sign up for ASWZ are represented by either 0 for 'No' or 1 for 'Yes'.
** $p < .001$, two-tailed * $p < .05$, two-tailed

5.2.9 Correlation between considering signing up for the ASWZ scheme and other variables

The questionnaire asks respondents who have heard about the ASWZ scheme if they understand what it is about; the majority replied the scheme aimed to help households save money, while others thought it was to make homes warmer and save energy. Of the respondents, 68 per cent agreed they would consider signing up for the scheme.

A positive and moderate relation appears between agreeing to join the scheme and priority for a new bathroom as future home improvements ($r= 0.266$,

p<0.05). This indicates that people might consider the scheme partly due to the fact that the scheme provides a modern bathroom for eligible homes.

Also, another positive and significant relation associates signing up for the scheme and having heard about it through information leaflets (r=0.348, p<0.01). This could reflect that through information leaflets, people were able to form a preliminary judgment about the scheme and might thus consider joining. Agreeing to join the scheme is positively and significantly associated with believing the scheme is good to improve the home (r= 0.617, p< 0.01). It is also positively and moderately related to anticipating improved home conditions (r=0.38, p<0.05).

Table 5.9 Means, standard deviations and correlations between 'considering signing up for the ASWZ scheme' (M= 0.68, Sd= 0.47), home performance, and energy-saving actions

Independent variable: considering signing up for the ASWZ scheme	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Future home improvement: new bathroom	0.5	0.504	0.042	0.266*
2. How have you heard about ASWZ?	3.26	1.775	0.007	0.348**
3. What do you think of ASWZ: good to improve my home	0.72	0.451	0.001	0.617**
4. Anticipations from ASWZ: improved home conditions	0.98	0.418	0.016	0.38*

Priority for home improvement, reasons for energy saving actions are represented by either 0 for 'No' or 1 for 'Yes'. In energy saving actions and lifestyle the scale runs from 0 for 'No' to 2 for 'Always'.
** p < .001, two-tailed
* p < .05, two-tailed

CONCLUSION

The total annual income of 69 per cent of the respondents' households is less than 12 thousand pounds. The mean figures for monthly gas bills and monthly electric bills have been determined to be £51 and £50 respectively, which identifies that most of the 69 per cent might be in fuel poverty. Concerning problems in their homes, respondents always and sometimes experienced cold 64 per cent and draughts 62 per cent, followed by mould 48 per cent and condensation 44 per cent.

There appears to be a general problem with people understanding how their heating systems and controls work and how best they could make them perform. Also, 61 per cent either sometimes or never use their heating controls, and 53 per cent of households heated most of the rooms most of the time and when in the house, while only 20 per cent heated all the rooms all the time. Households with the dominant heating trend of heating most of the rooms when in the house seem to report inadequate loft insulation in their homes ($r = -0.3$, $p<0.05$). This could either be due to not having any loft insulation done during their occupancy or not knowing whether their lofts are appropriately insulated or not, which might reflect the problem of lack of information provided. Moreover, 72 per cent of the sample reported they never received energy advice. These issues have been further delved into in phase B to find out when exactly they use their controls and how often they do so after the energy upgrade works.

It has been noted that the higher the income of households, the more people would prioritise heating upgrades to improve their homes ($r=0.472$, $p<0.001$). This relates to the higher tendency for people to pay towards insulating their homes with the higher household income (0.375, $p<0.001$); yet 68 per cent would consider signing up for the ASWZ scheme. However, 75 per cent of the sample is not prepared to pay towards home insulation and energy-efficiency improvements. Notably, agreeing to join the scheme is positively and significantly associated with believing the scheme is good to improve the home ($r= 0.617$, $p< 0.001$). It is also positively and moderately related to anticipating improved home conditions ($r=0.38$, $p<0.05$).

Respondents appear to already undertake straightforward energy-saving activities, such as turning off unwanted lights, using energy-saving bulbs and replacing inefficient equipment; with 78, 57 and 47 per cent respectively always doing so. This is also clear in the positive correlations between taking energy-saving actions to save energy and using energy-saving lamps ($r=0.36$, $p<0.001$), replacing inefficient equipment ($r=0.3$, $p<0.05$), boiling only water needed in kettle ($r=0.341$, $p<0.05$) and drive less ($r=0.3$, $p< 0.05$). This may indicate that people who take actions to save energy might be more aware of

energy-saving actions and thus take these actions intentionally to save energy. However, residents are less likely to use the heating and hot water controls to reduce energy use, as those might be more complicated and impractical to them. Personal carbon emissions from homes and transport account for almost half of the UK's carbon emissions. Choices people make - for example, to turn off lights, to cycle, etc. - have the potential to significantly contribute to the UK's climate change targets (Eyre et al., 2011a).

Phase A of the questionnaire thoroughly explored several factors that could possibly affect people's attitudes and behaviour concerning energy-efficiency measures. It tested the independent variables against the dependent variables; demographics, current experience with home conditions and heating efficiency, general energy awareness, and method of advice and information preferred. Thus, in phase A of the survey home conditions, fuel bills, tenants' lifestyle and energy consumption behaviour and their anticipations from the upcoming ASWZ scheme were explored. The analyses of this phase provided a reference for the second phase of the project; phase B questionnaire.

CHAPTER SIX

SURVEY ANALYSIS- PHASE B

Chapter Contents

INTRODUCTION

Phase B of the questionnaire was administered after analysing phase A and delved into more details of the significant aspects emerging from phase A analysis. The aim of phase B of the survey was to compare between home conditions, fuel bills, tenants' lifestyle and energy consumption behaviour before and after carrying out Aspley Super Warm Zone scheme. The survey designed for this phase was to map the experiences of another sample of tenants within the geographic domain of the ASWZ scheme who have had more than a year's experience with their home improvements. This phase of the survey also aims to explore people's experience throughout the process of their home improvement work. This chapter illustrates general survey findings of 63 households, and interpretations through correlations and further statistical analysis. The findings are highlighted, analysed and hereby discussed. As with the previous chapter, the first part of the chapter paints a general picture of the survey findings whilst the second part critically analyses the findings using statistical analysis. A comparative analysis of phases A and B results and correlations will be discussed in a subsequent chapter.

6.1 GENERAL SURVEY FINDINGS

Phase B of the questionnaire explores in detail a number of aspects that affect people's decisions and attitudes concerning energy-efficiency measures, i.e. demographics, current experience with home conditions and heating efficiency, general energy awareness, and method of advice and information preferred. Another important objective is to gauge participants' level of understanding and expectations from the ASWZ scheme, and experiences with the scheme (see appendix 3 for the full questionnaire).

6.1.1 Residents' socio-economic characteristics

This section comprises the analyses of questions 1-2 and 50 - 59 concerning the households' socio-economic position, length of residency, tenancy situation, age, ethnicity, employment, education and health condition. The information collected from this section aimed to draw a socio-demographic picture of the sample and to correlate this data with other variables in the

statistical analysis. A total number of 171 people were covered by the survey; 50 infants and children between 3 and 12 years, 19 teenagers, 94 adults between 20 and 65 years and 8 adults over 65 years. All the sample lives in social/council housing as at the date of the survey, none of the private sector housing had been completed for more than a year. The dominant ethnic group for the sample was white British with 79 per cent, followed by black African and mixed white and black Caribbean with 7 per cent each. The mean age of the respondents, who are considered to be responsible for their households was 43 years. Concerning the length of residency, the mean was found to be 12.5 years. Of the sample, 48 per cent have lived in their homes in Aspley for more than ten years. This might be due to health and mobility issues, or to be close to family and friends, or most importantly the need to sustain their affordable homes. As for the level of education, 7 per cent of respondents achieved university degree, 15 per cent achieved diploma degree, 23 per cent achieved college education, while 26 per cent achieved secondary school education and 26 per cent have no degree while 3 per cent was missing data. The information collected concerning levels of education aim to inform the appropriate means of disseminating energy saving information to tenants of similar areas.

The labour force demographically as previously defined (Barth & Heffley, 2004) includes all people that contribute with physical or mental efforts to the production of goods or services (in other words, those who are employed), as well as those who are capable of working and are searching for a job but have not found one yet (the unemployed). Employment status of occupants of sampled households is: 45 per cent employed, 39 per cent unemployed and 16 per cent are economically inactive. Understanding the employment status has a twofold aim; first, it helps relate employment status to income and fuel bill affordability, and second; helps build up a picture of occupancy that would reflect on the resultant energy use of households. From the previous results more than half the labour force in this area is not employed which might reflect the relatively high energy consumption rates of households.

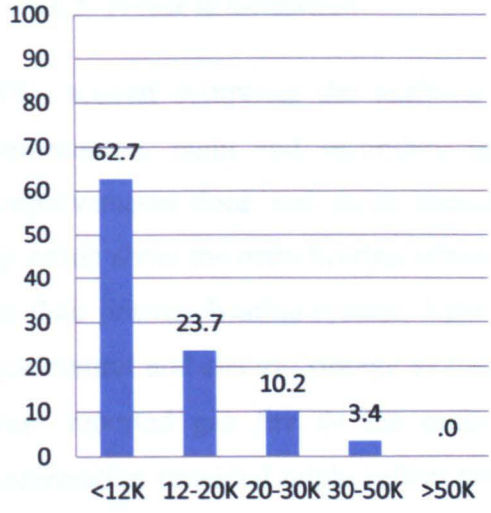

Figure 6.1 Total income of household

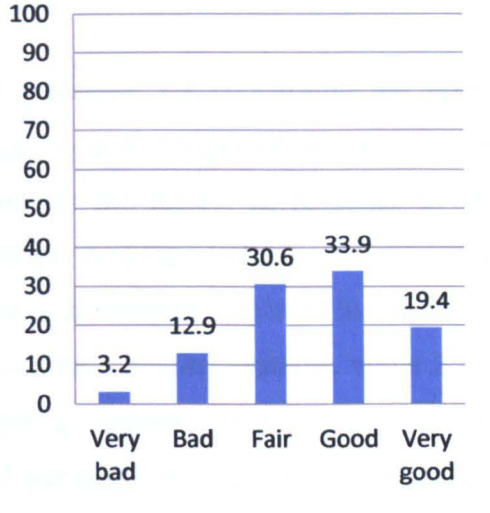

Figure 6.2 Health of respondents after home improvements

Once more, the survey affirmed Nomad Plus (2006) report that indicates that the dominant group in Aspley is the 'municipal dependency group', defined as low income families living in social/council housing. This group comprises 63 per cent of the sample, where the total annual income of the household is less than 12 thousand pounds. Low income families are mostly on benefits and tend to spend what they have on the basic requirements and entertainment. Based on this, 72 per cent do not own a car, while 28 per cent own one or two cars which could be directly related to income and employment status. This reflects the high dependency on walking and using public transportation in the area which is indicated in the results of a subsequent section of the survey.

Respondents' health conditions have been again accounted for in this phase. The purpose was to gauge whether residents' health conditions have relatively improved or even degraded after their home improvement in phase B of the questionnaire. Thirty one per cent reported a fair state of health, while 16 per cent reported it to be bad or very bad. The remaining 53 per cent reported their health as good or very good, as illustrated in Fig. 6.2. A comparison between respondents' health conditions before and after the scheme is further discussed in the following chapter.

6.1.2 Home information

This section comprises the analyses of questions 3-8 concerning the home information, main and secondary heating systems, type of glazing, home improvements done and those considered for the future. In response to the question about the main heating system; 95 per cent reported gas central heating as their primary heating system, 3 per cent of households reported having both, gas central and electric storage as their two main heating systems, while 2 per cent reported gas fire as the main heating system. At this instance, the information provided might reflect the 45 per cent who reported they had new heating systems installed by the scheme. This might also imply the remarkably increased level of knowledge of respondents when compared with the same question in phase A, and that the installation of heating systems helped people understand how to use their primary and secondary heating systems.

As for the secondary heating system; 58 per cent reported electric fire, while 15 per cent use gas fire and 20 per cent had no secondary heating systems. In this phase, nearly all respondents reported they had double glazed windows as some of them had it done through ASWZ. As for their external doors; 64 per cent had wooden doors while the rest had un-plasticised poly vinyl chloride (uPVC) doors. The uPVC doors replaced their worn out wooden doors through previous council schemes (Decent Homes, and Warm, Modern and Secure). Notably, 65 per cent reported they would prefer their wooden doors to be replaced by new uPVC doors, which came as their first priority due to the problems of draughts reported.

With regard to home improvements people had personally done to their homes; 45 per cent had interior decoration, 11 per cent fitted a new bathroom, and 10 per cent had a new kitchen installed. As in phase A, most people seem to consider interior decoration as a priority as it is probably more affordable and directly influences people's wellbeing and satisfaction with their homes.

6.1.3 Home use and performance

This section includes the analyses of questions 9-22 concerning problems in their homes before and after the scheme, heating patterns, heating controls and

trends in using them, monthly utility bills and method of payment, if they have changed the energy supplier and why, and whether they require energy advice and the format they would prefer it in.

In regard to problems in their homes, respondents were asked about how frequently they experienced damp, mould, cold, draughts, or condensation before and after their ASWZ home improvements. Notably, all problems that respondents always experienced before improvements have considerably reduced after their home improvements. Likewise in questionnaire A, the first problem reported was draughts 38 per cent, followed by cold, condensation, mould and damp at 13, 12, 8 and 3 per cent respectively as illustrated in Fig. 6.3. This indicates that the scheme has proven relative success when comparing between problems reported by residents before and after the energy upgrade.

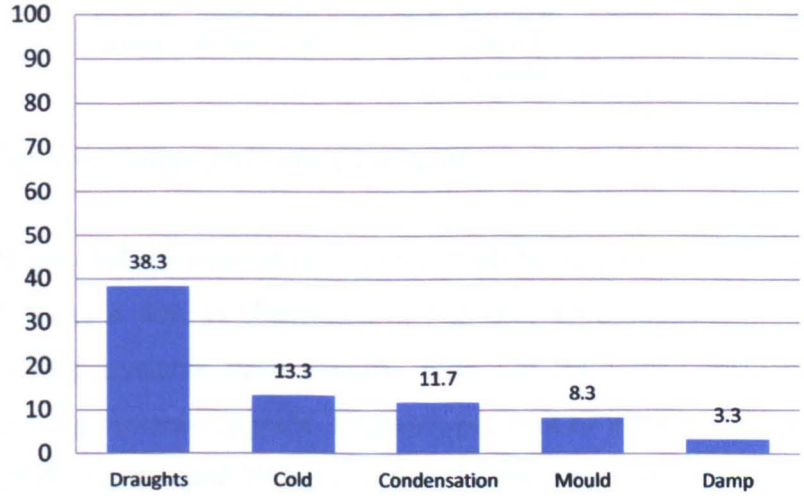

Figure 6.3 Problems experienced with homes after ASWZ scheme

The question concerning the dominant pattern of heating in the house illustrated that 49 per cent of households heated all rooms when in the house, while 16 per cent heated most of the rooms when in the house, 14 per cent heated all rooms all the time, 10 per cent only heated the living room and other rooms as they occupied them, 6 per cent heated their living room only, and 5 per cent heated most of the rooms most of the time as illustrated in Fig. 6.4. A possible reason for the high percentage of households that heat all the rooms when in the house in this phase is that during the course of home improvements people tended to understand more about how their central heating systems work more efficiently.

Another possibility could be their financial affordability of having all rooms heated compared with before their home improvements.

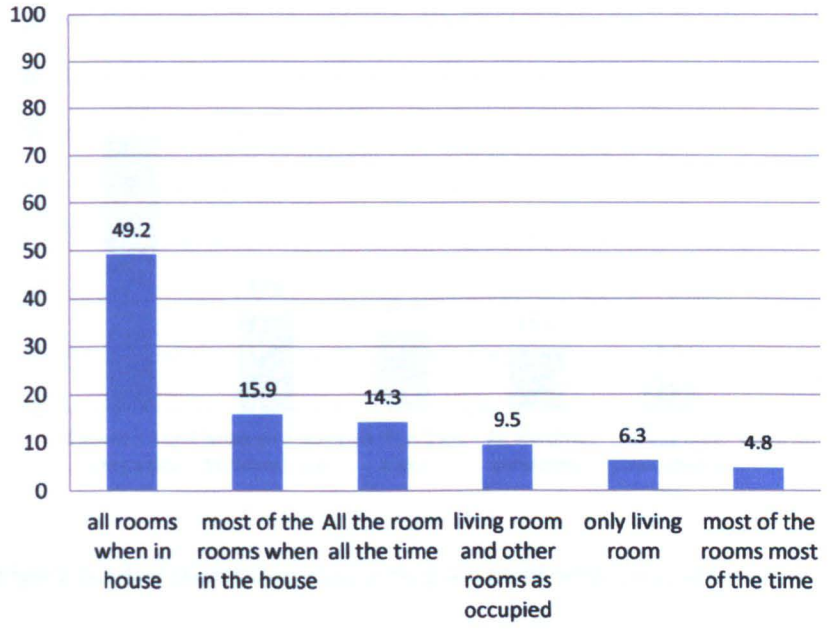

Figure 6.4 Patterns of heating the home

Nearly half the respondents turned their heating on in the winter between 2 and 6 hours a day, as illustrated in Fig. 6.6. This might imply the how efficient heating systems have become after the solid wall insulation coupled with heating systems upgrade. Eighteen per cent of respondents turned their heating on between 6 and 10 hours a day, 14 per cent turned it on less than 2 hours a day and only 6 per cent turned it on more than 10 hours a day. Notably, 11 per cent turned their heating on continuously all the time which reflects the need for guidance and advice on how to use their heating systems most efficiently.

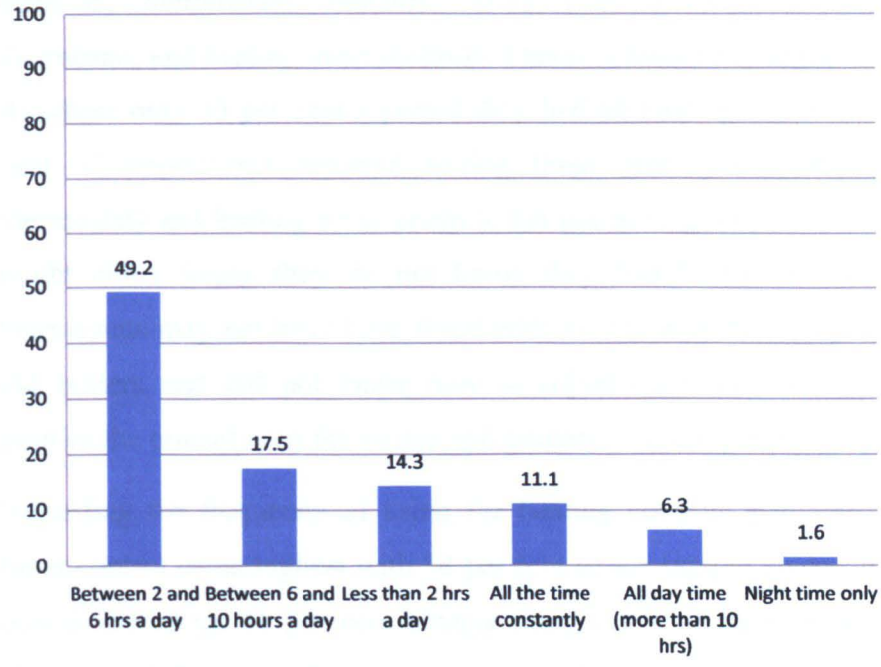

Figure 6.5 Duration of heating during a typical winter day after improvements

The mean temperature set on the wall thermostat for the sample is 21.45 °C, which is lower than the mean temperature set for thermostats in phase A which was 22.5 °C. Lowering the thermostat by 1 °C results in saving 300 kg CO_2 annually (EST, 2012). This might imply that residents could have gained some guidance on thermostat setting coupled with more efficient heating systems in place. Another possibility might be that after the home improvements buildings actually reached the thermostat temperature and switched off, whilst before the home improvements the heating might have been kept on continuously to achieve comfort.

The setting of the thermostats has been one of the key areas of interest for the researcher as it is a useful indicator of the heating trends of respondents. Notably, 64 per cent of respondents set their wall thermostat at a temperature less than 22 °C. On the other hand, 36 per cent set their wall thermostat temperature at 22 °C or higher. This is considerably better than what was reported in phase A, where 44 per cent set their thermostats lower than 22°C.

In regards to the question about what heating controls they have in their homes, 44 per cent reported they have all four heating controls mentioned in the

question; thermostatic radiator valves (TRVs), wall thermostat, boiler thermostat, and heating timer controls. This is considerably higher than in phase A, where only 33 per cent reported they had all heating controls. Sixteen per cent of respondents reported having three heating controls, TRVs, wall thermostats and heating timer controls but not having a boiler thermostat. This might either imply they do not know they had boiler thermostats or that thermostats may not have been fitted with the boiler or that they still had their old boilers and did not know how to adjust their thermostats. Again, this implies the crucial need for advice and guidance on using heating systems.

Regarding the frequency of using the heating controls available, the heating timer control came highest with 38 per cent of the sample always using it. This was followed by 24 per cent always using the wall thermostat, 16 per cent always used the boiler thermostat, and only 10 per cent always used the TRVs. This might indicate that either people do not fully understand how to use their heating controls of their systems or that they might not want the hassle of continuously adjusting them. People who never use all their heating controls indicates that they either cannot afford to use their heating systems, or because they leave them as they were set and they do not need to change them or that as long as they provide them with adequate warmth, they wouldn't consider adjusting their controls.

A significant factor questioned was the monthly utility bills for gas and electricity before and after home improvements. Notably, based on the responses, the mean figures for monthly gas bills reduced from £66 before home improvements to £55 after improvements. As for the monthly electricity bills, the mean has reduced from £54 to £48. This means that an average household in Aspley could possibly save up to £17 per month on utility bills, which could sum up to £204 of annual savings. Although this amount is still significant, it does not reach the £300 expected annual savings from the CESP. However, if the average annual energy price increase of 7% is dismissed, the potential net savings would reach £218 annually. Thus, with the anticipated rise in energy prices, the savings might even further diminish.

With regards to methods of utility bills payment, 59 per cent pay using the prepayment meter method despite paying considerably higher tariffs. Fourteen per cent of the sample pays by monthly direct debit, 11 per cent use payment cards, and 10 per cent pay by quarterly direct debit. This might indicate that prepayment meter method directly relates to the low income of households in this area where people tend to top up when they could afford.

In regards to electricity and gas supplier change; only 13 per cent of the respondents report they have changed their supplier after the home improvement work was done mostly to find a better deal and save more on utility bills. The majority, 87 per cent, did not change their supplier mainly because they did not want the hassle of changing, while others were satisfied with the services provided by their current suppliers. Similarly, in a study done in Sweden, an annual average rate of 11 per cent of households switched energy suppliers (Gamble et al., 2009). It was found that people neither tended to switch suppliers nor did they prefer various price agreements.

When asked about receiving any energy advice before their home improvements, only 21 per cent reported they received some advice from their suppliers or the council through booklets and fliers, door-to-door sales, and via online energy tracker. On the other hand, the majority of respondents, 79 per cent mentioned they never received any advice concerning saving energy. Again, it was not clear whether they actually 'never' received any advice or they could have been sent leaflets that they were not aware of. Fifty seven per cent reported they would like to receive energy saving advice. This implies that over half the sample are receptive to information/ advice concerning energy saving, whereas the rest of the sample require other methods of communicating information and advice to ensure a successful delivery of ASWZ. This is further discussed in the following chapter. Of those who would like to receive advice; 40 per cent would prefer it in leaflets while 13 per cent would prefer one to one support or visits. Notably, 25 per cent of the sample reported they would be interested in participating in workshops on energy saving advice. Again, this provides policy makers with some guidelines on means of raising the rates of

policy delivery by providing people with appropriate means of advice and guidance.

6.1.4 Lifestyle and behaviour

This section is split into two sets of questions; lifestyle of respondents, and their energy consumption behaviour.

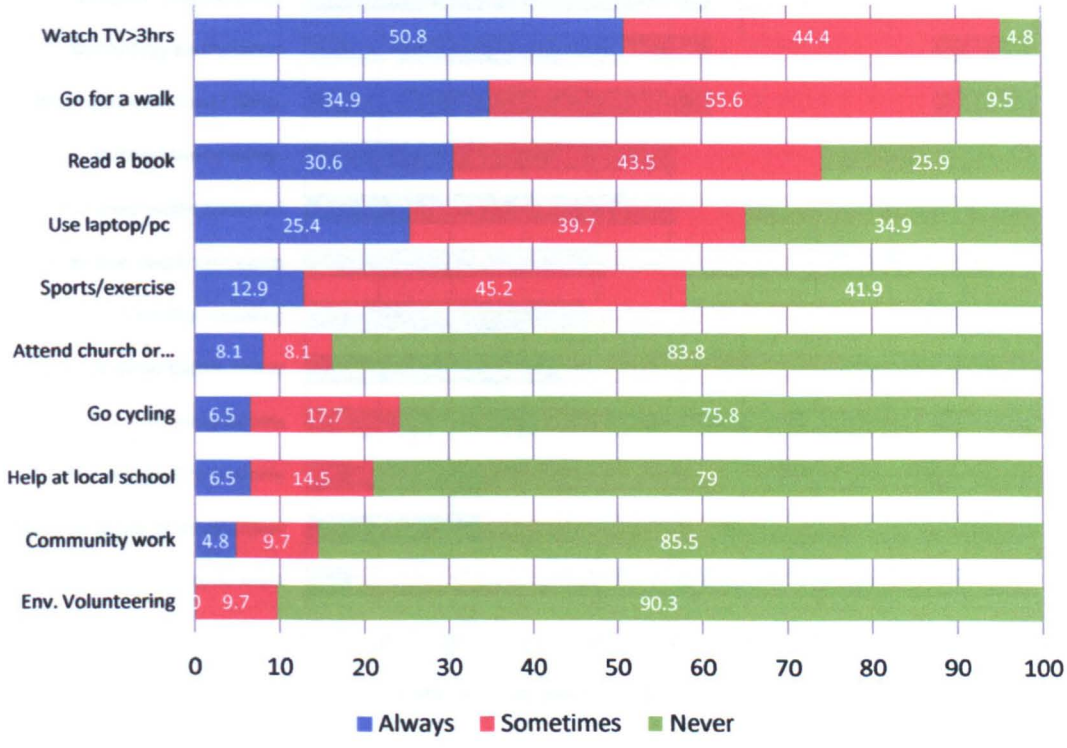

Figure 6.6 Lifestyle patterns

From Fig. 6.7, is can be seen that nearly half the sample always watch TV more than 3 hours on a daily basis, while 44 per cent only sometimes do. One quarter of the sample always use their PCs/ laptops daily, while 40 per cent sometimes do. This might relate to the high numbers of unemployed respondents who might spend most of their time at home using their PC or watching TV; thus consuming more energy than households with employed members. It might also imply that with half the sample having children and infants, and with a third of the sample having retired or disabled members, the probability of people watching TV more than 3 hours a day is quite high. Of the sample, 21 per cent reported that they always / sometimes help at the local school, 15 per cent always / sometimes volunteer in community work, and 10

per cent sometimes volunteer for environmental work. Likewise in phase A, only 25 per cent agreed they would like to volunteer to improve their local community.

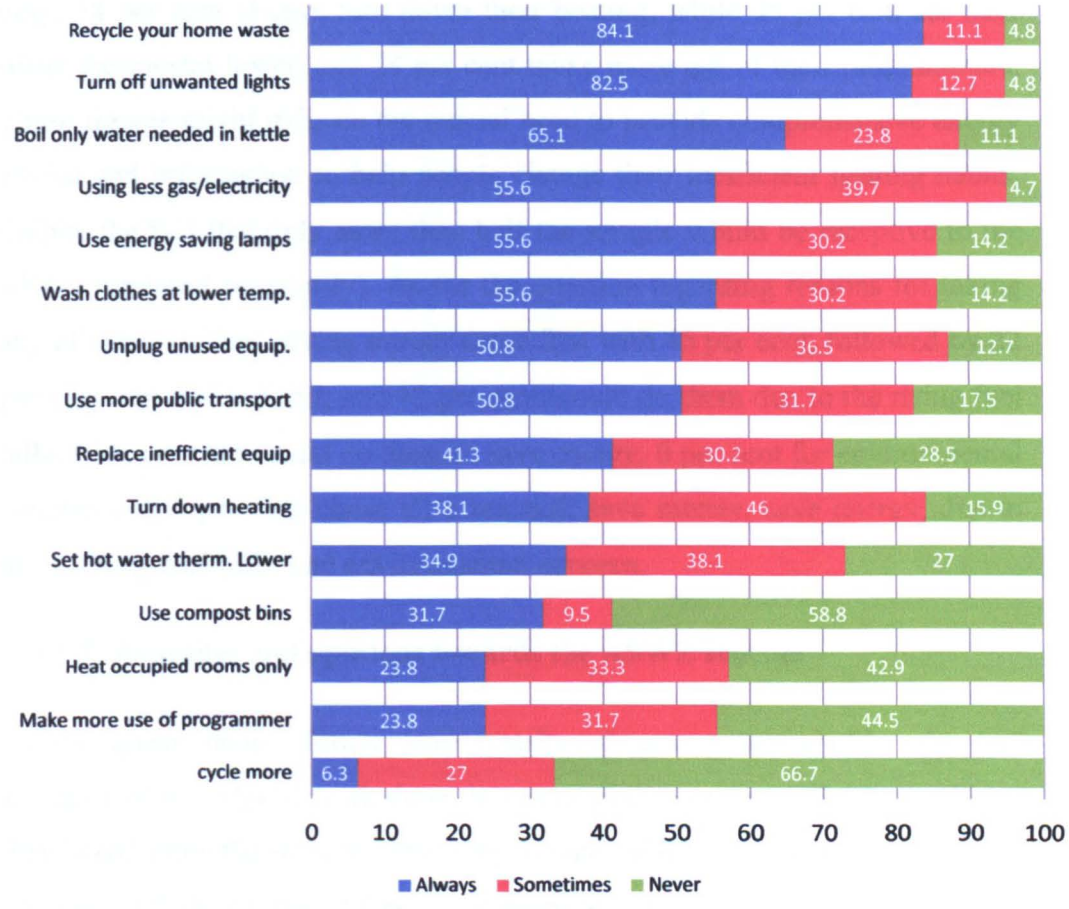

Figure 6.7 Energy consumption behaviour

As for the second set of questions concerning respondents' energy awareness and behaviour; again, the majority, 84 per cent, always recycle their home waste while only 31 per cent use their compost bins. The following top actions always taken by respondents are to turn off unwanted lights, and boil only water needed in kettle at 83 and 65 per cent respectively. The next three actions always taken are to use less gas and electricity, use energy saving lamps, and wash clothes at a lower temperature all at 56 per cent. Besides, 52 per cent always unplug unused equipment and the same for using more public transport, while 42 per cent replace inefficient equipment. However, the use of public transport might directly relate to the number of cars owned by households (72 per cent of the sample do not own a car). Besides, these

energy-saving actions might reflect people's basic awareness of energy-saving actions, in addition to their concern about their utility bills.

In regards to the heating behaviour and trends, 24 per cent heat occupied rooms only, 38 per cent always turn down their heating, while 35 per cent set their water thermostat lower, and 24 per cent make more use of their programmers. These figures might indicate the crucial need to provide comprehensive energy advice and information to help people change their inefficient heating habits, despite the fact that only more than half the sample would be receptive to the advice (reported previously). As for the question regarding reasons for taking any of those actions, saving money came first with 46 per cent, followed by 22 per cent was due to habit, and 12 per cent would do them due to the rising fuel bills. Nine per cent would do them to save energy, 6 per cent for environmental concern and 5 per cent chose all 5 reasons; save money, save energy, due to habit, rising fuel bills, and environmental concern.

6.1.5 Attitudes and opinions towards the ASWZ scheme

As the questionnaire forms were distributed among households who had already had the ASWZ work done, it was crucial to understand what and how they heard about the scheme, what they thought of it before the work was done, and after. Of the sample, 58 per cent heard about the scheme through a letter from NCH – which is the official means of informing residents, 15 per cent through the contractor liaison officer who work within the area, 10 per cent from the show home – although it is located opposite the local school and nursery entrance, 8 per cent information leaflets, while 6 per cent knew about it from neighbours. The majority of respondents, 80 per cent, thought the scheme was good in improving their homes before they had the work done.

In regards to the measures installed in residents' homes, as shown in the figure below all residents had a new kitchen fitted, the majority had a new bathroom and internal insulation, while 65 per cent had double glazing, 48 per cent had their old boiler replaced, 44 per cent had a new heating system with controls, and 33 per cent had loft insulation. The three main ASWZ measures for eligible houses are: a modern kitchen, a modern bathroom and internal wall

insulation. The other measures were carried out according to a set of criterion of eligibility.

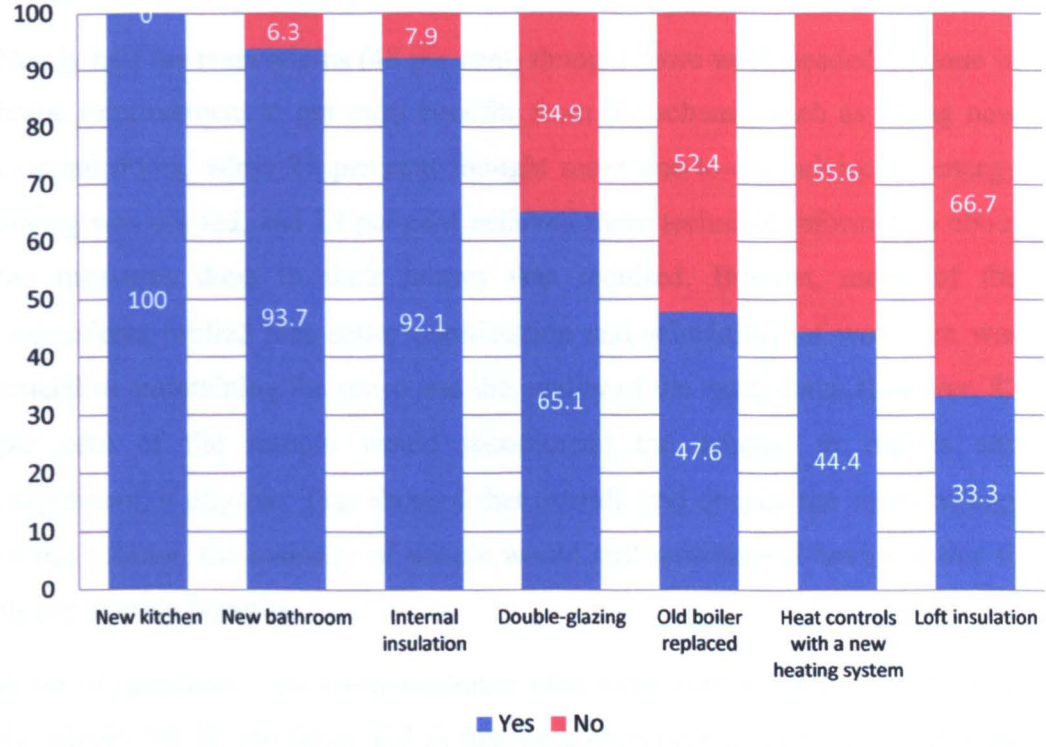

Figure 6. 8 Measures done in homes through ASWZ

From the open-ended question concerning the best thing about the work they have had done through the ASWZ scheme, the majority of people thought the most important outcomes from having the scheme were having a warmer home, and a new modern kitchen and bathroom, followed by the internal wall insulation and new windows. A few replied they were happier it helped improve their health and reduce illnesses 'due to cold snaps' and others thought it had a tangible effect on reducing bills.

In the DECC (2011a) CESP evaluation, the majority of respondents reported they have benefited from the scheme. However, it should be noted that the degree to which they benefited seemed to be dependent on how well they understood how to use their heating systems effectively as well as any energy saving advice they have received. Only 24 per cent of the sample received advice on energy during and after the work was completed, mostly from the contractor concerning adjusting the thermostats to achieve the maximum

benefits of the work. This highlights the crucial need for effective communication in supporting the householder in realising the benefits of energy efficiency measures.

Nearly half the respondents (48 per cent) thought more work needed be done in home improvement to get most benefits from the scheme, such as fitting new external doors, while 27 per cent thought more one-to-one advice on energy saving was needed, and 13 per cent believed more technical information about the measures done in their homes was required. Besides, many of the respondents replied that better coordination and scheduling of workmen was crucial in maintaining the speed and the quality of the work done. However, 82 per cent of the sample would recommend the scheme to friends and neighbours, if eligible. This showed that overall, and despite the shortcomings of the scheme, the majority of people would still recommend having it due to its remarkable benefits.

A set of questions concerning customer care were introduced in this phase of the survey. NCH was interested in finding how people rated the level of work done in their homes and it was also essential for the researcher to understand people's opinions of the scheme during and after the course of the work. Forty per cent reported they were partly kept informed of the work before and during the course of the work done, while 25 per cent reported they were very well informed. In regards to rating the arrangements done to minimise the inconvenience during the process, 34 per cent rated it as good, 21 per cent rated it as average and 20 per cent rated it as very poor - which might reflect the 18 per cent who would not recommend the scheme. As for the quality of the completed work 32 per cent rated it as average, 27 per cent rated it as good and 16 per cent rated excellent. Notably, 74 per cent agreed the final outcome was worth the disruption, while the rest disagreed and had some negative comments concerning disorder and cleanliness issues.

DECC (2011a) CESP householder survey found that 83 per cent of respondents reported they were satisfied with the installation process while the rest were dissatisfied with the care and attention workers showed to their homes and the disruption caused during the installation process. People's feedback on the

scheme could help provide useful suggestions for similar schemes in the near future to try and accommodate people's diverse needs and concerns.

6.2 CORRELATIONS

The overall aim of phase B of the questionnaire is to identify how residents of households that have had home improvements that made their properties more energy-efficient used their heating systems, their lifestyle and behaviour, and in what ways they think they have achieved from ASWZ. The questionnaire aimed to gauge people's knowledge about using their heating systems and controls and depict the changes in problems experienced before the energy upgrade to map out the benefits and shortcomings of the scheme. It also explored the factors that would encourage people to engage in a government policy and explored how different means of communicating information might, in effect, enhance the levels of policy engagement and uptake.

6.2.1 Correlation between 'average gas bills after improvements' and other variables

From the preliminary analysis, 52 per cent reported they had their heating on less than before they had their home improvements. Thus, it appears that the less people kept their heating on, the less gas bills they paid ($r = -0.273$, $p<0.05$). It also appears that the more they used their heating timer controls, the less gas bills they paid ($r=-0.343$, $p<0.05$). A positive and strong relation appears between average monthly gas bills and average monthly electricity bills after improvements ($r=0.578$, $p<0.001$). This implies that the gas and electric bills are directly proportional as they reflect a general trend of energy consumption.

Table 6.1 Means, standard deviations and correlations between gas bills (M= 55.39, Sd= 17.05), socio-demographic variables and home use determinants

Independent variable: average gas bills (after improvements)	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Have the heating on compared as with before	2.47	0.59	0.044	-0.273*
2. Heating timer controls	0.84	0.368	0.01	-0.343**
3. Average monthly electricity bills (after improvements)	48	15.76	0.001	0.578**

Have heating on compared with before runs from 1 'More' 3 'Less'. Using heating timer controls run on a scale from 0 'Never' to 2 'Always'.
** p <0.001, two-tailed
* p <0.05, two-tailed

6.2.2 Correlation between energy saving action: 'try using less gas and electricity' and other variables

Almost 56 per cent of the sample always tries using less gas and electricity, while 40 per cent sometimes do. Some positive (strong) relations appear between 'trying to use less gas and electricity' and 'turning down heating', 'use energy saving lamps', and 'wash clothes at lower temperature' at (0.343, $p<0.001$), ($r=0.364$, $p<0.001$), and ($r=0.476$, $p<0.001$). Other positive (moderate) relations appear between 'trying to use less gas and electricity' and 'replace inefficient equipment' and 'boil only water needed in kettle' at ($r=0.26$, $p<0.05$) and ($r=0.265$, $p<0.05$). This might indicate that after the home improvements were done, people tended to try and save more energy through other everyday actions. This could also be reflected back to the 'spill-over effect' where research describes it as the tendency of pro-environmental behaviour to spill and lead to other pro-environmental behaviour (Thøgersen & Crompton, 2009)

As 24 per cent of the sample received energy advice during and after the work was completed, this could imply that people who received energy advice actively took those up and have started to adopt them in their everyday life. Notably a positive (moderate) relation appears between trying to use less gas and electricity and actually receiving energy advice ($r=0.235$, $p<0.05$).

Another positive (strong) correlation appears between try using less gas and electricity and believing Aspley Super Warm Zone scheme has been good in reducing residents' energy bills ($r=0.392$, $p<0.001$). This implies many people are satisfied with the outcome of the scheme.

Table 6.2 Means, standard deviations and correlations between try using less gas and electricity (M= 1.51, Sd= 0.592), socio-demographic variables and home use determinants

Independent variable: Use less gas and electricity	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Energy saving actions: Turn down heating	1.22	0.706	0.006	0.343**
2. Energy saving actions: Use energy saving lamps	1.41	0.733	0.003	0.364**
3. Energy saving actions: Replace inefficient equipment	1.13	0.833	0.04	0.260*
4. Energy saving actions: Wash clothes at lower temperature	1.41	0.733	0.001	0.476**
5. Energy saving actions: Set hot water thermostat lower	1.08	0.789	0.004	0.361**
6. Energy saving actions: Boil only water needed in kettle	1.54	0.692	0.036	0.265*
7. Opinion about the scheme: Good to reduce energy bill	0.55	0.504	0.001	0.392**
8. Received energy advice	0.28	0.454	0.05	0.235*

Lifestyle and energy saving actions run on a scale from 0 'Never' to 2 'Always'. Opinion and received energy advice are represented by either 0 for 'No' or 1 for 'Yes'
** $p < .001$, two-tailed
* $p < .05$, two-tailed

6.2.3 Correlation between what people have achieved from ASWZ: 'pay less on energy bills' and other variables

From the preliminary findings, 46 per cent agreed they have achieved 'paying less on energy bills' after their home improvements. A positive (strong) relation appears between achieving less energy bills and achieving a warmer home with ASWZ ($r=0.382$, $p<0.001$). This implies that the home improvements done through the scheme have in fact delivered on the aim of providing warmer homes with less energy bills. This is further highlighted in the positive (moderate) relation that appears between 'paying less on energy

bills' and 'having heating on less than before the improvements' (r=0.254, p<0.05).

On relating achieving 'paying less on energy bills' and energy saving actions; a positive (strong) relation appears with 'making more use of the programmer' (r=0.338, p<0.001). Thus, it seems that making use of the programmer helped in reducing energy bills significantly.

Table 6.3 Means, standard deviations and correlations between achievement from ASWZ: paying less on energy bills (M= 0.81, Sd= 0.715), socio-demographic variables and home use determinants

Independent variable: pay less on energy bills	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Achieved with ASWZ scheme: A warmer home	0.89	0.512	0.002	0.382**
2. Have heating on compared to before / after improvements	2.47	0.593	0.047	0.254*
3. Energy saving actions: Make use of programmer	0.99	0.806	0.007	0.338**

Achieved represented by either 0 for 'No' or 1 for 'Yes'. Have heating on compared with before runs from 1 'More' 3 'Less'. Energy saving actions run on a scale from 0 'Never' to 2 'Always'.
** p < .001, two-tailed
* p < .05, two-tailed

6.2.4 Correlation between like help/advice to cut energy bills more and other variables

As almost 57 per cent of the sample reported they would like to receive help/ advice on cutting energy bills, this provided some meaningful relations when correlating this variable with other variables. It appears from the table below that those interested in receiving energy-saving advice may prefer it in written format such as leaflets, booklets, etc. (r=0.687, p<0.001).

Several positive moderate and strong relations emerge between wanting help/advice and a few energy-saving actions; unplug unused equipment (r=0.264, p<0.05), wash clothes at lower temperatures (r=0.303, p<0.05), and set hot water thermostat lower (r=0.4, p<0.001). A reason for the association of those variables with wanting energy advice could be that as people are already trying to save energy by taking up a few energy-saving actions, they might well

be open to even more advice that would help them reduce their energy bills more.

From the table below, it seems that people with lower incomes tend not to want energy-saving advice (r=-0.375, p<0.001) which is a strong correlation. From the qualitative data analysis it appeared that the majority of people had other more important issues to deal with rather than reading or listening to any advice on energy that they thought might not be helpful.

Table 6.4 Means, standard deviations and correlations between like help/ advice to cut energy bills more (M=0.57, Sd=0.5), socio-demographic variables and home use determinants

Independent variable: like help/advice to cut energy bills more	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Format of energy advice preferred: written (e.g. leaflets..)	1.75	1.218	0.001	0.687**
2. Energy saving actions: Unplug unused equipment	1.38	0.705	0.038	0.264*
3. Energy saving actions: Wash clothes at lower temp.	1.41	0.733	0.016	0.303*
4. Energy saving actions: Set hot water thermostat lower	1.08	0.789	0.001	0.404**
5. Total annual income	17,016	8,553	0.004	-0.375**

Interested in volunteering is represented by either 0 for 'No' or 1 for 'Yes' Format of energy advice scale runs from 1 'written format' to 5 'other'. Energy saving actions run on a scale from 0 'Never' to 2 'Always'.
** p < .001, two-tailed
* p < .05, two-tailed

6.2.5 Correlation between the rate of the quality of the completed work and other variables

The question concerning respondents' rating of the completed work, 60 per cent of the sample rated it between average and good (almost divided equally between average and good). On correlating this variable with other variables, several positive and strong relations appeared. People rating it as average/ good still reported having problems of draught after the work was completed (r=0.377, p<0.001). Most complaints from draught were reported to be due to the worn out front and back doors. However, 82 per cent of the sample would

still recommend it to friends although they rated the quality of work as average/ good (r=0.493, p<0.001). They also feel the final outcome was worth all the disruption that many have complained of (r=0.49, p<0.001).

Rating the work as average/good has also been associated with rating the work people as polite and respectful (r=0.524, p<0.001). People rating the work as average/ good also reported they have been kept informed before and during the improvements done in their homes (r=2.22, p<0.001), and also agreed the arrangements made to minimise the inconvenience caused during the work to be average (r=0.256, p<0.001).

Another strong relation appears between rating the quality of work as average/good and having the heating on less than before the improvements (r=0.397, p<0.001). This might imply that people are satisfied with the outcome of their home improvements as the majority of the sample agreed they achieved a warmer home with lower energy bills to pay.

Table 6.5 Means, standard deviations and correlations between rating the quality of the completed work (M=2.74, Sd=1.19), socio-demographic variables and home use determinants

Independent variable: rating the quality of the completed work	Mean	Sd	Significance two-tailed (p)	Correlation coefficient (r)
1. Problems after improvements: Draught	0.93	0.92	0.003	0.377**
2. Recommend ASWZ scheme to friends	0.82	0.388	0.001	0.493**
3. Feel the final outcome worth the disruption	0.74	0.44	0.001	0.490**
4. Rate the conduct of the work person (polite and respectful)	2.18	1.10	0.001	0.524**
5. Rate the arrangements made to minimise the inconvenience during the work	3.00	1.367	0.001	0.526**
6. Rate being kept informed prior to and during the improvement works	2.22	1.006	0.001	0.465**
7. Have heating on compared to before / after improvements	2.47	0.59	0.002	0.397**

Problems run on a scale of 0 'Never' 2 'Always'. Rating the scheme aspects run on a scale from 1 'Excellent' to 5 'Very poor'. Recommend the scheme, and feel the final outcome worth the disruption are represented by either 0 for 'No' or 1 for 'Yes'. Have heating on compared with before runs from 1 'More' 3 'Less'. ** p < .001, two-tailed, * p < .05, two-tailed

CONCLUSION

The previous sections illustrated the general findings of phase B of the survey, besides sets of relations between dependant and independent variables. The mean figures for monthly gas bills reduced from £66 before home improvements to £55 after improvements whilst the monthly mean of electricity bills has reduced from £54 to £48 which means that an average household in Aspley could possibly save up to £200 of annual savings on energy bills. However, with the anticipated rise in energy prices, the savings might significantly diminish.

As for the frequency of using the heating controls available, 38 per cent of the sample always using the heating timer control. This was followed by 24 per cent always using the wall thermostats, 16 per cent always used the boiler thermostat, and only 10 per cent always used the TRVs. With some people never using any of their heating controls, this might indicate that they either cannot afford using their heating systems, or because they leave them as they were set as long as they provide them with adequate levels of comfort; they wouldn't consider adjusting their controls.

On correlating variables, several moderate and significant relations emerged. It appeared that the higher the income of households, the more people would tend to heat all rooms when in the house, where 67 per cent do so, and would not prefer to receive energy advice. Several correlations indicated that the Aspley Super Warm Zone scheme did deliver on its aims of providing warmer homes with less problems of draught, condensation, damp and mould for some of the population. The significant drop in reporting problems of cold, draught, condensation and mould associated with saving money on energy bills prove the scheme was successful at some extent. Moreover, another positive relation associated paying less on energy bills and having heating on less than before improvements proves the relative success of the scheme.

In this phase, it should be noted that many positive (strong) relations appeared between energy saving actions. For instance, the energy saving action of using energy saving lamps was found to have several positive (strong) relations with

all the following energy saving actions: turn down heating, make more use of the programmer, heat occupied rooms, replace inefficient equipment, wash clothes at lower temperatures, and boil only water needed in kettle. Likewise, positive (moderate) relations were also evident between several aspects of lifestyle and energy-saving actions. This was clear in the positive relations between trying to use less gas and electricity and going for walks, sport/exercise and reading books. This might indicate that after the home improvements were done, people tended to try and save more energy through possible changes in lifestyle and energy-saving actions, which might indicate the 'spill-over effect' discussed previously.

Although the majority of respondents rated the quality of work as average / good, however, 82 per cent would still recommend it to friends and relatives, if eligible. To conclude, phase B of the survey continued from phase A to thoroughly explore several factors that could possibly affect people's attitudes and behaviour concerning home energy use, performance, gauging problems experienced before and after improvements, lifestyle and energy saving actions. It tested the independent variables against the dependent variables; demographics, current experience with home conditions and heating efficiency, general energy awareness, and method of advice and information preferred. The analyses of this phase together with the first phase have provided a clear pathway for developing some valid guidelines for researchers and policy-makers in the near future which is further discussed in the subsequent chapter.

CHAPTER SEVEN

DISCUSSION

Chapter Contents

INTRODUCTION

Both phases of the survey have been conducted; and the data were collected and analysed to provide significant correlations and findings concerning energy consumption behaviour and the means of communication and information dissemination to most effectively support this. The outcome is an examination of the likely impacts of the CESP policy on energy consumption behaviour, together with investigating how delivering on the policy could lead to a successful delivery. From the previous detailed analysis of both phases (A and B) of the ASWZ scheme survey, several significant aspects have emerged when drawing comparisons between phase A (as the control group) and phase B (as the experimental group) in home use and performance, tenants' lifestyles and behavioural trends. As mentioned previously, although the samples are different, the physical characteristics of the homes are the same, and the socio-demographic makeup is largely comparable (see Appendix H).

7.1 HEATING TRENDS

From Fig. 7.1, it is clear that before the ASWZ scheme home improvements, 37 per cent of the sample heated most rooms when in the house while 20 per cent heated all rooms all the time. This heating trend changed significantly after the home improvements where almost 64 per cent heated all rooms all the time when in the house. This indicates that people could either afford to heat all their rooms after the improvements, or that they are using their new central heating systems more efficiently. However, there still seems to be a minority who are careful with their heating, where 16 per cent either heat their living rooms and other rooms as they occupy them or only their living rooms after home improvements.

Notably, buildings with similar physical characteristics have been found to have significant energy consumption variations (Guerra Santin, 2010). Research has affirmed that patterns of occupancy determined by household characteristics, socio-demographic variables, tenants' lifestyle, perception of comfort, among other subjective factors cause significant variations in heating trends (Guerra Santin, 2010; de Groot et al., 2008; Poortinga et al., 2003). For

instance, Revisiting Easthall project (2002) has found that only 23 per cent of the surveyed sample was using their new heating systems effectively, whereas the rest were using them in a manner that suits their lifestyles and comfort.

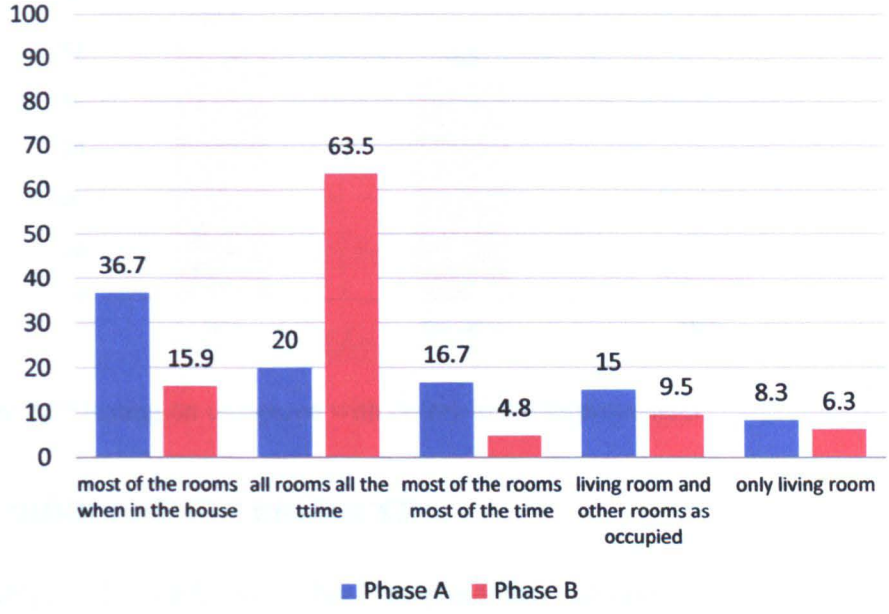

Figure 7.1 Home heating patterns in phases A and B

When comparing between how much people turned on their heating before and after improvements, around 52 per cent reported they used them less than before, while 44 per cent used them at the same frequency, as shown in Fig. 7.2. This is further highlighted in the positive (moderate) relation that appears between 'paying less on energy bills' and 'having heating on less than before the improvements' ($r=0.254$, $p<0.05$). This relation is also confirmed by the DECC (2011a) evaluation of CESP where it reported that around half their survey respondents had reduced the use of heating since installation measures were done. Besides, more than half the people surveyed before the scheme reported they found it too expensive to heat their homes adequately, whereas with the CESP measures they were currently able to do so (DECC, 2011a).

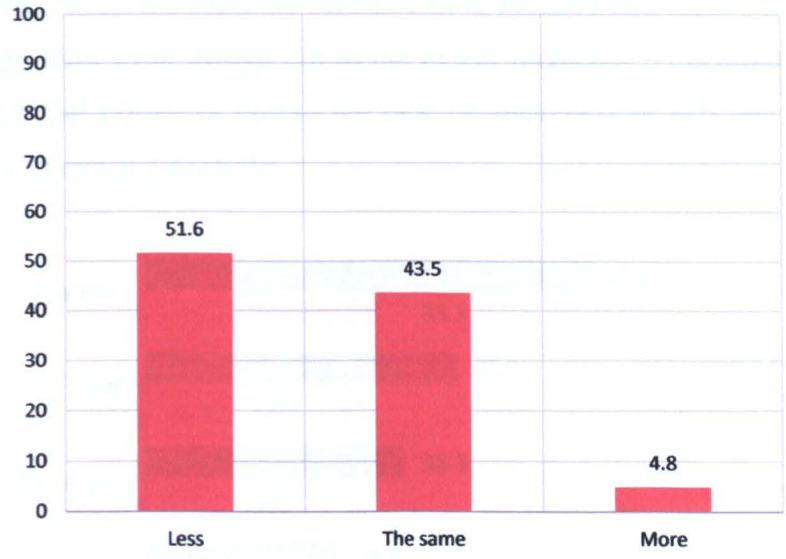

Figure 7.2 Heating on compared with before home improvement

7.2 PROBLEMS EXPERIENCED

Notably, all problems that respondents always experienced before improvements have considerably reduced after their home improvements. Problems with the cold, condensation, damp and mould have reduced at a much higher rate than problems with draught. Problems with draught which had been always experienced by 66 per cent of respondents before improvements went down to 38 per cent after improvements. A viable reason for this might be that replacing external doors was not one of the ASWZ scheme measures. However, problems with draught did not reduce as significantly as the other problems experienced after the improvements. Similarly, problems with cold, condensation, damp, and mould have gone down from 46, 38, 28, and 27 per cent respectively to 13, 12, 3 and 8 per cent. The main reason reported and discussed in the previous chapters is that only around 35 per cent of front and back doors have been replaced, whereas the rest were the main source of draughts. This indicates that ASWZ scheme was relatively successful in delivering homes which are warmer, with less problems of draught, damp, condensation, and mould. In Arbed 1 Scheme, 60 per cent of people surveyed agreed their homes were much warmer after their home improvements and 35 per cent reported their homes were more comfortable

(Patterson, 2012). Besides, the schemes have resulted in people saving money on energy bills, even though not to the extent predicted. This might be due to the rising fuel prices, or due to the lack of awareness of efficient use of the heating systems and controls.

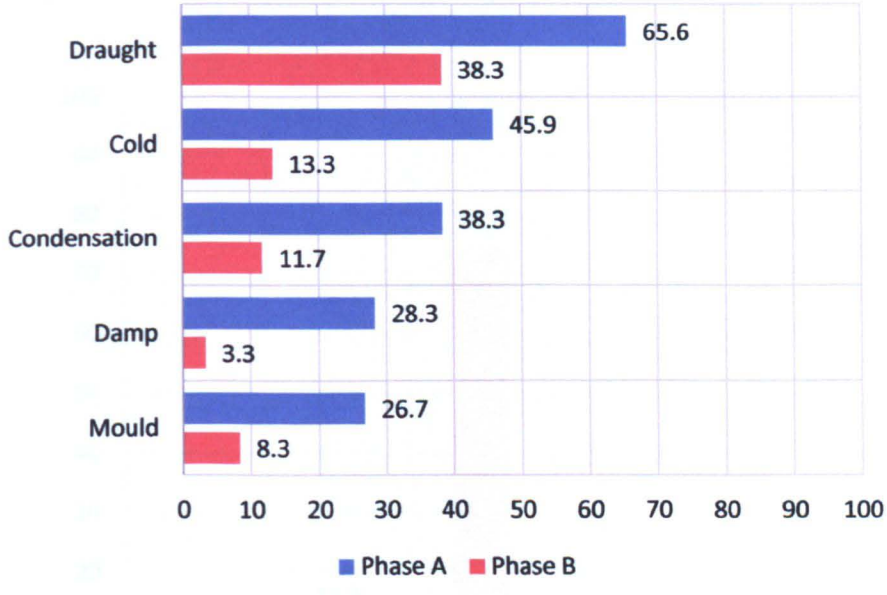

Figure 7.3 Problems experienced in homes in phases A and B

In response to the question concerning how people think the scheme could be better, many respondents stated that they believed all the benefits of the internal wall insulation and other measures provided by the ASWZ scheme are diminished by heat loss through the doors. Thus, most respondents suggested the old external doors to be replaced in order to make the most benefits of the scheme.

7.3 HEALTH AND WELLBEING

Notably, as shown in Fig. 7.4; 16 per cent of the sample reported their health to have become better or much better after more than a year's experience with their home improvements. On the other hand 10 per cent reported their health as getting worse than before their home improvements, but this is not necessarily related to the work done in their homes. From the open ended questions about the scheme; a few respondents affirmed that they believe 'fewer cold snaps' affected their health positively after the home improvements. Likewise in

Arbed 1 Scheme, where 27 per cent of respondents reported they feel better after their home improvements while 14 per cent feel worse (Patterson, 2012). Reasons for feeling worse were not clarified in this study as well, thus, more information would be required for explaining possible reasons for the health issues reported.

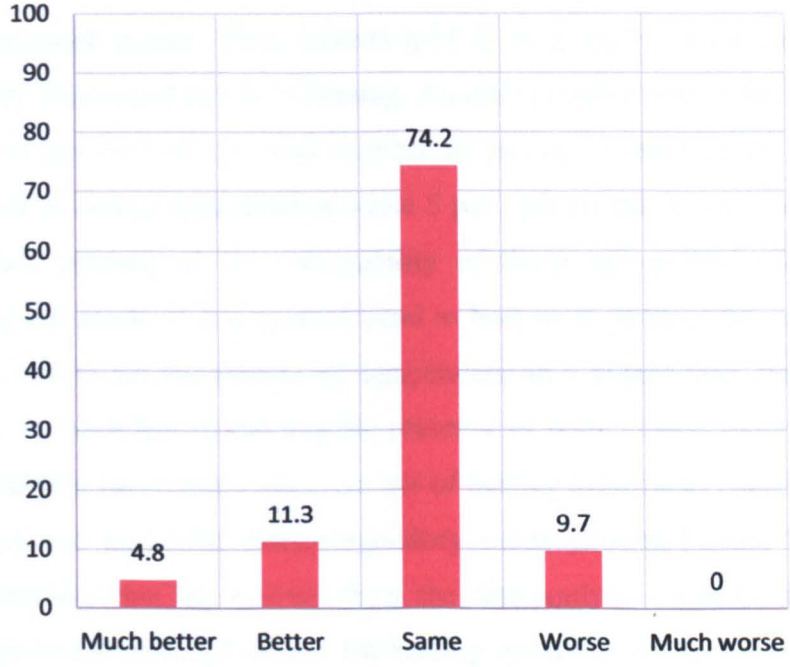

Figure 7.4 Health conditions after home improvements.

DECC (2011b) reported that evidence was found of wider benefits of some CESP schemes where significant aesthetic improvements occurred in the areas, increase in community pride was also reported, besides perceived health benefits resulting from warmer homes. It should be noted that people's assessment of their health tends to be related to their overall satisfaction in life (Self et al., 2012) such that those who report having good health tend to report higher levels of subjective well-being and vice versa. This has been proven through the Office for National Statistics where 62 per cent of respondents who reported bad health also reported low levels of well-being, whereas 18 per cent of those reporting good health associated with high levels of well-being (Self et al., 2012). Better health obviously means less burden on the National Health Services, less sick leave from work among other significant economic benefits.

7.4 WALL THERMOSTAT SETTINGS

With more than half of the phase A sample always heating most of the rooms most of the time and when in the house, and with 22.5° C being the mean thermostat temperature set, this definitely reflects a few possibilities. Solid walled houses are hard to heat, with high rates of heat transfer through walls, and these have been reported to be continuously cold; even with the heating set at its maximum power. Thus, tenants tend to keep their heating on with the previously mentioned trends of heating. Another possible reason for this is that around 40 per cent of the total number of people covered in the survey is comprised of infants and children while 5 per cent are adults over 65 years of age. Thus, because of the vulnerability of those age groups and specific physiological needs, it is a general trend to heat most of those houses most of the time and to set the thermostat temperature to a higher than average one. Previous research has shown that the presence of both, elderly individuals and young children cause more intensive use of heating systems to respond to their sensitivity and particular thermoregulatory needs (Guerra Santin, 2010). A final possibility that has evolved from the data analysis could be the lack of awareness and knowledge of how the heating systems work and how to use the heating controls efficiently. A possible factor that was asserted by a recent study is that average education levels might drive higher energy consumption when compared to higher education levels (Guerra Santin, 2010).

In case of phase B, the mean temperature set on the wall thermostat went down to 21.45° C (22.5°C in phase A), which is still slightly higher than the recommended temperature for user comfort and energy saving, which lies between 18 and 21° C. A study on dwellings of improved thermal properties in the Dutch housing stock showed that occupants tended to prefer higher indoor temperatures (Guerra Santin, 2010) thus providing evidence for a rebound effect where the lower energy costs were possibly compensated for higher levels of indoor comfort. In the present study, strong and positive relation appears between people who set thermostats at lower temperatures and have their heating on less than before home improvements ($r=0.362$, $p<0.001$). This

might indicate that the ASWZ scheme has delivered on reducing heating loads compared with homes surveyed before the heating upgrade.

Previous research on UK government energy efficiency programmes has reported that, for homes to achieve some energy saving, the overall temperature of the whole house is required to be within the range of 19-20° C (Milne & Boardman, 2000 quoted in Hamza & Gilroy, 2011). Reducing thermostats by 1°C results in saving up to 300 kg CO_2 annually (EST, 2012), which could lead to a reduction of around 540,000 kg CO_2 annually from the 1,800 ASWZ homes if all take the action of reducing temperatures on thermostats.

However, a study done on the Dutch housing stock has found that energy upgraded households with thermostats consume more energy than those without thermostats (Guerra Santin, 2010). This shows that although better thermal properties of dwellings might reduce energy consumption, the presence of systems controls (such as thermostats) does not always reduce energy consumption. The same study (Guerra Santin, 2010) affirmed that households with more information regarding indoor temperatures seemed to set their thermostats at temperatures that were below average, which again highlights the crucial need to provide tenants with information on the optimum ways of using their heating systems and controls. Another study (Druckman & Jackson, 2008) implied that with the increased take-up of central heating, householders may be more likely to maintain all rooms at one temperature rather than use heating controls to enforce temperature differentials between occupied and unoccupied rooms.

In this study, it was found that reporting problems of condensation was positively (strong) related to the temperature set on the wall thermostat in phase A, while a positive (moderate) relation appeared between temperature set on thermostat and problems of draught in phase B. This implied that the problems reported depended primarily on the home condition, which people then respond to by raising the temperatures on their thermostats. In phase A, where dwellings were less efficient and leaky, problems of condensation were

major, whilst in phase B, after energy improvements, draughts appeared to be more dominant due to infiltration through external doors.

7.5 GAS AND ELECTRICITY BILLS

Notably, DECC (2011a) reports that no monitoring has been undertaken on the income of CESP recipients, which the present study has been able to. An important aspect highlighted from phase B of the survey is that the mean electricity and gas bills together constitute more than 10 per cent of the majority of the sample's annual income, with the mean gas bill of £66 and the mean electricity bill of £54 before the home improvements. Both the mean gas and electricity bills reduced from £66 and £54 to £55 and £48 respectively. Nevertheless, these still add up to £103 energy costs a month, which in turn traps about two thirds of those households in fuel poverty. However, DECC (2011b) affirm that the English Housing Survey data reported that only around 20 per cent of CESP-eligible households in England are in fuel poverty, whereas the national average is 15 per cent.

This reduction in fuel bills results in average annual savings of £204 per household on energy bills. Although CESP aimed initially at annual savings of at least £300 per household (DECC, 2009c), it appears that with the rapid increase in energy prices and likely inefficient energy consumption behaviour in households, a significant part of the savings may possibly reduce. DECC (2012b) noted that the average provisional 2012 electricity bill across all payment types increased by £25 (5.5 per cent), compared to 2011 while the average provisional 2012 gas bill across all payment types rose by £79 (11.0 per cent), compared to 2011. Thus, the full benefit of delivering the CESP scheme is highly challenged and the viability of achieving the perceived targets could be problematic. In both phases, positive and strong relations appeared between average monthly gas bills and average monthly electricity bills after improvements. This implied that the gas and electric bills are directly proportional both, before and after the implementation of the scheme measures, as they reflect a general trend of energy consumption in a household.

However, it has been affirmed that evidence from household experience research on CESP schemes prove that CESP measures helped reduce fuel bills of a sizable minority of households in the previous 12 months (2010-2011) when energy prices increased (DECC, 2011a). From surveys and in-depth interviews it was found that savings on fuel bills were highest when participants associated them with receiving advice on how to use their heating systems efficiently. Besides, from DECC (2011a) CESP survey, a few householders reported they were unable to understand the instruction manuals of their new systems, which again highlights the need for better and more comprehensive instructions on measures.

7.6 LIFESTYLE TRENDS

Lifestyles define people's identity in terms of social position, cultural preferences and psychological aspirations. The area of lifestyle choice has often been ignored in policy interventions as it has been considered too subjective and too intractable to be targeted by policy interventions (UNEP, 2010). However, sustainable lifestyles need to be developed across all levels - individual, community, and business, among others - to help alleviate global carbon emissions. In the figure below a comparison between lifestyles has been plotted to depict any changes that the ASWZ scheme might have brought about in tenants of households who have had their home improvements for over a year. The ONS statistical data has been found to be quite similar to the data collected from the study and hereby presented.

As can be seen, in phase B, significantly fewer people always used their laptops/computers than in phase A which might relate to the finding that in phase B 45 percent of the labour force are employed, as opposed to 55 per cent in phase A who might be using their computers mostly at work. By contrast, however, more people watched TV more than three hours a day in phase B than in phase A. Likewise, with reading books; in phase B, significantly more respondents reported they always read books than in phase A. Those remarkable differences might imply several possibilities.

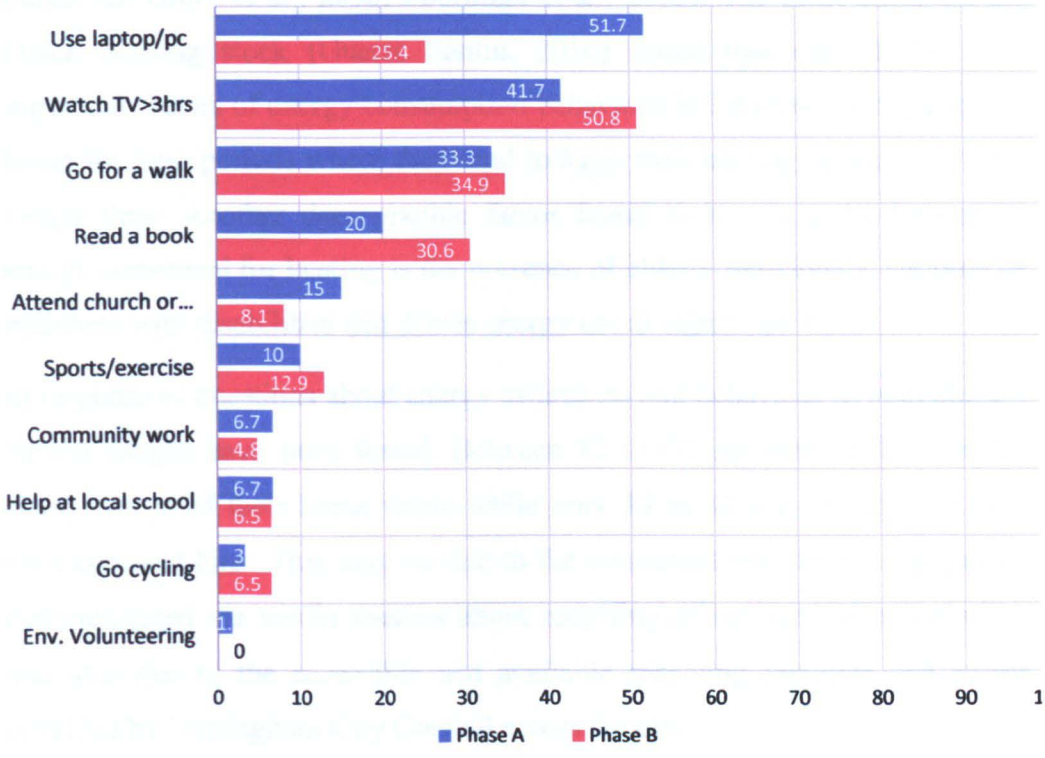

Figure 7. 5 Lifestyle trends in phases A and B

The demographics factor, relating to age, gender, employability, and level of education, among others, might offer explanation for these typically different trends and lifestyles. In phase A, 60 per cent of the sampled households have infants or children (or both), while in phase B only 48 per cent of the sample do. In both phases A and B, nearly 30 per cent of the samples have retired or disabled/ill-health members. Also, higher rates of watching TV might possibly be explained by higher levels of comfort provided by the ASWZ scheme, which encourage people to stay at home and watch TV or read a book.

7.7 BEHAVIOUR PATTERNS

Occupants' behaviour has been found to explain 12 per cent of the variation of energy consumed for heating in a study performed on recently built Dutch housing (Guerra Santin, 2010). Besides, patterns of occupancy determined by characteristics of households, socio-demographic variables, lifestyles, among other subjective factors have proved to cause significant variations in heating

trends (de Groot et al., 2008; Poortinga et al., 2003). The same study on the Dutch housing stock (Guerra Santin, 2010) found that one of the most important factors of energy consumption behaviour is the presence of people at home for long periods where they tend to keep their heating systems on for a longer time. Another demographic factor found to have a great impact on energy consumed for heating is the presence of elderly individuals, children or members with disabilities that drives energy use at significant rates.

In response to questions about energy awareness and behaviour in both phases; similar ranges have been found. Between 82 to 84 per cent of the samples always recycled their home waste while only 30 to 32 per cent always used their compost bins. This may be due to the consistent information campaigns communicated via media sources about recycling as opposed to composting, and also due to the accessible and available recycling facilities and points provided by Nottingham City Council across the city.

The following top actions always taken by respondents in both phases are to turn off unwanted lights between the range of 78 to 83 per cent, boil only water needed in kettle at 60 to 65 per cent, use energy- saving lamps at 56 per cent, and unplug unused equipment from 47 to 51 per cent. Besides, between 45 to 55 per cent always wash clothes at lower temperature with the same range reporting using less gas and electricity. This might reflect people's general awareness of basic energy-saving actions, or maybe their concerns about their fuel bills, which may be the main drivers for those actions. If people are aware to some extent of a few energy-saving actions, then they might be receptive to other more significant ones, such as more efficient use of their heating systems, if they were provided with sufficient guidance.Thus, it is possibe that the home improvements done through ASWZ have had an impact on tenants' energy consumption behaviour.

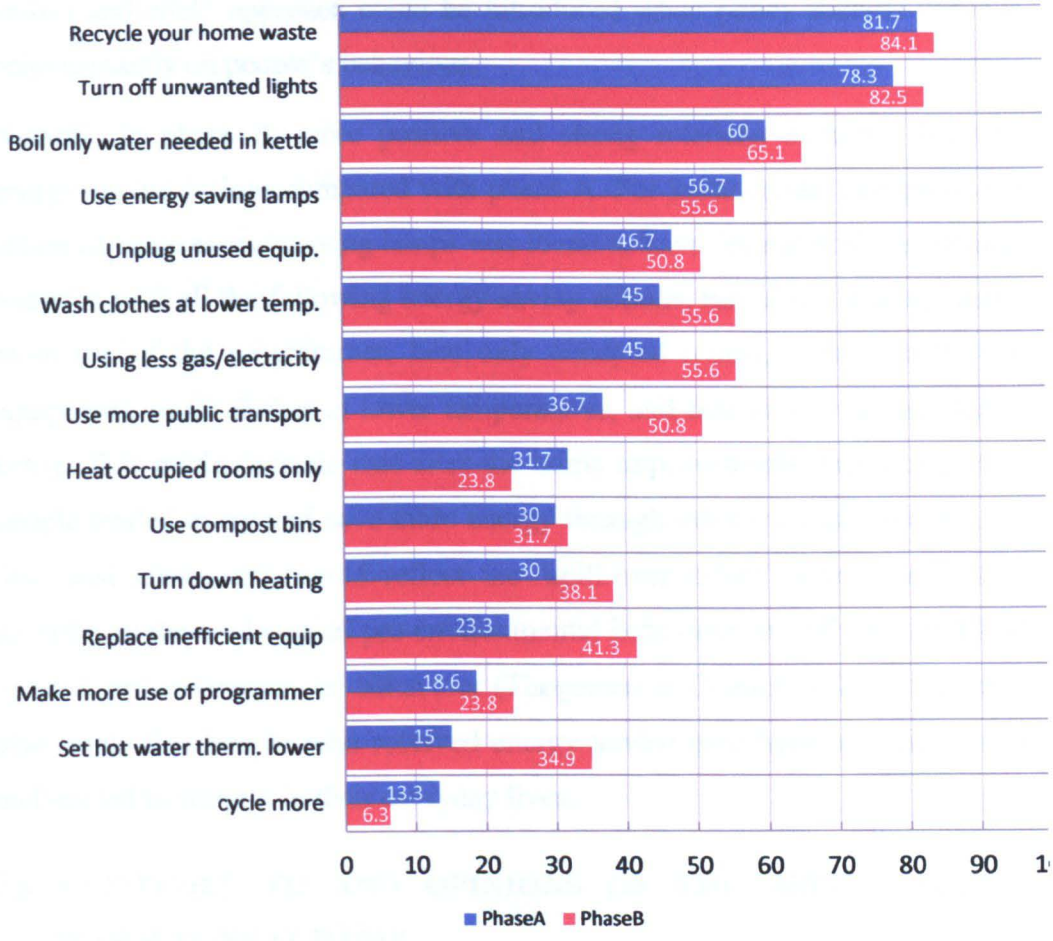

Figure 7.6 Behaviour patterns in phases A and B

With regards to 'reasons for taking any of the previous actions', saving money came first where the majority of both samples reported this to be the main reason, along with one or more of other reasons (save energy; due to habit; environmental concern). Around a quarter of the samples took these actions only to save money as the dominant reason; followed by to save energy and due to environmental concern, while around a fifth take these actions out of habit. This indicates that the first concern for most people in this area is to save money, which suggests that financial incentives could possibly be effective in encouraging policy uptake and delivery in this area. Steg et al (2006) implied that one of the most important policy features that influence policy effectiveness and acceptability is the use of incentives and disincentives. In their research they affirm that people, in principle, are willing to take up pro-environmental behaviour and hence reduce CO_2 emissions provided that this will not be associated with higher financial costs (Steg et al., 2006). Thus, a

'carrot and stick' approach could be introduced when policy success depends predominantly on people's behaviour.

Notably, in phase B, more positive and strong relations appeared between energy-saving actions compared with phase A. For instance, the energy-saving action of using energy-saving lamps was found to have several positive (strong) relations with all the following energy-saving actions: turn down heating, make more use of the programmer, heat only occupied rooms, replace inefficient equipment, wash clothes at lower temperatures, and boil only water needed in kettle. This might indicate that after the home improvements were completed, people tended to try and save more energy through other everyday actions. As discussed above, this could reflect the 'spill-over effect' which researchers describe as the tendency of pro-environmental behaviour to spill over and lead to other pro-environmental behaviour (Thøgersen & Crompton, 2009). It could also imply that people who received energy advice may have responded to it and started to adopt it in their everyday lives.

7.8 ATTITUDES TO AND OPINIONS OF THE ASPLEY SUPER WARM ZONE SCHEME

In phase A of the questionnaire, around 70 per cent agreed they would sign up for the scheme while the rest would not. Of those who would like to sign up, 65-70 per cent thought the ASWZ scheme was 'good to improve their homes and reduce bills'. The main reasons for 30 per cent rejecting the scheme was that either they would not want the disruption or that they had already had home renovations, while some others reported that their ill-health would prevent them from signing up. Some of this group replied that they may change their mind and sign up if they were given more technical or hands-on information of how the scheme worked.

With phase B, after experiencing the scheme for over a year, those concerned were asked what they achieved from the scheme. The majority (73 per cent) agreed they had a warmer home and improved home conditions, while less than half of the respondents thought they actually saved on energy bills. The majority also thought that the most significant outcomes of the scheme were,

first, achieving a warmer home, then having new kitchens and bathrooms, and then finally the internal wall insulation. This has been backed up by DECC (2011a, p.25) CESP evaluation which stated that "even where respondents did not save money they felt able to heat their homes to an adequate level, including those who said they had been unable to do so before installation of measures". A strong relation appears between rating the quality of work as average/good and having the heating on less than before the improvements ($r=0.397$, $p<0.001$). This might imply that people are satisfied with the outcome of their home improvements as the majority of the sample agreed they achieved a warmer home with lower energy bills

Regarding people's expectations of the ASWZ scheme, in phase A, those who agreed to sign up for the scheme believed the scheme would improve/had improved their homes. In phase B, people who achieved lower energy bills believed they achieved warmer homes. However, many thought the benefits of a warmer home were lost due to the draughty front and back doors which were in a bad state. Notably, 82 per cent would recommend the ASWZ scheme to others, which implied people were, overall, satisfied with the outcomes of the scheme.

Almost half the respondents agreed that more work in home improvements was needed to achieve the maximum benefits of the scheme, while 27 per cent thought one-to-one advice and support on how to get the maximum benefits was necessary, as illustrated in Fig. 7.7. With almost 40 per cent agreeing that more information and advice is required concerning measures installed and energy saving at home, it is clear that providing this is crucial to guarantee successful policy delivery.

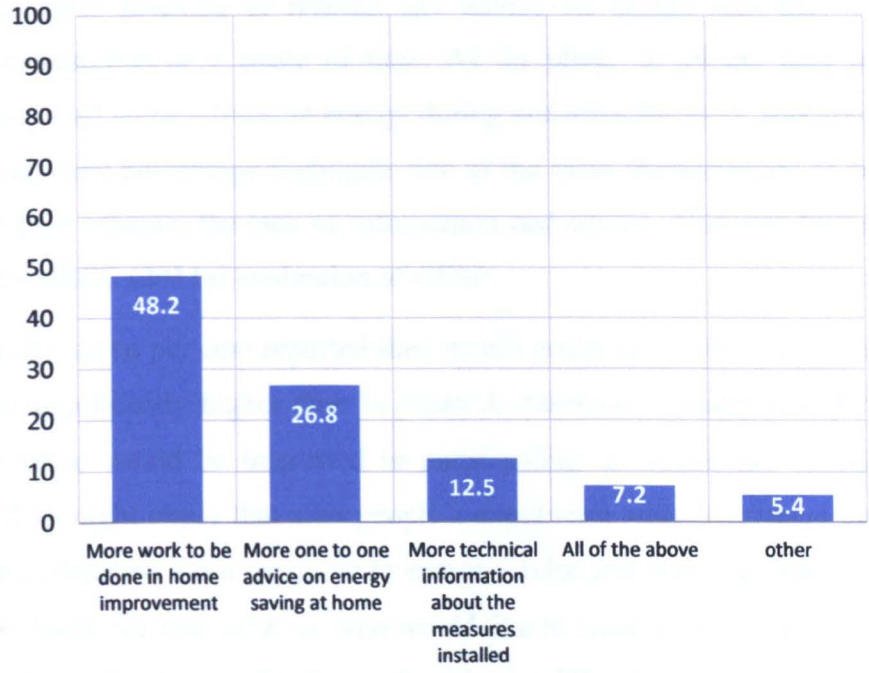

Figure 7.7 What needs to be done to get the most benefits of the scheme

7.9 INFORMATION/ADVICE RECEIVED

Interestingly, in phase A of the survey only 30 per cent of the sample heard about the ASWZ scheme. Only 16 per cent of those heard about it through the show home which is based in the centre of the community opposite the primary and nursery school entrance. Although the show home is hosted by NCH and NEP and has had all CESP measures installed to act as a live example, however, NCH and NEP reported it has hardly been visited by tenants of the area in spite of many attempts to invite eligible householders to social events at the show home to raise awareness of the scheme. This might imply that the majority of the people in the area were not interested or curious to learn about the scheme and that using a show home to market the scheme was not probably the best tool to be used in Aspley.

In phase A, 28 per cent of the sample reported they received energy advice in the form of leaflets and booklets or door-to-door sales from their energy suppliers or the City Council. Only 47 per cent would prefer to receive energy advice. From the overall analysis of the questionnaire, it appears that many had numerous problems and concerns relating to the fact that they would not

consider listening or reading any advice on energy that they believed was meaningless or a waste of time. As for phase B, 24 per cent reported they received some advice on energy during and after the work was completed. This very low percentage highlights one of the main shortcomings of delivering the CESP scheme; the lack of information and advice. This was further elucidated by DECC (2011a) evaluation of CESP.

Fifty seven per cent reported they would prefer to receive energy advice, which is significantly higher than in phase A. Moreover, twenty five per cent of this sample would be interested in participating in workshops on energy advice. This might imply that after people's experience with their home improvements, they became more receptive to energy advice and would actually like to receive it. Forty per cent of those who would like to receive energy advice would prefer it in written format (leaflets or booklets), while 13 per cent preferred one-to-one support.

Tailoring the information required to reduce energy consumption according to the specific requirements and characteristics of target groups has proved worthwhile in other studies (Abrahamse et al., 2007). As the majority of the sample preferred leaflets and booklets as the means of communicating advice, it is crucial that creative, simple and comprehensive design and communication methods are available. However, around 10-13 per cent preferred receiving energy advice via electronic medium, which would have been the easiest and most sustainable means of delivering tailored energy advice.

In order to assess whether CESP can effectively deliver on its aims, a number of key areas relating to the likely, potential solutions need to be examined, as well as the environment in which these solutions will be operating. The users' energy consumption behaviour and the policy interventions will mean the difference between promising policy, and policy which in fact delivers on its aims for energy efficiency and sustainability. The Aspley area is identified as one of the most deprived areas in Nottingham, as well as having a very high number of inefficient, solid wall houses that are 'hard to heat'. Thus, the effective delivery of energy advice in the area persistently faces challenges from the financial, social and cultural constraints. It is clearly recognised that

with the variety of formats of information and advice that people reported they would prefer to receive, tailored information should be the most effective approach for maximising the benefits of the scheme.

CHAPTER EIGHT

CONCLUSION

Chapter Contents

INTRODUCTION

This research sought to investigate the energy consumption behaviour of residents of inefficient homes that have been upgraded to more energy-efficient standards following a CESP scheme. The key aim was to examine whether the home energy upgrade scheme had an impact, both on energy bills and residents' energy consumption behaviour. The objective was to find feasible propositions that could be included in policy initiatives (or the way they are applied) that could result in the plausible success of policy schemes and programmes.

The study starts with a critical appraisal of some of the literature on energy consumption behaviour in the domestic sector. It then discusses the significant energy policy initiatives introduced by the UK government during the past decade or so. The research identifies the CESP, introduced in 2009, as one of the important vehicles for the significant reduction of carbon emissions from the existing housing stock. It closely examines the ASWZ scheme in Nottingham to identify the implications of the scheme for the household energy bills and energy consumption behaviour of tenants.

To perform this, a 'before-and-after' survey was undertaken; phase A, prior to the ASWZ home improvements, and phase B, a year (or more) after the home improvements. Thus, a mixed methods research methodology was employed; combining qualitative and quantitative data collection, analysis and interpretation to help fully explore the research hypothesis. A total of 122 households successfully participated in the survey. Data collected were analysed to produce descriptive and frequency statistics and regression analyses tests were performed to draw an overall picture of the ASWZ scheme delivery.

One of the important findings to emerge from the study was that changing home energy use behaviour requires both a bottom-up approach which focuses on understanding individual energy consumption behaviours and parameters, as well as a top-down perspective which finds the most appropriate policy instruments that target home energy conservation. The lack of communication is very likely to result in the loss of valuable outcomes through uncoordinated efforts and approaches between concerned parties.

The following sections present the conclusions and recommendations of this research.

8.1 IMPLICATIONS OF PEOPLE'S ENERGY CONSUMPTION BEHAVIOUR AND LIFESTYLE ON THE SUCCESS/FAILURE OF POLICY DELIVERY IN THE UK DOMESTIC SECTOR

Users' behaviour is a key determinant of energy consumption. Patterns of occupancy determined by characteristics of households, socio-demographic variables and lifestyles, among other subjective factors have proved to cause significant variations in heating trends. One of the most important elements of energy consumption behaviour is the presence of people at home for long periods where they tend to keep their heating systems on for a longer time. Another demographic factor found to have a great impact on energy consumed for heating is the presence of elderly individuals, children or members with disabilities in the home, which drives up energy use at significant rates. In the current study, only 45 per cent of the labour force in phase A was employed while in phase B this was slightly higher, at 55 per cent which is lower than the national average of 58 per cent. This may probably account for the generally high energy consumption rates in this area due to the long periods of time that economically inactive or unemployed people tend to spend in their homes.

In the present study, and after the energy measures were installed in the ASWZ houses, occupants' heating patterns still showed significant variations, although most houses have had similar measures installed. In phase B, only 64 per cent of the sample seemed to be using their central heating systems properly and efficiently while the rest had different patterns of heating that might relate to their financial capabilities or insufficient information on how to use their systems effectively while saving on energy bills.

Observed thermostat settings may infer general household energy consumption behaviour. In this study, a strong and positive relation is observed between people who set thermostats at lower temperatures and have their heating on less than before the home improvements were carried out ($r=0.362$, $p<0.001$). This indicates that the ASWZ scheme may have delivered on the target of reducing

heating loads compared with homes surveyed before the heating upgrade. An important aspect that emerged from this research was that the mean electricity and gas bills together constitute more than 10 per cent of the annual income of the majority of households in both phases A and B. The ASWZ scheme succeeded in ensuring that the annual savings in utility bills could reach up to 200 GBP per household, which could help households significantly in this deprived area. However, the annual rise in energy tariffs, tenants' inefficient use of heating controls and unsustainable energy consumption behaviour, and the possibility of the rebound effect, continue to pose challenges to delivery of the full benefits of the scheme.

The rebound effect was also highlighted as an important implication to the success of the ASWZ energy efficiency measures. This rebound effect may be one of the reasons why the expected savings (of up to 300 GBP annually on energy bills) were not achieved by the CESP scheme in Aspley; where tenants might have chosen higher levels of comfort in their homes over making actual savings on energy bills. Another important finding of this study was possible evidence of 'spill-over effect' where several positive (strong) correlations were found between energy-saving actions. Examples of this were positive (strong) correlations between 'try using less gas and electricity' and 'turn down heating', 'use energy-saving lamps', and 'wash clothes at lower temperatures, at (0.343, $p<0.001$), ($r=0.364$, $p<0.001$), and ($r=0.476$, $p<0.001$). This suggests the possibility that after home improvements, people tended to try and save energy through everyday actions.

Besides, people usually resist making major cuts in energy use when it involves sacrificing their comfort, but they tend to do so only when they perceive a general emergency or when the household is financially strapped (Gardner & Stern, 1996). The limitations of changing daily behaviour do not affect energy-saving approaches that change household technology so that people have the same level of comfort with less energy use. However, physical measures such as changing boilers, heating systems and wall insulation among others are costly, so money is a barrier to action, thus Government-funded programmes play an effective role in addressing this.

At present, the UK Government has largely opted to gain compliance and not bring about a change in underlying values, in order to establish a new culture of low-carbon lifestyles; however, Government aspirations to reduce energy consumption might go unheeded if they are inconsistent with the social and physical context of real life. Financial costs, past behaviour, social values and physical infrastructure are considered some of the most difficult barriers to changing energy behaviours. Policies should not only inform people about technological improvements that can be installed in their homes, but should also strongly encourage and incentivise them to use them efficiently. Thus, assessing the effectiveness of policy interventions requires a clear understanding of consumer behaviour and motivations across all income groups so that the most appropriate approaches are developed.

8.2 FACTORS UNDERLYING HOUSEHOLD ENERGY CONSUMPTION AND CONSERVATION

This research investigated and discussed factors affecting domestic energy consumption including societal factors, technological developments, economic growth, demographic factors, and institutional and cultural developments. These factors are among many others that are multiply determined and interdependent, which in turn increase the complexity of the energy consumption behaviour issue. Further, the interdisciplinary literature concerned with energy consumption suggests that social structure and cultural practice are major elements of energy consumption. Significant energy use and energy conservation differences have been studied between income groups, across lifecycle stages, and among ethnic subcultures. However, many of these studies have not considered technical variables that influence consumption, such as important housing and technology differences between social groups (Lutzenhiser, 1997).

Another important factor affecting household energy consumption behaviour is energy demand from appliances. Personal choices people make in their everyday lives such as purchasing appliances and using heating controls more efficiently, among others, have the potential to significantly contribute to the UK's climate change targets. Changing unsustainable behaviour requires multidisciplinary conventions that capture all aspects of energy consumption. Energy conservation

could be made possible by driving change in inefficient behavioural patterns and unsustainable lifestyle trends.

8.3 THE ROLE OF POLICY INITIATIVES IN MOTIVATING THE UK DOMESTIC SECTOR TO SUPPORT SUCCESSFUL DELIVERY OF ENERGY AND CARBON TARGETS

From the findings of this two-phased study, it is noted that policy changes to the way homes are built or retrofitted may only reduce carbon emissions to a certain extent; whereas the greater challenge of addressing behaviour patterns of consumption needs to be addressed if existing homes are to meet the UK carbon emissions reduction target. Findings from the study show that, although the ASWZ scheme may have succeeded in providing people with warmer homes, it may not actually achieve the carbon savings anticipated due to the inefficient behaviour of tenants noted in both survey phases. Thus, behavioural change is a viable key for achieving significant carbon savings in the UK.

Previous studies, however, implied that policy formulation and decision making with respect to environmental issues tend to be complicated. Typically, there are several factors to consider - physical, psychological, economic, ethical, and political - as well as the often-conflicting interests of different groups. In fact, the complexity of environmental decision problems is such that they may appear to defy rational analysis, and that effort to establish environmental policies encounter controversy on many issues (McManus et al., 2010; Nickerson, 2003). Government policies send important signals to consumers about institutional goals and national priorities. They indicate in sometimes subtle but very powerful ways the kinds of behaviours that are rewarded in society, the kinds of attitudes that are valued, the goals and aspirations that are regarded as appropriate, what success means, and the worldview which consumers are expected to adhere to. Policy signals have a major influence on social norms, ethical codes and cultural expectations.

Another issue is the lack of transparency in the climate policy, where some policies such as Carbon Emissions Reduction Target (CERT) and Renewables Obligations (RO) have been implemented in such a way that their implications

are barely visible to the public. This has been a main reason for the general unawareness and disengagement of the public with the Government initiatives towards reducing emissions. It is clear, therefore, that delivering a sustainable energy strategy for the UK housing sector should entail a full and thorough examination of the barriers and implications discussed.

Single policy tools have not proven successful in reducing domestic energy consumption, and the most effective interventions for household action should incorporate behavioural, economic and engineering elements. Effective interventions should utilise a number of policy tools to change behaviour, including information and incentives. These interventions also require the use of social marketing that targets community and social norms through mass media appeals and community-based initiatives. Interventions need to address all sectors and parties within society (individuals, communities and businesses among others) to ensure they encapsulate diverse interests.

It is worth noting that Gardner and Stern's (1996) four basic solutions for influencing consumption behaviour need to be carefully considered and integrated by government and policy makers according to each particular problem. Four basic ways were identified to encourage individual behaviour for the common good: government laws, regulations and incentives; programmes of education, which attempt to encourage pro-social behaviour by giving people information and trying to change their attitudes; small social groups and communities, and the use of moral, religious, and/or ethical appeals. Although the laws/regulations/incentives method encourages individuals to behave in the public interest by making it in each individual's personal self-interest to do so, the other three basic solution approaches try to encourage prosocial individual behaviour in a fundamentally different way. These methods assume that under the right conditions, people will want to behave in a public-spirited fashion, whether or not such behaviour is in their own personal interest (Gardner & Stern, 1996).

In order to promote energy conservation in the domestic sector, Gardner and Stern (1996) suggested several feasible incentives; energy price changes and financial rewards being the most promising. In a study that undertook a

comparison between the outcomes of two different ways of explaining time-of-use rates, significant findings emerged. It was noted that the electric company's default information pack, comprising notification letters and a brochure, did not affect the consumers' energy use to the same extent that the enhanced communications package did; this comprised frequent reminders about rates, letters from the state Consumer Advisory Council, detailed information about rates, advice on how to monitor home energy use, and other information. In this study, consumers who received the enhanced communications package reduced peak-period energy use by 16 per cent compared to those who received the default information package (Heberlein & Warriner, 1983 cited in Gardner & Stern, 1996). Thus, the success of the energy price incentive depends on how it is explained to people and the means of communicating information.

In the case of financial rewards and incentives, attracting people's attention and making the procedure convenient are both important factors for success (Gardner & Stern, 1996). Attracting people's attention and raising awareness when a strong incentive is offered are crucial in raising the level of success of a programme. Besides, the more convenient the procedure is, the more successful the outcomes are. However, monetary incentives and disincentives are targeted to specific activities; their aim is not to change the underlying value system of individuals, but rather the relative prices of alternative actions (Santopietro, 1995). Some studies (Abrahamse, 2007; Gardner & Stern, 1996) have affirmed that several financial rewards succeeded in changing behaviour in a limited way as they only affected people's daily behaviour and did not change, for example, the inefficient equipment many people have in their homes.

8.4 INFORMING AND EDUCATING PEOPLE TO SUPPORT THE GOVERNMENT INITIATIVES IN HOME-ENERGY UPGRADE

In both phases of this research only around one quarter of the respondents received advice on energy saving, mostly through their energy suppliers. There was nothing to indicate whether those who received advice actually acted on the advice received or not. However, around half the respondents in both phases agreed they would prefer to receive energy-saving advice. This indicates that many people are receptive to advice, but the means of advice proved to be

another major issue. It is also crucial to investigate why the rest (around half the sample) would prefer not to receive advice on energy saving. This may indicate that people who do not want to receive advice would not consider reading or listening to advice as they might have other, more pressing concerns (possibly financial concerns in this area). This finding may also imply that the amount of 'junk mail' that people tend to receive nowadays may have a negative impact on people's perception of important advice. People may tend to throw away mail that they consider as 'junk mail' without actually checking it first.

As the majority of the sample in the current study preferred leaflets and booklets ($r=0.687$, $p<0.001$) as the means of communicating advice, innovative, simple and informative design of communication methods is crucial. Also, periodic one-to-one energy advice and support could help households to further reduce their energy bills through feedback and advice. Visual prompts are another means of driving sustainable energy consumption. "The purpose of a prompt is not to change attitudes or increase motivation, but simply to remind us to engage in an action that we are already predisposed to do" (McKenzie-Mohr, 2011, p. 84). Prompts proved effective in reminding people with repetitive behaviours that they have the potential and the ability to change their lifestyles into more environmentally sustainable ones (McKenzie-Mohr, 2011; Cialdini, 2010). Several studies have proven that prompts targeting specific behaviours have, in fact, had a significant impact on promoting sustainable behaviour (Kurtz et al, 2005 in McKenzie-Mohr, 2011).

Furthermore, the DECC states that in order to support the consumer in household energy management, web- and telephone-based information services should be provided, informing individuals of 'how to reduce energy by making changes to behaviour, eligibility of subsidies and alternative financing packages' (DECC, 2010). Thus, behavioural change could be achieved by engaging people and raising awareness through home-energy audits, media campaigns, and powerful incentives. A viable recommendation would be for researchers to ensure their research findings are incorporated into policy programmes, as well as involving policy makers in the formative stages of the research (Cialdini, 2010), as a lack

of communication is highly likely to result in the loss of valuable outcomes of policy initiatives.

Nevertheless, economic and regulatory factors that seek to motivate environmental actions are not the only efficient tools for the changing of energy behaviour. Besides tailored information and providing prompts, developing and activating social norms is an important social psychological motivator that decision makers need to consider (Cialdini, 2010). In fact, some studies imply that if norms are internalised by people of a community, this is more likely to have a positive impact than providing prompts and information only. This is described in a study by Wes Schultz et al (2007), where some households were given information on their energy consumption in relation to that of the neighbourhood. Notably, households informed of their above-average consumption reduced their energy consumption while those who have been praised for their less-than-average energy consumption continued using less energy.

In a scheme such as the Community Energy Saving Programme, where houses are approached within the same neighbourhood, activating the social norms amongst households by providing information and feedback, comparing between their energy performances and praising those who achieve the lowest levels of energy consumption could, in effect, boost the delivery of such a scheme. It could also create a stronger link between the label of the scheme and the actual approach it adopts in using the 'community' label, both physically and socially.

LIMITATIONS OF THE STUDY AND FUTURE RESEARCH

This research sought to identify and understand the implications of tenants' energy consumption behaviour on the outcomes of one of the CESP schemes in Nottingham. It aimed to conclude with energy consumption determinants at the household level, to help examine the effect of this Government policy initiative. This section discusses a few limitations of the study and provides recommendations for future research based on the current research findings as there is a need to develop and expand further research in a few areas discussed.

One of the limitations of this study is the before-and-after survey design which was undertaken on two different samples with largely comparable socio-demographic characteristics. The experimental variable considered in this study was the energy upgrade work done in ASWZ scheme and based on this, phase A was considered the control group whereas phase B was considered the experimental group. However, without careful analysis and interpretations, all the before-and-after differences cannot be firmly attributed to the experimental variable under investigation. It is possible that some differences/ changes may have taken place with or without the experimental variable (Oppenheim, 1992). Another implication may be that as people become aware of the expectations or outcome of the survey they are participating in, they might try and respond positively which might generate changes in the overall survey results.

Another limitation to the study is the number of questions in the survey where the researcher was advised by NCH and NEP to minimise the number of questions in order to encourage higher response rates. The researcher would have been likely to add more questions regarding respondents' lifestyle and behaviour particularly more detailed questions on the running hours and specific energy consumption of electrical appliances. This would have immensely supported the statistical results and interpretations regarding fuel bills and use of appliances, and type of information and advice required for tenants of varying energy consumption attitudes.

Moreover, another limitation acknowledged is where the time limit allocated for the study to be completed had been extended; the researcher would have set up focus groups for respondents who expressed their interest in participating in workshops on energy saving advice (25 per cent of phase B sample). The researcher would have endeavoured monitoring participants' energy consumption behaviour and fuel bills following the workshops to observe the effect of information and communication on home energy use and people's energy consumption behaviour. At the time of writing, NEP is currently undertaking a third phase to the survey that incorporates workshops and focus groups on energy saving with ASWZ tenants who expressed interest in participating.

Finally, prior to undertaking the survey questionnaire, it would have been essential to plan and administer a number of structured interviews with tenants of ASWZ to support and reinforce the analysis and interpretation of the statistical findings from both phases of the questionnaire. Those structured interviews would have primarily helped identify and draw meaningful trends and patterns emerging from the questionnaires. In regards to providing projections for future research, several aspects are hereby highlighted as essential to further expand upon based on the findings of the present study.

As a strong and positive correlation emerged between gas and electricity bills and the number of occupants in the household, finding correlations between heating patterns and numbers and ages of respondents (particularly the presence of elderly members and children) highlights another major demographic variable which might have a significant impact on energy used for heating. Besides, most studies on domestic energy consumption currently focus on the overall electricity and gas consumption; therefore, a typical examination in a household's direct energy use for heating, cooking, use of appliances and lighting, among others, is crucial. This will have a direct impact on determining the successful delivery of policy initiatives that aim at raising the energy efficiency of homes. Another important aspect that requires further research is planning policies that also target indirect domestic energy requirements and methods for reducing it, as most energy policies have only focused on direct energy requirements in the domestic sector.

The role of behaviour change in energy policy and carbon emission reduction initiatives has been established in the momentous body of research in recent years on developing policy to encourage behaviour change (Eyre et al., 2011b; Guerra Santin, 2010; Thøgersen & Crompton, 2009). Some evidence of possible rebound and spill-over effects of energy consumption behaviour has been found in this research. However, further studies are required to provide more concrete evidence of the impact of rebound effect and spill-over effect on home energy consumption behaviour which would considerably impact on policy delivery.

A final major issue highlighted in the study was the importance of tailored energy-saving information in the form of advice and feedback in energy upgrade

programmes and initiatives. Besides, raising awareness of the public regarding Government carbon emission reduction initiatives and programmes is crucial in order to generate wider understanding and genuine commitment of the public towards these programmes. Thus, more rigorous and directed research in tailored, state-of-the-art communication methods that target all consumer levels and provide more transparency of policy is required in order to support successful delivery of current and future carbon emission reduction programmes.

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Appendix A: Questionnaire Phase A

Dear Sir/Madame,

The **Aspley Super Warm Zone** is one of the Government's 100 pilot Community Energy Saving Programme (CESP) schemes across the country. Consequently, a clear understanding of the impact of the scheme upon both properties and their residents is essential.

This questionnaire is designed to develop an understanding of household energy efficiency and residents' opinions regarding this scheme. This will help develop appropriately tailored approaches that support and maintain effective delivery of current and future policy schemes.

The questionnaire should only take 15-20 minutes and will be extremely useful in this research project. The research project main partners are: *Nottingham City Homes*, *Nottingham Energy Partnership,* and *University of Nottingham*.

Your responses will be confidential and will be used for research purposes only. No individual will be identified as a result of completing this questionnaire.

If you have any questions or comments about this questionnaire, please use the contact details below. Your comments will be greatly appreciated.

Yours Sincerely,

Mrs Heba Elsharkawy
PhD researcher
University of Nottingham
Email: laxhe2@nottingham.ac.uk
Mobile: 07846791555

SURVEY QUESTIONNAIRE
Users' energy consumption behaviour (Part A)

Section 1: Home information

1. Tenancy situation

☐ Private ownership ☐ Social/council housing
☐ Other (please specify)

2. How long have you lived in this house?

☐ <12 mths ☐ 1-5 yrs
☐ 5-10 yrs ☐ 10-20 yrs
☐ >20 yrs

3. What rooms do you have and state the number of each?

☐ Porch ☐ Hall ☐ Living room ☐ Dining room ☐ Balcony/sunspace
☐ Kitchen ☐ Pantry ☐ Bedrooms ☐ Bathroom ☐ Conservatory

4. Main heating system

☐ Gas central heating ☐ Electric storage ☐ Gas fire ☐ Electric fire
☐ Oil ☐ Wood ☐ Coal

5. Other secondary heating

☐ Gas wall heaters ☐ Solar panel ☐ Electric portable ☐ Liquid petr. gas
☐ Other (.....) ☐ None

6. Glazing

☐ Single ☐ Ordinary double ☐ High e-double

7. What improvements have been made to your home? (tick all that apply)

☐ New kitchen ☐ New bathroom ☐ Interior redecoration ☐ External rendering
☐ Double glazing ☐ Loft insulation ☐ Heating upgrade ☐ None
☐ Other (.....)

8. What would be your next priority for your home improvement?

☐ New kitchen ☐ New bathroom ☐ Interior redecoration ☐ External rendering
☐ Double glazing ☐ Loft insulation ☐ Heating upgrade ☐ None
☐ Other (.....)

Section 2: Home use and performance

9. How much of the house do you heat?

☐ Only the living room when in the house
☐ Only the living room when in the house, and other rooms as I/we occupy them
☐ Most of the rooms when in the house
☐ Most of the rooms most of the time
☐ All rooms all the time

10. Do you have any of the following problems in your home?

	Never	Rarely	Sometimes	Usually	Always
Damp	☐	☐	☐	☐	☐
Mould	☐	☐	☐	☐	☐
Cold	☐	☐	☐	☐	☐
Drafts	☐	☐	☐	☐	☐
Condensation	☐	☐	☐	☐	☐
Other (.....)	☐	☐	☐	☐	☐

11. What heating control(s) do you have?

☐ Radiator valves ☐ Wall thermostat ☐ Boiler thermostat ☐ Other (.....,)

12. Do you use your heating controls?

☐ Never ☐ Rarely ☐ Sometimes ☐ Usually ☐ Always

13. At what temperature do you set the wall thermostat? (If applicable)

☐ <18 ☐ 18 ☐ 19 ☐ 20 ☐ 21 ☐ 22 ☐ 23 ☐ 24 ☐ >24 ☐ N/A

14. Average amount of monthly bills paid:

(a) for gas

..... per month

(b) for electricity

..... per month

15. How do you pay your bills?

☐ Prepayment meter ☐ Monthly direct debit ☐ Quarterly direct debit ☐ Standing order
☐ Cash/ Cheque ☐ Payment cards ☐ Other (.....)

16. Have you changed your electricity or gas supplier?

☐ Yes ☐ No

17. Why have you changed/ not changed?

18. Do/did you receive any energy advice?

☐ Yes ☐ No

19. If yes, who from/ what about?

20. Would you like help/advice on how to cut energy bills more?

☐ Yes ☐ No

21. If yes, what format do you prefer to receive energy advice?

☐ Written e.g. leaflet ☐ Visual e.g. pictures, video ☐ One to one support/visit
☐ Electronically e.g. email, website ☐ Other (.....)

22. Home appliances owned (*number of each*)

☐ Electric cooker	☐ Gas cooker	☐ Fridge/freezer	☐ Fridge
☐ Freezer	☐ Washing machine	☐ Washer/dryer	☐ Tumble dryer
☐ Electric heater	☐ Boiler	☐ Electric kettle	☐ Toaster
☐ Television	☐ Sat/cable	☐ Microwave	☐ DVD player
☐ Computer/laptop	☐ Hi/Fi stereo	☐ Games console	☐ Energy saving lamps
☐ Hair dryer	☐ Slow cooker	☐ Power down	☐ Vacuum cleaner

23. As part of your lifestyle, do you do any of the following?

	Never	Rarely	Sometimes	Usually	Always
Watch TV more than 3hrs/day	☐	☐	☐	☐	☐
Use your laptop/pc daily	☐	☐	☐	☐	☐
Go for a walk	☐	☐	☐	☐	☐
Sports/exercise	☐	☐	☐	☐	☐
Go cycling	☐	☐	☐	☐	☐
Read a book	☐	☐	☐	☐	☐
Attend church (or other)	☐	☐	☐	☐	☐
Environment volunteering	☐	☐	☐	☐	☐
Community work	☐	☐	☐	☐	☐
Help at the local school	☐	☐	☐	☐	☐

24. Would you be interested in volunteering to help improve your local community?

☐ Yes ☐ No

25. Do you do any of the following actions?

	Never	Rarely	Sometimes	Usually	Always
Try using less gas and electricity	☐	☐	☐	☐	☐
Turn down heating	☐	☐	☐	☐	☐
Make more use of programmer	☐	☐	☐	☐	☐
Heat occupied rooms only	☐	☐	☐	☐	☐
Turn off unwanted lights	☐	☐	☐	☐	☐
Use energy saving lamps	☐	☐	☐	☐	☐
Unplug unused equipment	☐	☐	☐	☐	☐
Replace inefficient equipment	☐	☐	☐	☐	☐
Wash clothes at lower temp.	☐	☐	☐	☐	☐
Set hot water thermostat lower	☐	☐	☐	☐	☐
	Never	Rarely	Sometimes	Usually	Always

Boil only water needed in kettle	☐	☐	☐	☐	☐
Recycle your home waste	☐	☐	☐	☐	☐
Use compost bins	☐	☐	☐	☐	☐
Cycle more	☐	☐	☐	☐	☐
Drive less	☐	☐	☐	☐	☐
Use more public transport	☐	☐	☐	☐	☐

26. If so, what is the reason(s) for doing any of the previous actions?

☐ Save money ☐ Save energy ☐ Due to habit ☐ Environment concern

☐ Other (please specify) .....

Section 3: Aspley Super Warm Zone scheme

27. Do you know about Aspley Super Warm Zone scheme? *(If not, go to explanation provided below question 27))*

☐ Yes ☐ No

28. If yes, how have you heard about it?

☐ Neighbours ☐ Visited show home ☐ Information leaflets ☐ Affordable warmth champions

☐ Liaison officer ☐ Other (please specify) .....

29. What do you understand the programme to be about?

The main aim of the scheme is to improve the building envelope by providing a combination of measures, e.g. solid wall insulation, loft insulation, replacing G-rated boilers, etc. This is to improve home energy efficiency and ensure a significant reduction in household fuel bills.

30. What do you think of this kind of scheme? (tick all that apply)

☐ Good to improve my home ☐ Interfering/ disrupting

☐ Useless ☐ Good for the environment

☐ Good to reduce my energy bill ☐ Don't know

31. Would you consider signing up for this programme? *(If not, go to question 33)*

☐ Yes ☐ No

32. If yes, what do you anticipate from joining Aspley Super Warm Zone scheme? *after completing, go to question 33*

	Yes	No	Don't know
Pay less on energy bills	☐	☐	☐
A warmer home	☐	☐	☐
Improved home conditions	☐	☐	☐
Add value to the property	☐	☐	☐
Doing something good for the environment	☐	☐	☐

33. If not, what is the reason(s) for not considering signing up to the scheme?

☐ Ill health ☐ Don't think it is effective ☐ Have already had home renovations
☐ Don't want the disruption ☐ Other (.....)

34. What would help you change your mind?

☐ More technical information ☐ More hands-on information ☐ More physical help and support
☐ Guarantee of workmanship ☐ Other (.....)

35. How much are you prepared to pay towards insulating your home to protect yourself against fuel price rises?

☐ Not prepared to pay ☐ Up to £250 ☐ £250-500
☐ £500-1000 ☐ £1000-2000 ☐ More than £2000

Section 4: Basic information

36.English first language?

☐ Yes ☐ No

37. Number of members of the household

☐ Infants (<3yrs) ☐ Children (3-12yrs)
☐ Teenagers (12-19) ☐ 19-25yrs
☐ 25-35yrs ☐ 35-50 yrs
☐ 50-65 yrs ☐ >65yrs

38.Employment activity (no. of each)

☐ FT employment ☐ PT employment
☐ Self-employment ☐ Unemployed
☐ Disability/ill-health ☐ Retired
☐ Full-time carer ☐ Student

39.Total income of household

☐ <12K ☐ 12-20K
☐ 20-30K ☐ 30-50K
☐ >50K

40.Number of cars owned by household?

☐ None ☐ One
☐ Two ☐ More

41. How is your health in general?

☐ Very good ☐ Good ☐ Fair ☐ Bad ☐ Very bad

42. Any further comments?

Thank you for your time

Appendix B: Questionnaire Phase B

Dear Sir/Madam,

The **Aspley Super Warm Zone (ASWZ)** is one of the first trials of the Government's Community Energy Saving Programme (CESP) schemes across the country. It is therefore important that we understand how the scheme affects both the properties and the people living in them.

The aim of this survey is to help us understand how energy efficient your home is, and your opinion of the insulation and other improvement work that's been done in your home. This will help us make sure that other schemes in the future are designed to support and meet you and your community's needs.

The questionnaire should only take 15-20 minutes and the information you provide will be extremely useful to us. The survey is being carried out by: *Nottingham City Homes*, *Nottingham Energy Partnership,* and *University of Nottingham*.

Your answers will be confidential and will be used for research purposes only. You will not be identified as a result of completing this questionnaire.

If you have any questions or comments about this questionnaire, please use the contact details below. Your comments will be greatly appreciated.

Yours Sincerely,

Mrs Heba Elsharkawy
PhD researcher
University of Nottingham
Email: laxhe2@nottingham.ac.uk
Mobile: 07846791555

All completed surveys will be entered in a prize draw for £25 retail vouchers

SURVEY QUESTIONNAIRE
Users' energy consumption behaviour (Part B)

Section 1: Home information

1. Tenancy situation

☐ Private tenancy ☐ Social/council tenant ☐ Home owner ☐ Housing association

2. How long have you lived in this house?

3. What rooms do you have? Please state the number of each.

☐ Porch ☐ Hall ☐ Living room ☐ Dining room ☐ Balcony/sunspace
☐ Kitchen ☐ Pantry ☐ Bedrooms ☐ Bathroom ☐ Conservatory

4. Main heating system (choose one)

☐ Gas central heating ☐ Electric storage ☐ Gas fire ☐ Coal
☐ Oil ☐ Wood

5. Other secondary heating (choose one)

☐ Electric fire ☐ Gas wall heaters ☐ Electric portable ☐ Liquid petr. gas
☐ Solar panel ☐ None ☐ Other (.....)

6. Windows glazing

☐ Single glazing ☐ Double glazing ☐ A combination of both

7. External doors

☐ Wooden ☐ uPVC (plastic)

8. Have you *personally* done any of the following improvements in your house (not improvements done by NCH)?

☐ New kitchen ☐ New bathroom ☐ Double glazing ☐ Rendering outside
☐ Redecoration inside ☐ Loft insulation ☐ Heating upgrade ☐ None
☐ Other (.....)

Section 2: Home use and performance after the insulation work has been done

9. How much of the house do you heat during the winter, since the work was completed?

☐ Only the living room when in the house
☐ Only the living room when in the house, and other rooms as I/we occupy them
☐ Most of the rooms when in the house
☐ Most of the rooms most of the time
☐ All of the rooms when in the house
☐ All rooms all the time

10. During the winter time since the work was completed, how long do you have the heating on?

- ☐ All the time constantly
- ☐ All day time (more than 10 hrs)
- ☐ Night time only
- ☐ Less than 2 hrs a day
- ☐ Between 2 and 6 hrs a day
- ☐ Between 6 and 10 hours a day

11. Do you have the heating on more, less or the same compared to before work was completed?

☐ More ☐ The same ☐ Less

12. Did/ do you have any of the following problems? (Please mention these problems before and after improvements)

Before improvements

	Never	Rarely	Sometimes	Usually	Always
Damp	☐	☐	☐	☐	☐
Mould	☐	☐	☐	☐	☐
Cold	☐	☐	☐	☐	☐
Drafts	☐	☐	☐	☐	☐
Condensation	☐	☐	☐	☐	☐
Other (.....)	☐	☐	☐	☐	☐

After improvements

	Never	Rarely	Sometimes	Usually	Always
Damp	☐	☐	☐	☐	☐
Mould	☐	☐	☐	☐	☐
Cold	☐	☐	☐	☐	☐
Drafts	☐	☐	☐	☐	☐
Condensation	☐	☐	☐	☐	☐
Other (.....)	☐	☐	☐	☐	☐

13. What heating control(s) do you have? (tick all that apply)

☐ Thermostatic radiator valves ☐ Wall thermostat ☐ Boiler thermostat ☐ Heating timer control

14. How often do you use your heating controls?

	Never	Rarely	Sometimes	Usually	Always
Thermostatic radiator valves	☐	☐	☐	☐	☐
Wall thermostat	☐	☐	☐	☐	☐
Boiler thermostat	☐	☐	☐	☐	☐
Heater timer controls	☐	☐	☐	☐	☐

15. If you never use your heating controls, please tell us the main reasons for this?

16. At what temperature do you set the wall thermostat?

☐ Less than 18 ☐ 18 ☐ 19 ☐ 20 ☐ 21 ☐ 22 ☐ 23 ☐ 24 ☐ More than 24 ☐ N/A

17. Average amount of monthly bills paid before/after improvement:

Before improvements

(a) gas ..... per month	**(b) electricity** ..... per month

After improvements

(a) gas ..... per month	**(b) electricity** ..... per month

18. How do you pay your bills?

☐ Prepayment meter ☐ Monthly direct debit ☐ Quarterly direct debit ☐ Standing order
☐ Cash/ Cheque ☐ Payment cards ☐ Other (.....)

19. Have you changed your electricity or gas supplier after the insulation work has been done?

☐ Yes ☐ No

20. Why have you changed/ not changed?

21. Do/did you receive any energy advice before the improvements?

☐ Yes ☐ No

22. If yes, who from/ what about?

23. Home appliances owned (number of each)

☐ Electric cooker	☐ Gas cooker	☐ Fridge/freezer	☐ Fridge
☐ Freezer	☐ Washing machine	☐ Washer/dryer	☐ Tumble dryer
☐ Electric heater	☐ Boiler	☐ Electric kettle	☐ Toaster
☐ Television	☐ Sat/cable	☐ Microwave	☐ DVD player
☐ Computer/laptop	☐ Hi/Fi stereo	☐ Games console	☐ Energy saving lamps
☐ Hair dryer	☐ Slow cooker	☐ Power down	☐ Vacuum cleaner

24. As part of your lifestyle, do you do any of the following?

	Never	Rarely	Sometimes	Usually	Always
Watch TV more than 3hrs/day	☐	☐	☐	☐	☐
Use your laptop/pc more than 3 hrs/day	☐	☐	☐	☐	☐
Go for a walk	☐	☐	☐	☐	☐
Sports/exercise	☐	☐	☐	☐	☐
Go cycling	☐	☐	☐	☐	☐
Read a book	☐	☐	☐	☐	☐
Attend church (or other)	☐	☐	☐	☐	☐
Environment volunteering	☐	☐	☐	☐	☐
Community work	☐	☐	☐	☐	☐
Help at the local school	☐	☐	☐	☐	☐

25. Would you be interested in volunteering to help improve your local community?

☐ Yes ☐ No

26. Do you do any of the following actions?

	Never	Rarely	Sometimes	Usually	Always
Try using less gas and electricity	☐	☐	☐	☐	☐
Turn down heating	☐	☐	☐	☐	☐
Make more use of programmer	☐	☐	☐	☐	☐
Heat occupied rooms only	☐	☐	☐	☐	☐
Turn off unwanted lights	☐	☐	☐	☐	☐
Use energy saving lamps	☐	☐	☐	☐	☐
Unplug unused equipment	☐	☐	☐	☐	☐
Replace inefficient equipment	☐	☐	☐	☐	☐
Wash clothes at lower temp.	☐	☐	☐	☐	☐
Set hot water thermostat lower	☐	☐	☐	☐	☐
Boil only water needed in kettle	☐	☐	☐	☐	☐
Recycle your home waste	☐	☐	☐	☐	☐
Use compost bins	☐	☐	☐	☐	☐
Cycle more	☐	☐	☐	☐	☐
Drive less	☐	☐	☐	☐	☐
Use more public transport	☐	☐	☐	☐	☐

27. If so, what is the main reason(s) for doing any of the previous actions? (choose only one)

☐ Save money ☐ Save energy ☐ Due to habit ☐ Rising fuel bills

☐ Environmental concern ☐ Other (.....)

Section 3: Aspley Super Warm Zone scheme

28. How did you hear about the scheme?

☐ Neighbours ☐ Show home/consultation ☐ Information leaflets ☐ Affordable warmth champ
☐ Liaison officer ☐ Letter from NCH ☐ Other (.....)

29. What did you think of this scheme before the work was done? (tick all that apply)

☐ Good to improve my home
☐ Useless
☐ Good to reduce my energy bill
☐ Interfering/ disrupting
☐ Good for the environment
☐ Other (.....)

30. What measures have been done in your home? (tick all that apply)

☐ New kitchen ☐ New bathroom ☐ Internal insulation ☐ Old boiler replaced
☐ Heat controls with a new heating system ☐ loft insulation ☐ Draught proofing
☐ Double-glazing ☐ Other (.....)

31. Do you think you've achieved the following with Aspley Super Warm Zone scheme?

	No	Yes	Don't know
Pay less on energy bills	☐	☐	☐
A warmer home	☐	☐	☐
Improved home conditions	☐	☐	☐
Doing something good for the environment	☐	☐	☐

32. What do you think is the best thing about the work you've had done through the Aspley Super Warm Zone scheme?

33. Are there any ways that the scheme could be improved?

34. Did you receive any energy advice during/after the works were done?

☐ Yes ☐ No

35. If yes, from whom, and what about?

36. What do you think would help you get the most benefits out of the improvements?

☐ More technical information about the measures installed

☐ More one-to-one advice on energy saving at home ☐ More work to be done in home improvemer

☐ Other (.....)

37. Would you like help/advice on how to cut your energy bills more?

☐ Yes ☐ No

38. If yes, how would you prefer to receive energy advice?

☐ Written e.g. leaflet ☐ Visual e.g. pictures, video ☐ One to one support/vi

☐ Electronically e.g. email, website ☐ Other (.....)

39. What improvements in your home would you /NCH like to do next?

☐ Redecoration inside ☐ Rendering on the outside ☐ Improving heating sy:

☐ Replace external doors ☐ Other (.....) ☐ None

40. Would you recommend the scheme to friends and neighbours, if they were eligible?

☐ Yes ☐ No

Section 4: Aspley Super Warm Zone Customer Care Questions

41.How do you rate the level of notice given prior to commencement of works in your property?

☐ Excellent ☐ Good ☐ Average ☐ Poor ☐ Very poor ☐ No information received

42.How well were you kept informed, prior to and during the improvement works?

☐ Very well informed ☐ Informed ☐ Partly informed ☐ No information received

43.How do you rate the arrangements that were made to minimise the inconvenience during the works?

☐ Excellent ☐ Good ☐ Average ☐ Poor ☐ Very poor ☐ No arrangements made

44. How do you rate the conduct of the work person, e.g. polite and respectful?

☐ Excellent ☐ Good ☐ Average ☐ Poor ☐ Very poor

45. How do you rate the quality of the completed work?

☐ Excellent ☐ Good ☐ Average ☐ Poor ☐ Very poor

46. If a fault occurred as a results of the works, how do you rate the contractor's response

☐ Excellent ☐ Good ☐ Average ☐ Poor ☐ Very poor

47. How would you rate the standard the contractor left your property?

☐ Excellent ☐ Good ☐ Average ☐ Poor ☐ Very poor

48. Do you feel the final outcome was worth the disruption?

☐ Yes ☐ No

49. Were identification badges shown at all times?

☐ Yes ☐ No

Section 5: Basic information

50. Is English your mother tongue?

☐ Yes ☐ No

51. What is your ethnic origin?

☐ Indian ☐ Pakistani ☐ Black Caribbean ☐ Black African ☐ Chinese

☐ Mixed white and Black Caribbean ☐ Mixed white and Black African ☐ Mixed White And As

☐ White British ☐ White Irish ☐ Other (.....

52. How old are you? ..... years

53. Your level of education

☐ No degree ☐ Primary school ☐ Secondary/ High school

☐ College ☐ Diploma ☐ University

54. Number and age of members in your household (including yourself)

☐ Infants (less 3yrs) ☐ Children (3-12yrs)

☐ Teenagers (12-19) ☐ 19-25yrs

☐ 25-35yrs ☐ 35-50 yrs

☐ 50-65 yrs ☐ More than 65yrs

55. What does each member in your house do? (number of each)

☐ Full Time job ☐ Part Time job

☐ Self-employed ☐ Unemployed

☐ Disability/ill-health ☐ Retired

☐ Full-time carer ☐ Student

56. Total annual income of household (£)

☐ Less than12,000 ☐ 12,000 to 20,000

☐ 20,000 to 30,000 ☐ 30,000 to 50,000

☐ More than 50,000

57. Number of cars owned by household

☐ None ☐ One

☐ Two ☐ More

58. How is your health in general?

☐ Very good ☐ Good ☐ Fair ☐ Bad ☐ Very bad

59. Have you noticed any change in your health since your home was improved?

☐ Much better ☐ Better ☐ Same ☐ Worse ☐ Much worse

60. Would you be interested in participating in a workshop on energy saving advice?

☐ Yes ☐ No

61. Any further comments?

Thank you for your time

Appendix C: Energy Policy Journal- Manuscript Number: JEPO-D-12-02024

Home energy use, lifestyle and behaviour: A pre-Community Energy Saving Programme (CESP) survey in Aspley, Nottingham

Abstract

With increasing concern over national green house gas (GHG) emissions, combined with the widespread economic impact of global commodities such as coal, natural gas and oil and their effect on energy prices, improving household energy efficiency can be seen as a key vehicle against which both energy emissions can be reduced and domestic GHG emissions curtailed. It is argued that factors that form the basis of choices, habits and values of individuals dictate an individual's decision to either adopt environmentally sustainable behaviour or not (Abrahamse, Steg, Vlek & Rothengatter, 2005; McKenzie-Mohr, 2011). This article reflects on how this specific area of energy policy is being enacted through policy and regulation, notably through one of the Community Energy Saving Programme (CESP) schemes, rolled out by the UK government in 2009.

Although Government can play a pivotal role helping people foster more sustainable behaviour, it must do so in a manner that engages individuals and the public at large. As such, the aim is to adopt a more long term outlook towards encouraging sustainable energy use. The article reflects therefore on the results of a survey questionnaire administered to the residents of one of the pilot CESP schemes in Aspley, Nottingham. The questionnaire sought to identify how tenants of energy-inefficient homes tend to behave with respect to domestic energy consumption. This was augmented by quantitative data comprising utility bill figures gathered from the homes under investigation.

Ultimately, the aim of the research is to understand residents' lifestyle and behaviour with a view to developing appropriately tailored approaches that support and maintain effective delivery of current and future policy initiatives. Nearly 37% of the sample reported heating most of the rooms most of the time, while 20% heated all the rooms all the time. Almost 70% of the sample paid an average of £100 monthly utility bills. However, only 53% would prefer to receive energy advice. Further analysis showed how people receptive to advice prefer the means of receiving it.

1. Introduction

Energy use in the domestic sector accounts for a large proportion of total national energy consumption. In the 1970s it accounted for 24-27% of UK energy consumption, estimated to be 556 $MtCO_2$ (Mega tonnes Carbon Dioxide) (DCLG, 2007; DECC, 2010), but since 1980 it has risen to 28-31% (Utley & Shorrock, 2008). At present, it is estimated that the average UK household is responsible for almost five and a half tonnes of CO_2 every year for its heat and power (EST, 2009). However, according to Ofgem, a 'medium user' consumes annually 16,500 kWh gas and 3,300 kWh electricity (Ofgem, 2012), which equates in total to approximately four and three quarters tonnes of CO_2 annually for the medium user. To meet government targets domestic emissions have to fall to 17 $MtCO_2$ per annum by

2050, to guarantee a suitable reduction of carbon emissions (McManus, Gaterell & Coates 2010).

Notably, the Energy White Papers of 2007 and 2011 have set out the long-term energy challenges which ensure that the UK's future electricity supply is low-carbon and affordable (DECC, 2011). Additionally, the Climate Change Act of 2008 has established a long-term target for an 80% reduction in UK net greenhouse gas (GHG) emissions by 2050 via a system of legally binding five year carbon budgets. Furthermore, the UK has committed to reduce its net emissions of GHGs to at least 34% below 1990 levels in its third carbon budget period 2018-1022 (DTI, 2007). Instruments to drive these carbon reduction targets include part L of the Building Regulations Conservation of Fuel and Power, the Standard Assessment Procedure (SAP), the Code for Sustainable Homes (CSH), amongst other standards and legislations set in place for existing and new buildings in the domestic sector.

Statistics show that a significant fraction of household carbon emissions is due to both space and water heating, where over 80% of heating systems in UK are fuelled by gas (GCH 2010). The Department of Energy and Climate Change (DECC) claims in its 2010 quarterly review that carbon emissions from the domestic sector decreased by 5% between 2008 and 2009 but also points out that this fall has been due to a raise in overall temperatures thus a reduction in heating loads in the subsequent year (DECC, 2010). However, even if there is evidence of a reduction in household carbon emissions, this does not necessarily indicate that people are changing their way of life in order to lower their household energy consumptions (Gardner & Stern, 1996; Abrahamse, 2007).

Previous studies affirm that policy initiatives are to be considered a potential instrument for driving pro-environmental and sustainable behaviour (Stern, Berry, & Hirst, 1985; Gardner & Stern 1996; Lutzenhiser, 1997; Stern, 2002; Parag & Darby, 2009; McKenzie-Mohr, 2011). Yet, although policy instruments, particularly those concerned with setting verifiable standards for controlling heat transfer in buildings such as the European Energy Performance in Buildings Directive (EPBD)[6], have succeeded in imposing rules and regulations; to a large extent, patterns of consumption and user behaviour have proven to limit the benefit expected from policy delivery. Such interactions have been discussed in previous studies, particularly those surrounding the feasibility of achieving zero carbon homes and the

[6] EPBD was first published in 2002, required all European Union countries to enhance their building regulations and to introduce energy certification schemes for buildings, besides requirements for inspections of boilers and air-conditioners (Concerted Action EPBD, 2012).

impact of policy and human behaviour on achieving these targets (Osmani & O'Reilly, 2009; McManus et al., 2010; Elsharkawy et al., 2011).

The research presented within this article therefore looks critically at the interrelationships between energy efficiency, policy (and its implementation), energy consumption patterns and human behaviour. In order to explore these factors, a survey questionnaire was administered to identify how tenants of energy-inefficient homes behaved in terms of home energy use and lifestyle. The field work survey was performed in one of the pilot Community Energy Saving Programme (CESP) schemes currently under delivery in the Aspley area of Nottingham. Designed and executed in two survey phases, the first phase sought to understand residents' attitudes and behaviour and explore how this related to home energy use and performance prior to extensive energy-related upgrades to their dwellings. The second survey phase sought to examine changes - if any - in users' energy consumption behaviour and dwelling performance after their dwellings were upgraded to higher energy efficiency standards. This second phase also explored the possible reasons for any behavioural change depicted; whether it was due to policy uptake, information provided and feedback or means of communicating energy saving advice.

The article focuses on the potential effect of the CESP policy scheme on lowering energy consumption in the domestic sector by critically examining key findings from the Aspley Super Warm Zone (ASWZ) scheme. In so doing, it will present an overview of the data collected and a comprehensive analysis of the results that have emanated from the first phase of the survey (pre energy efficiency upgrade). The aim is to understand the variables that affect home performance and dominant trends of behaviour of the 'before ASWZ' phase in order to delve into more in-depth investigations in the 'after ASWZ' phase. The overall aim is to help develop appropriately tailored approaches that support and maintain effective delivery of current and future policy schemes.

2. ENERGY POLICY IN THE UK DOMESTIC SECTOR

In the case of the UK construction sector, energy policy initiatives have progressed considerably in the years since the 1965 Building Regulations (McManus et al., 2010). Now incorporated within Approved Document L, 'Conservation of Fuel and Power' (ODPM, 2006) and as demonstrated for example through the DECC's

approved methodology, Standard Assessment Procedure[7] (SAP), such policy has sought to limit (or minimise) both energy gains and losses from buildings, encourage more efficient approaches to building services, their controls and operation as well as providing benchmarks against which a building's performance (and ultimately CO_2) emissions can be measured (BRE, 2011; DEFRA, 2005).

The Department of Communities and Local Government (DCLG) has proposed a rolling implementation programme comprising three key milestones in their quest for delivering new zero carbon domestic dwellings. Relating directly to Approved Document L from 2006, these milestones explicitly specify energy performance improvements / carbon reductions of 25% by 2010, 44% by 2013 then finally to zero carbon by 2016 (DCLG, 2007). In order to help achieve this, the Government published the Code for Sustainable Homes (CSH) in 2007 that seeks to look at the wider environmental impact of new dwellings, focusing on the delivery of zero carbon homes. Fundamental to achieving a code rating is demonstrating that any new dwelling exceeds the regulatory requirements outlined in Approved Document L as demonstrated through the SAP. A mandatory rating against the Code builds on Energy Performance Certificates (EPCs), which have become compulsory since October 2008 for any building that has been built, sold or rented out. The government also decided that all new homes should be built to the 'zero-carbon' standard from 2016 (DCLG 2008).

As for the existing domestic stock, which comprises around '*99% of the building stock at any one time*' (Sustainable Development Commission, 2005, p.3), the Community Energy Saving Programme (CESP), was initiated in September 2009 as part of the Government's Home Energy Saving Strategy (HESS). CESP requires gas and electricity suppliers and electricity generators to deliver energy-saving measures to domestic consumers in specific low-income areas of the UK. The programme has been designed to promote a 'whole house' energy efficiency upgrade that aims to treat hard to heat solid wall dwellings of specific low income areas (DECC, 2009). It includes several measures fitted in homes that meet certain eligibility criteria such as loft insulation, internal wall insulation, replacing inefficient (e.g. g-rated) boilers, and fitting modern kitchens and bathrooms. Ofgem (2012) reported that 58,931 carbon-saving measures have been successfully installed in 30,588 properties across the

[7] SAP was first developed in 1992 by the Building Research Establishment (BRE) as a tool for energy efficiency policy delivery. It is based on the energy costs associated with space and water heating, ventilation and lighting. It is adjusted for floor area and is measured on a scale of 1 to 100, where the higher the rating the less the running costs (BRE, 2011).

UK, resulting in an estimated 2.9 $MtCO_2$ (lifetime, including adjustments) emissions reduction which comprises 15 % of the overall CESP target.

3. ASPLEY SUPER WARM ZONE (ASWZ) SURVEY

The Aspley Super Warm Zone is one of 100 Government pilot CESP schemes in the UK, funded by Scottish and Southern Electric and Nottingham City Council. It covers a target area of 1,800 social and private homes in three lower super output areas[8] (LSOAs) within the Aspley ward in Nottingham (Nottingham City Council, 2011). The social housing phase is being carried out alongside the Decent Homes Programme by replacing every single-glazed window with double glazing and installing additional energy efficiency measures. Only three LSOAs in Aspley ward are eligible for the ASWZ scheme according to the criteria set out in the CESP policy and those LSOAs constitute the sample domain of this research.

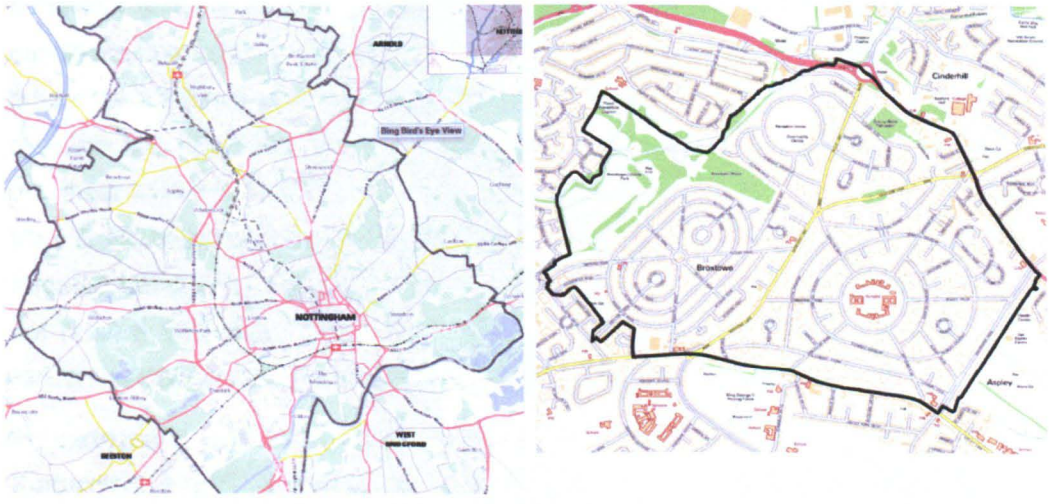

Figure 1: (Above) Location of Aspley ward in Nottingham, (below) Aspley ward boundary (Source: Nottingham City Council, 2011)

3.1 Research aims

This research sheds light on the most dominant patterns of home energy use, trends of energy consumption and the level of awareness of environmental behaviour. It aims to understand tenants' attitudes and behaviour within homes known to be energy-inefficient and in so doing help develop appropriately tailored approaches that support and maintain effective delivery of current and future policy schemes. It explores the factors that could possibly influence policy delivery with low (or no) effect on people's energy consumption behaviour and lifestyle. The research also

[8] LSOA Lower Super output Areas are geographical areas of defined boundaries, consistent sizes and similar social characteristics developed following 2001 consensus to facilitate the calculation of Indices of Deprivation (Office for National Statistics).

aims to investigate the most appropriate means of communicating and disseminating energy help, advice and support based on participants' responses to the questionnaire.

3.2 Research method

A descriptive, statistical survey has been set up in two phases; the first phase performed before the CESP scheme was implemented and energy upgrade work done and the second phase after a year following the CESP scheme work in Aspley. These two survey phases were performed to gauge and compare both home energy performance and people's lifestyle and energy consumption behaviour before and after the energy upgrade. Phase A of the questionnaire was administered, data collected, analysed and interpreted first, and is therefore discussed in this article. It examined aspects that affect the relationships between people's lifestyle and behaviour and energy consumption including demographics, experience with home conditions and heating efficiency, general energy awareness, and method of energy advice and information they would be more receptive to. This built on previous research that has asserted that tailored information, feedback and advice would be the most effective instruments for reducing home energy use (Abrahamse, Steg, Vlek & Rothengatter, 2005; Gardner & Stern, 1996; McKenzie-Mohr, 2011). The targeted sample for phase A was households eligible for the ASWZ scheme that did not receive information about the scheme. This was decided when devising the random sample from the NCH register of CESP eligible properties in Aspley.

In partnership with Nottingham City Homes (NCH) and Nottingham Energy Partnership (NEP)[9] a total of 224 households (which constitute around 13% of ASWZ eligible households) eligible under the ASWZ scheme were selected randomly and approached; of which 60 responses to the survey were completed. These responses represent around 4% of the number of houses identified within the ASWZ scheme target area of 1800 social and private houses.

3.3 Questionnaire design

The survey was used to explore in detail how those 'hard to heat' homes performed, identify household patterns of energy consumption and examine the effect of policy uptake on occupants' lifestyles and behaviour. It also sought to gauge any noticeable change in the previous aspects before and after policy delivery. The

[9] Nottingham Energy Partnership (NEP) and Nottingham City Homes (NCH) are both partners in this survey; NEP is responsible for the private housing sector of ASWZ and NCH is responsible for the social housing sector.

questionnaire was designed and developed from three previous studies performed in the UK concerning users' behaviour with respect to energy use in their homes; 21st Century Living Project (Gatersleben et al., 2010), Users' Behaviour (Pett & Guertler, 2004), and Revisiting Easthall (2002).

The questionnaire was based on a scenario-building strategy and was used to map the personal constructs of a broad category of respondents. It explored gaps between tenants' expectations and aspirations, and decisions taken by policy makers that do or do not affect their energy consumption behaviour. The questionnaire comprised five sections. The first section asked for general information about the household; number of rooms, main and secondary heating systems, type of glazing, general improvements made to date and priorities for future improvements to understand residents' aspirations. The second section dealt with home use and performance; heating trends, heating controls available and frequency of use, problems experienced (draught, cold, etc), electric appliances owned, average utility bills paid, and whether or not they received energy advice. This set of questions aimed to understand more about the status of their homes in terms of energy use and performance, and also their concerns about problematic issues in their dwellings. The third set of questions dealt with lifestyle, habits and environmental behaviour that related to direct and indirect energy use within different areas. The fourth part of the questionnaire incorporated questions about the respondents' awareness to the ASWZ, what they anticipate from it, if they would consider signing up to it, and if they would be ready to contribute towards their home energy upgrade costs. The final section sought basic information about the respondent; demographics of the household, employment, income, and health status. Data collected was analysed to produce descriptive and frequency statistics and regression analyses tests were performed to compare levels and rationale for tenants' energy consumption behaviour and home energy performance in the ASWZ. As the aim of the present research is to understand residents' lifestyle and behaviour with respect to energy use and home energy performance; only the second and third sections of the questionnaire analysis will be thoroughly discussed; home energy use and performance, and tenants' lifestyle and behaviour.

3.4 Results

1. Home energy use and performance

When reporting on the main heating system in the household; 55% reported gas central heating (GCH) as their primary heating system, 33% of households reported having both, GCH and electric fire as their two main heating systems, while 7% reported electric fire as the main heating system. The type of main heating systems

reported in the questionnaire indicated considerable variation with the information provided by NCH. In fact, the majority of social housing in Aspley has GCH as the main heating system. A likely possibility for this misconception could be the lack of awareness of respondents concerning their home heating systems and therefore their ability to use them appropriately and efficiently. Besides, some of the low-income households might believe that using their central heating systems could be too costly and thus would prefer to use their electric fire for heating mainly their living rooms. Another possibility could be that some respondents were confused by the question wording and might have interpreted it as what is the main heating system *they use* in their homes.

With regards to problems in their homes, respondents were asked about how frequently they experienced damp, mould, cold, draughts, condensation or any other problems. These questions also implied how people perceived their homes and consequently how it had a significant impact on their health and wellbeing. From Figure 2, it appeared that the two most commonly experienced problems were the cold and draught, followed by mould and condensation; and finally problems with the damp came at the end of the list. Most respondents reported the cold and draught was due to the worn out front and back doors that were not included in several home improvement schemes carried out in Nottingham. The 'Secure, Warm and Modern' scheme states that doors are only replaced if they are 'warped, rotten or beyond repair', which is not the case in most homes in Aspley. However, Nottingham Secure scheme, as part of the Decent Homes Standard scheme (NCH, 2012) is commencing replacement of front and back doors that are old or in poor condition with composite security doors in social houses. Requiring new front and back doors has been reported by 60% of the sample, which reflects people's awareness of the direct impact the doors have on problems of draught and cold, besides health implications. In addition, in such a scheme which adopts a 'whole house' energy upgrade approach, it is a major downside to overlook the fact that the major benefit of maintaining heat gains by internal wall and loft insulation is in fact overridden by heat loss and air infiltration through old and draughty doors.

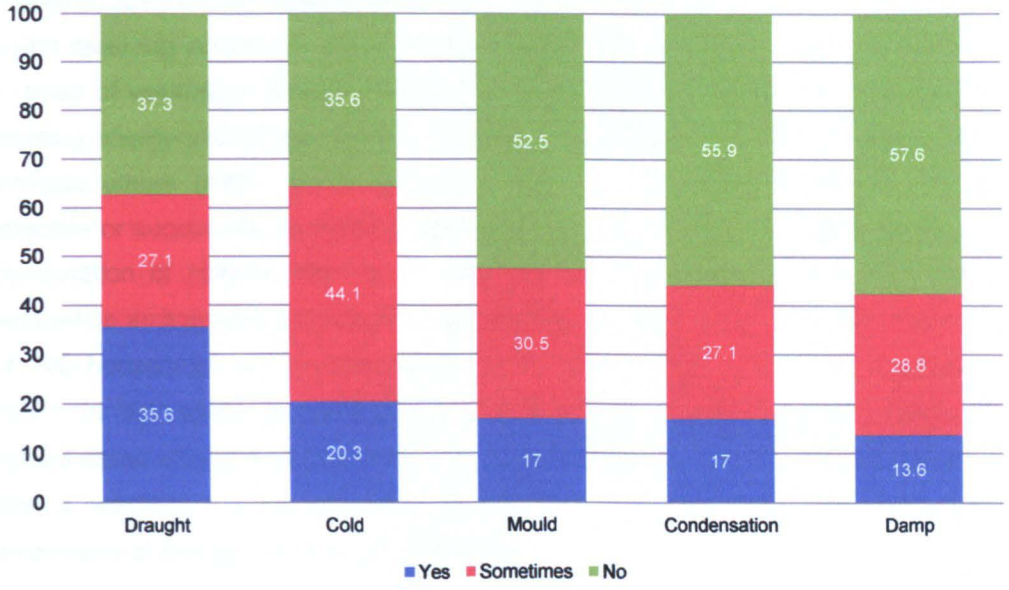

Figure 2: Problem issues experienced at home

Energy used for space heating depends on the heat losses and gains of a dwelling, which are determined by the architectural and technical characteristics of the dwelling, besides residents' energy consumption behaviour (Guerra-Santin, Itard, & Visscher, 2009). Knowing the technical characteristics of ASWZ dwellings, it was imperative to understand the dominant patterns of heating through a question that many found difficult to answer. The researcher noted that several answers were crossed out and then reinserted which reflected the difficulty the respondents found in determining their dominant pattern of heating their homes. Besides, due to the questionnaire being administered in the summer, many might not have been able to recall and relate their heating patterns to the options provided in the question. However, the overall result reported seemed logical and related to the general analysis of the questionnaire. Nearly 37% of households reported they heated most of the rooms most of the time when in the house while 20% heated all the rooms all the time. Households with both those heating trends seemed to report less loft insulation being installed in their homes ($r= -0.3$, $p<0.05$). This could either be due to not having any loft insulation done during their tenancy or due to their not knowing whether their lofts are appropriately insulated or not. Notably, less loft insulation would imply greater heat loss through the building envelope. Hence, GCH could be quite costly to run in the long term due to continuous heat loss through the building envelope. Thus, electric fires might be used as a supplementary heating system to boost heating, and when comfort temperatures are not achieved by the GCH system only.

However, households heating most of the rooms when in the house seemed to prefer receiving advice on cutting energy use and bills ($r=0.272$, $p<0.05$). In Aspley, a group of volunteers 'Energy Champions' meet frequently at NEP for training and learning energy saving tips that they consequently spread within their community to educate others (NEP, 2011). However, there is no concrete evidence of how effective or successful the Energy Champions group in Aspley has been to date. A combination of tailored information, goal setting and feedback might also prove worthwhile as it proved successful in remarkable reduction of gas and electricity use of 190 households in the Netherlands (Abrahamse, Steg, Vlek, & Rothengatter, 2007). In that study, a combination of interventions encouraged households to uptake some energy-saving actions (such as lowering/ turning off thermostat when absent, washing at lower temperatures, etc) and resulted in higher knowledge and awareness of energy conservation behaviour.

Concerning the question about the heating controls they have in their homes, another issue with conflicting information to that provided by NCH has evolved. It emerged that 33% of the sample reported they have all three heating controls listed in the question; thermostatic radiator valves (TRVs), wall thermostat, and boiler thermostat. Notably, 38% of households reported they have only one heating control, and most of those stated it as the boiler thermostat, although nearly all homes in Aspley had TRVs and the majority had wall thermostats. Nottingham City Homes asserts that the majority of dwellings in Aspley have all three controls fitted, but this conflict reflects the lack of knowledge of respondents concerning where their heating controls are and how they could use them. Also, it reflects the minimal advice, if any, that they get from utility providers or NCH concerning how to utilise their heating systems efficiently.

Setting the thermostat temperatures has been one of the important issues in the research, as it is a direct indicator of the prevailing heating trends of respondents. Forty four per cent of respondents set their wall thermostat at a temperature less than 22°C, which might reflect their concern about their utility bills and might also indicate they may have received some advice regarding energy use in their homes. On the other hand, 26% set their wall thermostat temperature at 22°C or higher. This may possibly be due to the presence of very young children, old age, or ill health. Of the sample, 28% reported that determining the wall thermostat was not applicable, where half of those only reported they do not have a wall thermostat.

From figure 3 below, it appears that the mean temperature set on the wall thermostat has been found to be 22.5°C for the sample (with a standard deviation of 2.5), which is to a great extent higher than the recommended temperature for user comfort and energy saving, which lies between 18-21°C. With more than half the sample always heating most of the rooms most of the time and when in the house,

and with 22.5°C being the mean thermostat temperature set, this definitely reflects a few possibilities for improvement. Solid walled houses being hard to heat, with high rates of heat transfer through walls, besides significant heat loss through ventilation and air infiltration, have been reported to be continuously cold; even with the heating set at its maximum power. Thus, tenants tend to keep their heating on with the above-mentioned trends of heating at a relatively high thermostatic temperature. Another possible reason for this could be that 60% of the sampled households have infants or children (or both), while 30% of the sample have retired or disabled/ ill-health individuals. Thus, because of the vulnerability of those age groups and specific physiological needs, it is a general trend to heat most of the rooms most of the time and to set the thermostat temperature to a higher than average one.

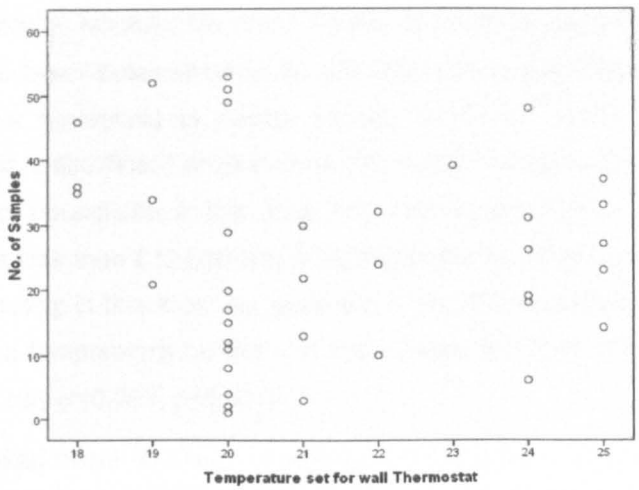

Figure 3: Scatter plot for the temperature set on the wall thermostat

When correlating the temperature set on wall thermostat with other variables, several significant correlations appeared. Households with members aged 25-35 years seem to set the thermostat to lower temperatures, which might either indicate that people of this age are more resilient to lower temperatures as comfort directly relates to health and age, or it might indicate they are aware of the impact of lowering the thermostat on their energy bills. A positive relation appears between households with the problem of condensation, and their tendency to set their thermostats to higher temperatures ($r=0.376$, $p<0.01$). People might be unaware that condensation might be the counter effect of higher indoor temperatures, along with other factors for example cooking vapours, transpiration or drying clothes inside. They might also believe that setting thermostats to higher temperatures might reduce the problem of condensation, however, the fact that warm air holds more moisture increases the problem rather than reduce it.

Another possibility for the high mean temperature could be the lack of awareness and knowledge of how the heating systems work and how to use the heating

controls efficiently. By examining the heating trends, we can clearly show that nearly 40% of households in Aspley require comprehensive guidance on thermostat setting if a scheme or policy is determined to deliver its aims of reducing energy bills and consumption. Another important implication to this relatively high mean temperature is that turning down a room thermostat by one degree could make annual savings of £55 and 230 $kgCO_2$ in a three bedroom semi-detached house (EST, 2012). It has also been asserted in previous research on UK government energy efficiency programmes that for homes to achieve some energy saving, the overall temperature of the whole house is required to be within the range of 19-20°C (Milne & Boardman, 2000 in Hamza & Gilroy, 2011). Thus, if this heating trend continues after the CESP energy upgrade, it is unlikely that any energy savings could be attained.

An important aspect questioned in this section was the monthly utility bills for gas and electricity. Notably, the mean figures for monthly gas bills and monthly electric bills have been determined to be £51 and £50 respectively. This means that on average a household in Aspley spends £100 per month on utility bills, which comprises a significant proportion of the income compared with the income of the majority of households in this area. The total annual income of around 70 % of the sample is less than £12,000 which highlights the fact that many households may be in fuel poverty in this area. As expected, a significant relation emerges between the higher the temperature on the wall thermostats (M=22.5, StD=2.5), the higher gas bills they pay ($r=0.362$, $p<0.01$).

When asked about receiving energy advice at all; 28% reported they have received some advice from their suppliers through booklets and flyers, door to door sales, and via online energy trackers. On the other hand, the majority of respondents 72% mentioned they never received any advice concerning saving energy. However, it is not clear whether those who responded that they 'never' received advice in fact did not receive any, as they may have been sent leaflets that they might have ignored or were not aware of. From analysing open ended questions, it appeared that a lot of people had problems and concerns they would hardly consider listening or reading any advice on energy that they believed was either pointless or a waste of time.
Thus, the subsequent question was concerned with whether they would like to receive energy advice. Unexpectedly, the majority, 53%, would not prefer to receive any advice concerning energy savings, whilst 47 % would. Of those who were interested in receiving advice, 65% preferred to receive it in written format such as leaflets and booklets, while 25% preferred one-to-one support/visit in order to be provided with more comprehensive information; 10% would prefer it electronically, and the rest would prefer visual information. Tailoring the information required to reduce energy consumption according to the specific requirements and characteristics of target groups has proven worthwhile in other studies (Abrahamse,

Steg, Vlek, & Rothengatter, 2007). In the present research, 10% preferred receiving energy advice via an electronic medium which for them would have been the most practical means of delivering tailored energy advice.

In response to respondents' priority for future home improvements, the order of priorities has been given first to a new bathroom followed by a new kitchen, and heating upgrading ranked as the third highest priority. This could help to anticipate their receptivity to sign up for the CESP intervention as it would provide those households with modern bathrooms and kitchens and people might consider these as influential incentives to the scheme uptake. Fifteen per cent of the respondents reported they would not consider any improvements in their homes due to ill health, age-related problems or they had already invested in some improvements (ie. new kitchen fitted, interior decoration, among others), although they understood home improvements would be done for free. Thus, a variety of incentives are required to be put in place to facilitate people's engagement and receptivity to such schemes. One scheme created by NCH is the 'Helping Hands', for vulnerable, disabled or elderly tenants of ASWZ where they are given extra help and support before, during and after the course of work done to their homes (Nottingham City Homes, 2012). Besides, NCH and NEP together refurbished a show case home in Aspley, according to CESP standards, and tenants who have the work in progress could come to this show home and use the facilities there (kitchen, washing machine, etc.). This show home also acts as a source of information and awareness of what the scheme is about, and is located at the heart of the Aspley area.

When responding to the question about how much tenants were prepared to pay towards any home improvements (home insulation and energy efficiency improvements in response to the fuel price rise), 75% indicated they are not prepared to pay any contribution. From the Survey of Personal Incomes (2012); total income of the 25th percentile points after tax deduction is £11,800. However, as the study was performed on one of the areas in the UK defined as one with multi-deprivation; this category is nearly three times higher. Notably, 70% of the sample earned less than £12,000 annually as previously mentioned, and most of which is made up of benefits. This question was particularly useful in anticipating how the private sector of ASWZ would react when NEP launched the scheme for the private landlords and private home owners, which was due to start in winter 2011. Unlike the social sector, a fixed contribution of up to £1086 is required from private individuals wanting to join the scheme, through a no interest loan scheme with the Nottingham Credit Union.

2. Lifestyle and behaviour

The following set of questions is split into two parts; lifestyle patterns of respondents and behaviour related to energy use that might reflect their energy awareness. It is

worth mentioning that from the Office for National Statistics ONS (2011); 89% of adults aged 16 and over watched television more than 3 hours a day, 59% used their computers more than 2 hours a day for internet and mailing while 67% spend their leisure time in reading (Seddon & Beaumont, 2011). The ONS statistical data has been found to be quite similar to the data collected from the study and hereby presented.

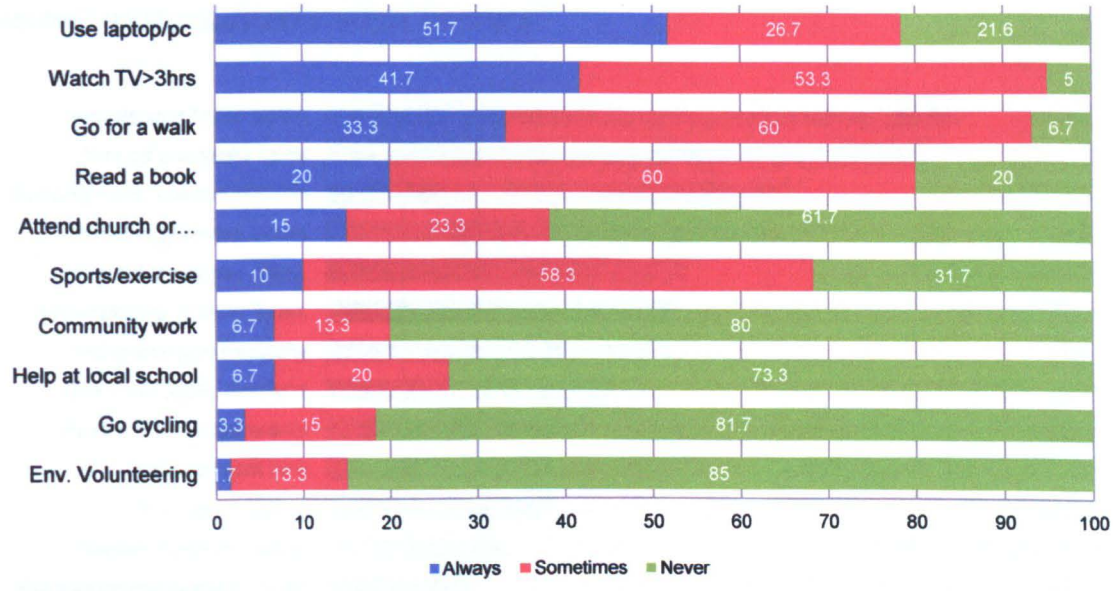

Figure 4: Lifestyle patterns

From the above figure, 78% of the sample always or sometimes uses their computers and laptops on a daily basis, whilst 95% watch TV more than three hours a day. This may be due to the high numbers of unemployed respondents who might spend more time at home using their computers or watching TV, thus probably consuming more energy than households with employed members. This might also relate to the 60% of households with children/ infants and 30% of households with disabled/ ill-health, as previously mentioned, who might as well spend much of their time at home. Ninety three per cent of the sample always or sometimes goes for walks, 68% practice sports/exercise, while only 18% cycle. Besides going for walks in leisure time, another reason why the majority of people go for walks, could be as only 29% of the sample owns a car, thus most people walk or use public transport for their work/ errands. Of the sample, 80% reported they often or sometimes read books, and 38% attend church (or other).

Twenty seven per cent help, or used to help, at the local school, while 20% volunteer in community work, and only 15% volunteer with environmental efforts. According to ONS (2011), 25% of adults in the UK volunteer formally and informally, respectively, once a month which reflects that the sample in this study might well be considered a representative sample. Notably, Nomad Plus (2006) reports that many people in this

area might be environmentally aware, but could not afford to support environmental activities or buy environmentally friendly products. Thus, people might have the motivation for a more pro-environmental lifestyle, but they might not have the opportunities or abilities to do so. Gatersleben and Vlek (1998) suggested that the degree of 'behavioural control' people have is manipulated by opportunities available and abilities of individuals. If a specific consumption action is required; motivation and behavioural control are needed according to the "Needs- Opportunities-Abilities" (NOA) model of consumer behaviour.

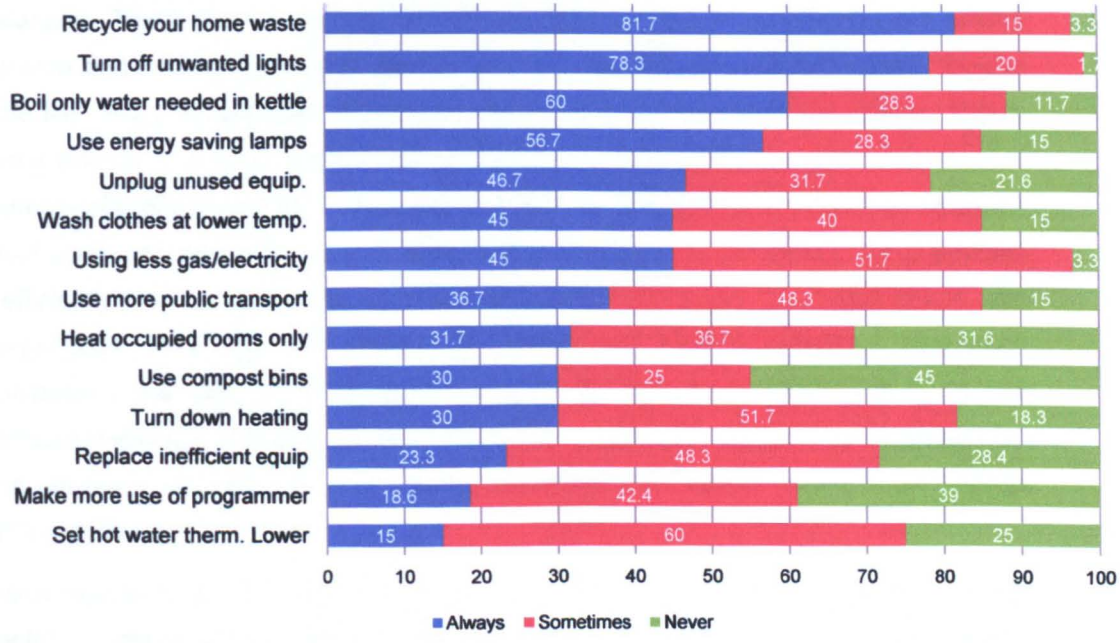

Figure 5: Behaviour and energy consumption

In response to questions about energy awareness and behaviour, 82% of the sample always recycled their home waste while only 30% always used their compost bins. This may be due to the consistent information campaigns communicated via media sources about recycling as opposed to composting, and also due to the accessible and available recycling facilities and points provided by Nottingham City Council across the city. The following top actions always taken by respondents are to turn off unwanted lights, use energy saving lamps, and unplug unused equipment, with 78%, 57% and 47% respectively. Besides, 60% always boil only water needed in the kettle, while 45% wash clothes at lower temperature. This might reflect people's general awareness of basic energy-saving actions or maybe their concern about their fuel bills, which might be the main driver for those actions. If people are relatively aware of a few energy-saving actions, then they might be receptive to other more significant ones, such as more efficient use of their heating systems, if they were provided with sufficient guidance.

When analysing heating behaviour and heating trends, 32% always heat occupied rooms only, which also has a moderate correlation with 'always using heating controls' (r=0.35, p=0.035*). This relation shows some people understand how to use their heating controls and could be using them in an energy efficient way. Thirty per cent always turn down their heating, whilst only 19% make more use of their programmers and 15% set their water thermostat lower. There also appears a correlation between 'heat occupied rooms only' and 'make more use of the programmer' (r=0.4, p=0.001**). This may imply that people who always use their programmers do use them effectively to heat occupied rooms only as opposed to those who never use them (13% of the sample). These figures indicate the crucial need to provide comprehensive energy advice and information to help people change their energy-inefficient habits, despite the fact that only just over half the sample would be receptive to the advice. This is also evident in a study undertaken by Pett & Guertler (2004) on users' behaviour in energy-efficient homes on social tenants in the UK, where energy efficiency measures had been installed; only 23% of tenants surveyed were using their heating systems 'efficiently', as designed. The majority were using them to suit their lifestyle and gain reasonable value, but not utilising the systems at optimum efficiency This study underlined the fact that what appeared best to the tenants, delivering them new efficient heating systems, may well not equate to optimum usage of the systems from an efficiency point of view, and may not in turn deliver 'design level' carbon savings (Elsharkawy *et al.*, 2011).

With regards to the final question in this section, 'reasons for taking any of the previous actions', saving money came first where 73% reported this to be the main reason, along with one or more of other reasons (save energy, due to habit, environmental concern). Twenty five per cent chose to take these actions only to save money as the dominant reason; 18% take these actions both to save energy and due to environmental concern, while 15% take these actions out of habit. This indicates that the first concern for most people in this area is to save money, which proves that financial incentives could possibly be effective in encouraging policy uptake and delivery in this area.

4. CONCLUSION

The survey presented has been conducted, and the data collected have been analysed to provide significant correlations and findings concerning energy consumption behaviour and the means of communication and information dissemination to support this (Elsharkawy *et al.*, 2012). The outcome is an examination of the likely impacts of the CESP policy on energy consumption behaviour, together with an investigation of how delivering on the policy may or may not lead to a successful delivery. It is noted

that policy changes to the way homes are built or retrofitted will only reduce carbon emissions to a certain extent; whereas the bigger challenge of addressing behaviour patterns of consumption needs to be targeted if existing homes are to meet the carbon emissions reduction target.

Over the long term, energy demand has grown fastest from appliances, with energy for heating remaining largely stable, although recent changes are much smaller. Personal choices people make in their everyday life such as turning off lights, and using heating controls more efficiently have the potential to significantly contribute to the UK's climate change targets (Eyre *et al.*, 2011). From previous research, it is clear that both overall energy consumption and energy used for space heating has remained roughly constant since 1970 (Pett & Guertler, 2004). However, it is predicted that by 2020, 45% of the domestic energy use will be due to 'expanding growth in home entertainment systems' (Hamza & Gilroy, 2011). To further highlight where the problem lies, Jackson asserted that individuals often become 'locked-in to unsustainable patterns of consumption' (Jackson, 2005). Thus, unlocking unsustainable behaviour requires multidisciplinary conventions that capture all aspects of energy consumption.

An important aspect that emerged from the survey was that the mean electricity and gas bills together constitute more than 10% of the majority of the sample's income; raising the significant issue of fuel poverty. The CESP scheme aims to ensure the annual savings in utility bills could reach up to 300 GBP per household (DECC, 2009), which could help households significantly in this deprived area. However, with the annual rise in energy tariffs, tenants' inefficient use of heating controls and unsustainable energy consumption behaviour, the full benefit of delivering the scheme is highly challenged and could even be unachievable.

As such, it is possible that government aspirations to reduce energy consumption will go unheeded if they are inconsistent with the social and physical context of real life. Financial costs, past behaviour, social values and physical infrastructure are considered some of the most difficult barriers to changing energy behaviours. Energy consumption is habitual and an integral part of people's everyday life (Whitmarsh, 2009). The Sustainable Development Commission (SDC) has stated that consumers need clear and consistent signals about policy directions and priorities in order to change behaviour. Policies should not only inform people about technological improvements that can be installed in their homes, but should also strongly encourage and incentivise them to use them efficiently. Thus, assessing the effectiveness of policy interventions requires a clear understanding of consumer behaviour and motivations across all income groups so that the most appropriate approaches are developed (SDC, 2006; Elsharkawy et al., 2011).

In order to assess whether CESP can effectively deliver on its aims, this will require the examining of a number of key areas relating to the solutions likely to be employed, and the environment in which these solutions will be operating. The users' energy consumption behaviour and the policy interventions will make the difference between promising policy, and policy which in fact delivers on its aims for energy efficiency and sustainability. The Aspley area in Nottingham is identified as one of the most deprived areas in Nottingham, besides the number of inefficient solid wall houses that are 'hard to heat'. Thus, the effective delivery of energy advice in the area persistently faces challenges from the financial, social and cultural constraints. It is clearly recognized that with the variety of formats of information and advice that people reported they would prefer to receive; tailored information is indispensable.

As the majority of the sample preferred leaflets and booklets as the means of communicating advice, innovative, simple and informative design of communication methods is crucial. Visual prompts are other means of driving sustainable energy consumption. Prompts proved effective in reminding people with repetitive behaviours that they have the potential and the ability to change their lifestyles into more environmentally sustainable ones (McKenzie-Mohr, 2011; Cialdini, 2010). *"The purpose of a prompt is not to change attitudes or increase motivation, but simply to remind us to engage in an action that we are already predisposed to do"* (McKenzie-Mohr, 2011, p. 84). Several studies have proven that prompts targeting specific behaviours have, in fact, had a significant impact on promoting sustainable behaviour (Kurtz, Donaghue, & Walker, 2005 in McKenzie-Mohr, 2011).

Furthermore, the DECC states that in order to support the consumer in household energy management, web and telephone-based information services should be provided, informing individuals of 'how to reduce energy by making changes to behaviour, eligibility of subsidies and alternative financing packages' (DECC, 2010). This is particularly important at the time where the UK's flagging economy and the rising energy prices are affecting the most vulnerable sectors of the population. Parag & Darby (2009) have supported this, by arguing that, to meet demanding carbon reduction targets, the Government is required to take actions that 'encapsulate interest' in emissions reductions and provide comprehensive guidance and support. Thus, behavioural change is a viable key to achieving significant carbon savings in the UK. This could be done by engaging people and raising awareness through home energy audits, media campaigns, and influential incentives. A viable recommendation would be for researchers to ensure their research findings are incorporated into policy programmes, as well as involving policy makers in the formative stages of the research (Cialdini, 2010). The lack of communication is very likely to result in losing valuable outcomes through disparate efforts and approaches between concerned parties.

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Appendix D: PLEA 2011- The Code for Sustainable Homes as a Viable Driver Towards a Zero Carbon Target in UK

The Code for Sustainable Homes as a viable driver towards a zero carbon target in UK

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ABSTRACT: *The urge for lower carbon emissions from buildings has seen the development of policies to cater for energy conserving methods in new and existing buildings, innovative methods of conserving and generating energy and numerous campaigns to help raise awareness of carbon footprints. However in a growing world population and an increasing number of people now living in urban areas, achieving high levels of sustainability fronts many challenges. Among these include overcoming the barriers that society poses, that of behavioural and social patterns which drive energy consumption and resource use. It is argued that such factors form the basis of choices, habits and values of individuals and which impact on an individual's decision to act in favour of or against environmentally sustainable / energy efficient behaviours. However, in order to meet the carbon emissions reduction target, the government's approach in confronting household carbon emissions is predominantly policy-based. This discussion reflects on how this specific area of energy policy is being enacted through policy and regulation, particularly through the CSH. The outcome is an examination of the likely impacts of the policy on the energy consumption behaviour, together with investigating why delivering on the policy may not lead to the environmental benefits assumed.*

Keywords: energy consumption, code for sustainable homes, behaviour

1. INTRODUCTION: Energy consumption in the UK domestic sector

'Domestic sector energy consumption is defined as energy used in dwellings, excluding petrol and other fuel use for family cars (which are classified under transport). It also implies energy used in residential establishments such as hotels.' (Utley & Shorrock, 2008)

Energy use in the domestic sector accounts for a large proportion of total national energy consumption. In the 1970s it accounted for 24-27% of UK energy consumption but since 1980 it has risen to 28-31% of UK energy consumption. (Utley & Shorrock, 2008) In 2005 the UK's total carbon dioxide emissions were 556 MtCO2 (Mega ton Carbon Dioxide). Emissions from the domestic housing sector represent around 27 per cent of this figure (DCLG, 2007). The average UK household creates almost five and a half tonnes of CO2 every year to heat and power their home (EST, 2009). To meet government targets domestic emissions have to fall to 17 MtC p.a. by 2050, if the domestic sector were to reduce in line with overall carbon emissions targets. (McManus, Gaterell and Coates 2010)

Statistics show that much of the carbon emissions from homes is due to heating, both of space and water with household electricity consumption accounting for fewer emissions (see Fig 1.). The Department of Energy and Climate Change (DECC) claims in its quarterly review that carbon emissions from the domestic sector decreased by 5% between 2008 and 2009 but also points out that this fall was due to a raise in overall temperatures in the subsequent year (DECC, 2010). However, even if there is evidence of a reduction in household carbon emissions, this does not necessarily indicate that people are changing their way of life in order to lower their household energy consumptions.

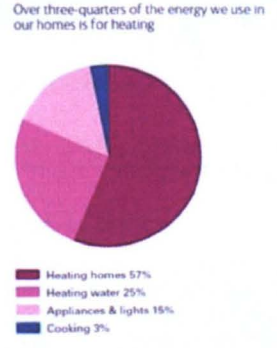

Fig 1: Energy Used for Heating Purposes in Households in 2008 (UK Low Carbon Transition Plan, 2009)

Consequently, patterns of consumption and user behaviour may have the effect of negating some of the benefit expected from reducing the carbon intensity of the UK's energy sources in the future. This 'rebound' effect is especially likely to manifest itself more strongly in households for which fuel costs constitute a large proportion of household income, as households become able to afford a higher standard of heating or increased appliance usage (McManus, Gaterell and Coates 2010). However, behavioural aspects are also highlighted in other research work that includes recommendations on how to behave in an energy-efficient mode on a daily basis. In order to lower energy use in households with policy measures there is a need for development and renewal of policy instruments (Linden, Carlsson-Kanyamab, & Eriksson, 2006).

The following section discusses two remarkable barriers to achieving sustainable energy consumption behaviour particularly in energy efficient buildings of the domestic sector. The first regards individual lifestyle and behaviour as a main barrier and the second is the 'rebound effect' as another.

2. BARRIERS TO SUSTAINABLE ENERGY CONSUMPTION

2.1 Individual behaviour

Energy consumption is often inconspicuous to individuals as it becomes part of an ordinary lifestyle such as the use of household appliances. Heiskanen (2009) implies that consumption behaviour is not based on individualistic choices rather shared conventions that evolve historically, creating common understandings of decency and appropriate behaviour. These conventions are a result of 'a vast commercial system of technologies and media that provide collective "comfort, cleanliness and convenience"' signifying the enormity of what creates consumption behaviour. Nonetheless, it is ultimately the choices of individuals that become a key factor in the process of changing consumption behaviour (Heiskanen E, et al, 2009).

This has also recently been recognised by the Sustainable Development Commission in the development of policies for behaviour change towards more environmentally sustainable behaviour. There is considerable doubt about whether or not policies alone are a viable means to effectively changing behaviour, considering that factors that determine an individual's behaviour originate from a social context.

Personal habits are one of the main implications to sustainable energy consumption. Habits come into existence when 'behaviours are frequently and consistently repeated' *(Bechtel et al., 2002) and* become a major factor in predicting the outcomes of a behaviour change as they are unique to individuals. Jackson highlights that habits occur against rational choice and describes them as being part of low cognitive processes that require little in the way of thinking or even 'unconscious decisions'. As this is the case, they often tend to interfere with an individual's ability to make decisions in his/her own best interest *(Jackson, 2005)*. This is evidence of a major barrier between intentions and behaviour. Even though an individual may intend to reduce household energy emissions for example, habit or routine may cause them to do otherwise, such as leaving the light on when leaving a room rather than switching it off, switching a fan on rather than opening a window. In order for successful behaviour change, 'old habits need to be broken and new ones established' (Stern, 2000). Even if policies are in place to induce environmentally sustainable behaviour, the choice of short term reward that originates from existing habits may override paying the consequences for the action, such as fines or taxes.

2.2 'Rebound Effect'

The 'rebound effect' is an umbrella term for a variety of mechanisms that reduce the potential energy savings from improved energy efficiency. An example of a rebound effect would be the driver who replaces a car with a fuel-efficient model, only to take advantage of its cheaper running costs to drive further and more often (Sorrell, 2009). Sorrell has implied that on the micro level, the question is whether improvements in the technical efficiency of energy use can be expected to reduce energy consumption by the amount predicted by simple engineering calculations. Simple economic theory suggests that it will not; since energy-efficiency improvements reduce the marginal cost of energy services such as travel, the consumption of those services may be expected to increase. This increased consumption of energy services may be expected to offset some or all of the predicted reduction in energy consumption. (Sorrell, 2009)

In the context of housing, decreased costs of household energy whether through efficiency or renewable energy technologies may be used to alleviate fuel poverty. Home-owners may be able to afford to heat their home to a higher standard, and may also use the savings for extra appliances. This rebound will have a negative impact when examining the overall energy consumption of the dwelling. McManus et al suggest that this issue must be understood in the context of technologies likely to be installed to meet the Code requirements, with an acknowledgement that along with the generation characteristics of a technology, the major influencing factor will be the usage of these systems. Without methods of control and support for tenants of energy efficient homes, energy performance assumptions based on calculations relating solely to building fabric and nominal technology performance may not be realised. (McManus, Gaterell, & Coates, 2010)

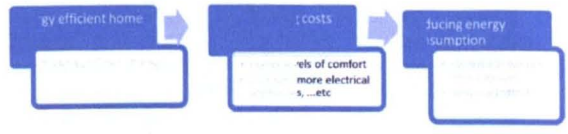

Fig 2. Illustration of the optimal scenario and the 'rebound effect' scenario in energy efficient homes (adapted from (Sorrell, 2009))

3. LOW CARBON INITIATIVES IN UK

Policy instruments have been in place in an attempt to reach the low carbon goal for over 40 years in the UK, with standards for limiting energy loss through buildings first introduced in the1965 Building Regulations. This now falls under Part L of current building regulations, 'Conservation of Fuel and Power' (ODPM, 2006), which takes account of limiting heat gains and losses, as well as of energy efficient building services and controls. The energy performance is now expressed in terms of CO2 performance, with a carbon emissions value expressed in kgCO2/m2 resulting from heating, hot water, ventilation and internal lighting referred to as the Dwelling Emission Rate (DER). This figure is calculated using the Standard Assessment Procedure (SAP) (DEFRA 2005). The 'SAP rating' itself is based on the costs of energy for the above uses for the dwelling, with the result on a scale of 1–100—a rating of 100 indicating 'zero' net energy costs. The current SAP rating includes provision for energy savings from energy generation technologies, with appropriate reductions in running costs included

in the calculation and the possibility of a rating over 100 for homes that are net energy exporters.

The average SAP rating of households has risen steadily over the past 30 years. However, despite a threefold increase in the average SAP rating over this period, this has not translated into a reduction in overall energy usage in the housing sector as a whole. This may be attributed to the rapid and continuous growth of central heating systems over this period. Replacing a single heated room with whole house heating is likely therefore largely to blame for the lack of any demand reduction over this period. (McManus, Gaterell and Coates 2010) The SAP rating therefore provides a useful measure of potential energy performance, however it does not take into account how occupants behaviour and uses of heating and lighting systems in particular, affect the results.

In 2007, the government published the Code for Sustainable Homes (CSH) as a pathway to achieving zero carbon homes in England. The CSH sets ambitious targets for the house building industry, for which the commercial benefits and costs are not clear-cut. The higher levels of the CSH are a laudable aim, and have the potential to dramatically lower the energy consumption and carbon footprint of homes built to these standards. It has proposed that all new homes will be built to the 'zero-carbon' standard from 2016, with interim energy requirements based on those contained within the Code. (DCLG 2008) The following section discusses CSH as a main proposed solution in the UK to reduce energy use in newly built homes.

3.1 The Code for Sustainable Homes (CSH)

'Energy policy for homes is being taken forward through a number of routes and the Code for Sustainable Homes is a major driver for achieving low and zero carbon homes.' (ZeroCarbonHub, 2009)

The Code for Sustainable Homes (CSH) was introduced in 2007 as a tool to achieve the 'step-change' required for improving the overall environmental performance of new housing. The Code was developed with the Building Research Establishment (BRE) and is based on Ecohomes, which it has replaced for new homes in England. To support the Code CLG have worked with BRE to put in place an assessment and certification system. The Code is part of a wider package of measures which is aimed at reducing UK carbon emissions from buildings and adapting to climate change. (CLG 2007) It takes a whole house approach and measures the sustainability of a dwelling against nine different categories: energy/carbon; water; waste; materials; surface water run-off; and health and well being, which have mandatory performance standards; and pollution; ecology; and management. Central to the CSH are the energy efficiency and CO2 emissions of new homes, which are embedded in a mandatory section of the CSH in which minimum standards must be met in order to become accredited. (DCLG, The Callcutt review of housebuilding delivery 2007).

Table 1: Shows regulatory steps to zero carbon and corresponding Code levels. (CLG, 2009)

Code Level	Current energy standard (Percentage improvement over 2006 Part L)	When change to regulations takes place	2009 Code consultation proposals (Percentage improvement over 2006 Part L)
1	10%		25%
2	18%		25%
3	25%	2010	25%
4	44%	2013	44%
5	100% regulated emissions		70% onsite+30% allowable solutions
6	Zero carbon onsite -100% onsite plus appliances	2016	"Zero Carbon Home"- 70% onsite+allowable solutions to reach zero carbon

Depending on the number of points gathered, a star rating is then awarded (one star being the lowest achievable level and six stars being a zero carbon home). Consultations are currently ongoing, however, the proposals involve incorporating level 3 (25% improvement over part L) in 2010 and level 4 (44% improvement) in 2013 before finally moving to zero carbon homes by 2016 (DCLG, The Callcutt review of housebuilding delivery, 2007). In a study by Osmani and O'Reilly, they affirm that the potential introduction of the CSH as legislation, along with the implementation of Energy Performance Certificates in line with the Energy Performance of Buildings Directive, has been highlighted in a study by Vorsatz et al. (2007), as being highly successful in terms of reductions in CO2 emissions and cost effectiveness, to the point that these measures could be major drivers for zero carbon housing. (Osmani & O'Reilly, 2009)

4. DISCUSSION: Implications to the Code delivery

However, the question is how does the government plan to inform people on a mass scale with detailed, comprehensible information of the changes they would need to make in order to establish a zero carbon future? The Warm Homes, Greener Homes strategy set out in March 2010 highlights that in order to support the consumer in household energy management, web and telephone based information services will be provided, informing individuals of 'how to reduce energy by making changes to behaviour, 'eligibility of subsidies' and 'alternative financing packages' (Warm Homes, Greener Homes Strategy, 2007). As stated by Parag & Darby, meeting demanding carbon reduction targets requires the Government to take actions that 'encapsulate interest' in emissions reductions (Parag & Darby, 2009).

In order to assess whether the CSH can effectively deliver on its aims will require examining a number of key areas relating to the solutions likely to be employed, and the environment in which these solutions will be operating. The users' energy consumption behaviour and the policy interventions will make the difference between promising policy,

and policy which in fact delivers on its aims for energy efficiency and sustainability.

4.1 Users' behaviour

'Effective systems of policy making such as development of Building Regulations should engage individuals and industry in an open and transparent system, with defined goals. Local governance is vital in promoting sustainable development through the activities in housing, local environments and regeneration'. (SDC, 2006)

A key determinant of energy consumption within households is users' behaviour. Over the long term, energy demand has grown fastest from appliances, with energy for heating remaining largely stable, although recent changes are much smaller. It can be seen from previous research that both overall energy consumption and energy used for space heating has remained roughly constant since 1970. Households chose to install central heating for a more comfortable living environment throughout the dwelling, whereas previously the main living area may have been the only heated space. This effect is now being mirrored by research which suggests that, given the choice between saving money and a more comfortable living environment, a household will heat their home to a higher standard (Pett and Guertler 2004). Jackson suggests that individuals often become 'locked-in to unsustainable patterns of consumption' *(Jackson, 2005)*. It is noted that policy changes to the way homes are built or retrofitted will only reduce carbon emissions to a certain extent; whereas the bigger challenge of addressing behaviour patterns of consumption needs to be targeted if new homes are to be addressed as zero-carbon.

From a study of social tenants in UK (Pett & Guertler, 2004), it has been found that where energy efficiency measures had been installed, only 23% of tenants surveyed were using their heating systems 'efficiently', as designed. The majority were using them to suit their lifestyle and gaining reasonable value, but not utilising the systems at optimum efficiency. This study underlined the fact that what appeared best to the tenants, delivering them the greatest perceived benefit, may well not equate to optimum usage of the systems from an efficiency point of view, and may not in turn deliver 'design level' carbon savings. In another study of a Code level 6 home, it has been implied how important control systems are to be properly regulated and designed appropriately for users and that this should be considered at the early design stage.. (Hormazabal, Gillott, Guzman, & Revell, 2009)

Certainly government exhortations to reduce energy consumption will go unheeded if they are incongruous with the social and physical context of everyday life. Barriers – such as financial costs, past behaviour, social values and physical infrastructure – are considered some of the most intractable barriers to changing energy behaviours. According to Whitmarsh (2009); for most individuals, energy consumption is habitual and an integral part of their everyday life. The Sustainable Development Commission (SDC) has found that consumers need clear and consistent signals about policy directions and priorities in order to change behaviour. Policies should not only inform them about technological improvements that can be installed in their homes, but should also strongly encourage and incentivise people to do so and to use them efficiently. Assessing the effectiveness of policy interventions requires a clear understanding of consumer motivations across all income groups so that the most appropriate approaches are developed. (SDC, 2006)

Fig 3: The diamond model summarises the key policy recommendations for reducing carbon emissions from the existing housing stock. (SDC, 2006)

The options for pushing this change can be either at the macro-level, through policy instruments, economic benefits etc., or at the micro-level, involving education and information disseminated to individual households. Both approaches are required, and both will entail benefits and drawbacks. Providing a household with information tends to result in higher knowledge levels, but not necessarily in behavioural changes or energy savings (Abrahamse, Steg, Vlek, & Rothengatter, 2007). However, there are ways in which the user can be incentivised to change their behaviour in order to gain maximum benefit from any available technology. Gardner and Stern have mentioned three types of incentives that have been used effectively to promote energy conservation in homes: energy price changes, financial rewards for desired behaviour, and methods that simplify the task of conserving energy and thus make conservation more convenient. (Gardner and Stern 1996) In fact it has been asserted that the reasons given for changing one's behaviour are motivated both by lower energy costs, a reduced impact on the environment, and sometimes even better health. (Stern, Berry, & Hirst, Residential Conservation Incentives, 1985)

4.2 Policy implications

While the housing sector entails a significant part of the UKs' environmental impact -accounting for over a quarter of all carbon dioxide emissions-; the policy formulation and decision making with respect to environmental issues tend to be complicated. Typically, there are many kinds of factors to consider -physical, psychological, economic, ethical, and

political - as well as the often-conflicting interests of different groups. In fact, the complexity of environmental decision problems is such that they may appear to defy rational analysis, and that effort to establish environmental policies encounter controversy on many issues. (Nickerson, 2003), (McManus, Gaterell, & Coates, 2010) The 2007 White Paper has set out a response to the Energy Review Report, involving increased international cooperation as well as action at home. One of the key elements of its strategy has been stated as: "Encourage more energy saving through better information, incentives and regulation. By removing barriers to the take up of cost-effective energy efficiency measures, all of us, business, individuals and the public sector, can take steps to reduce emissions and our energy dependence." (DTI, 2007)

It is notable that the CSH intends to promote higher environmental standards in housing ahead of implementation of regulatory standards; as all new homes would be required to have a mandatory Code rating indicating whether they had been assessed and, the performance of the home against the Code (DCLG, The Callcutt review of housebuilding delivery, 2007). A mandatory rating against the Code is expected to build on Energy Performance Certificates (EPCs), which have been a mandatory requirement since October 2008 whenever a building has been built, sold or rented out. It has also been stated by CLG that to further support the aim of zero carbon homes; planning policy will be developed by the Government to set a framework for development to deliver zero carbon outcomes (DCLG, 2007). Besides, proposals for a Planning Policy Statement on Climate Change have been published to help through the national planning structure to promote the role of local planning in supporting the delivery of zero carbon homes (CLG, Definition of Zero Carbon Homes and Non Domestic Buildings: Consultation, 2008)

Notably, there are a number of other, closely related areas of policy, including the Stamp Duty Land Tax exemption for zero carbon homes, the criteria for meeting the energy components of the Code for Sustainable Homes, the details of the amendments to be made to the energy efficiency and carbon requirements of the Building Regulations in 2010 and 2013, the requirements for eco-towns to be zero carbon and the timetable for Government-funded social housing to be zero carbon. Ongoing consultations take into account, where relevant, the lessons learnt to date in the development of this policy. (CLG, Definition of Zero Carbon Homes and Non Domestic Buildings: Consultation, 2008)

Moreover, in an attempt to create widespread uptake of renewable energy technologies, the UK government has brought about schemes such as Feed-in-Tariffs (FITs) and a proposed Renewable Heat Incentive (RHI) as well as a Pay As You Save (PAYS) scheme for 'green' financing . Although it seems as a compatible solution to financially support reduction of the groups' household emissions, it does little in the way of changing behaviour to encourage sustainable energy consumption as individuals may still continue to behave in an environmentally irresponsible way.

5. CONCLUSION

Current thinking suggests that it would be infeasible for government to change individual consumer behaviours. Research does not support this presumption. Government plays a vital role in shaping the cultural context within which individual choice is negotiated through its influence on technology, market design, institutional structures, the media, and the moral framing of social goods. (Jackson & Michaelis, Policies for Sustainable Consumption, 2003) Yet, current legislation does little to tackle underlying values and address the issue of habits -which as discussed previously- exist as a result of routine behaviour and recurring events (Verplanken and Wood, 2006). It can be said then, that if habits are developed over time, a zero carbon society may be achievable in the future, but effectively changing behaviour to more energy efficient behaviour may not be possible as soon as regulation sets in. Clearly then, the Government has opted to merely gain compliance and not bring about a change in underlying values, to establish a new culture of low carbon lifestyles. 'Monetary incentives and disincentives are targeted to specific activities. They are not aimed at changing the underlying value system of individuals, but rather only the relative prices of alternative actions' (Santopietro, 1995).

It is worth noting that Gardner and Stern's four basic solutions for affecting consumption behaviour need to be carefully considered and integrated by government and policy makers according to the problem. They have identified the four basic solution types, or ways to encourage individual behaviour for the common good as: government laws, regulations, and incentives; programs of education, which attempt to encourage pro-social behaviour by giving people information and trying to change their attitudes; small social groups and communities; and the use of moral, religious, and/or ethical appeals. Although the laws/regulations/incentives method encourages individuals to behave in the public interest by making it in each individual's personal self-interest to do so, the other three basic solution approaches try to encourage prosocial individual behaviour in a fundamentally different way. These methods assume that under the right conditions, people will want to behave in a public-spirited fashion, whether or not such behaviour is in their own personal interest. (Gardner and Stern 1996)

Furthermore, it has been implied in previous studies that policy formulation and decision making with respect to environmental issues tend to be complicated. Typically, there are several factors to consider -physical, psychological, economic, ethical, and political - as well as the often-conflicting interests of different groups. In fact, the complexity of environmental decision problems is such that they may appear to defy rational analysis, and that effort to establish environmental policies encounter controversy on many issues. (Nickerson, 2003), (McManus, Gaterell, & Coates, 2010) Government policies send important signals to consumers about

institutional goals and national priorities. They indicate in sometimes subtle but very powerful ways the kinds of behaviours that are rewarded in society, the kinds of attitudes that are valued, the goals and aspirations that are regarded as appropriate, what success means and the worldview under which consumers are expected to act. Policy signals have a major influence on social norms, ethical codes and cultural expectations. (Jackson, 2005)It is clear, therefore, that delivering a sustainable energy strategy for UK housing sector will entail a full and thorough examination of the barriers and implications discussed. It is not guaranteed that 'zero-carbon' housing as currently defined within the Code will in practise deliver on this promise, or that enforcing this level of decentralised energy generation will lead to the long term net benefits assumed.

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Appendix E: Communication methods for effective policy delivery

Communication methods for effective policy delivery

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(Word count: 758)

Policy planning for building or retrofitting homes could only assist in reducing carbon emissions to a certain limit; whereas the bigger challenge is to address behavioural patterns of consumption. Personal choices people make in their everyday life, such as turning off lights or using heating controls more efficiently have the potential to significantly contribute to the UK's climate change targets [1]. Jackson [2] suggests that individuals often become 'locked-in to unsustainable patterns of consumption'. Thus, behavioural change is a viable key to significant carbon savings in the UK.

This article presents a survey of Aspley Super Warm Zone (ASWZ) scheme, one of the CESP schemes in Nottingham. The focus is on energy consumption behaviour data and means of communication and information dissemination to support this [3]. The outcome is an examination of the likely impacts of policy planning on energy consumption behaviour, together with investigating how tailored means of communication could lead to a successful policy delivery.

The survey analysis indicates that although 72 % of the sample mentioned they have never received any energy advice (from their energy supplier or other bodies), only 47 % reported they would like to acquire it. However, 65 % of those interested in receiving advice preferred to receive it in written format such as leaflets and booklets, while 25 % preferred one-to-one support or visits, for more comprehensive information. Notably, only 10 % would prefer information electronically.Tailoring the information required to reduce energy consumption according to the specific requirements and characteristics of target groups has been proven worthwhile in other studies [4], and is further advocated in this study. This is supported by DECC Warm Homes, Greener Homes Strategy that suggested web and telephone based information services, informing individuals of 'how to reduce energy by making changes to behaviour, 'eligibility of subsidies' and 'alternative financing packages' in order to support consumers in household energy management [5].

As the majority of the sample preferred leaflets and booklets as the means of communicating advice, simple, creative and comprehensive design of communication methods seems to be imperative. Visual prompts have proved effective in reminding people with repetitive behaviours to change. Several studies [6], [7] have proved that prompts targeting specific behaviours have actually had a significant impact on promoting sustainable behaviour. Yet, the lack of interaction between researchers and policy makers is very likely to result in losing valuable outcomes through disparate efforts and approaches [7], [11]. A viable recommendation would be for researchers to ensure their research findings are incorporated into policy programmes whilst also involving policy makers in the formative stages of research [8].

Furthermore, providing information and prompts that seek to motivate environmental actions are not sufficient tools. Developing and activating social norms is an important social psychological motivator that decision makers need to consider [8]. If norms are internalised by people of a community, they are more likely to have a positive impact than providing prompts and information only. In such a scheme as CESP, houses are approached within the same neighbourhood. Activating social norms amongst households by providing knowledge, feedback, and comparing between their energy performances and praising those who achieve the lowest levels of energy consumption could, in effect, boost the delivery of such a scheme [8].

As such, it is possible that government aspirations to reduce energy consumption will go unheeded if they are inconsistent with the social and physical context of real life. Financial costs, past behaviour, social values and physical infrastructure are considered some of the most intractable barriers to changing energy behaviours. Energy consumption is habitual and forms an integral part of people's everyday life [9]. Thus, assessing the effectiveness of policy interventions requires a clear understanding of consumer behaviour and motivations across all income groups so that the most appropriate approaches are developed [10], [3].

In order to meet demanding carbon reduction targets the Government is required to take actions that 'encapsulate interest' in emissions reductions [11]. The Aspley area is identified as one of the Lower Super Output Areas LSOAs in Nottingham, besides its inefficient solid wall houses that are 'hard to heat'. Thus, a challenge is persistently faced with the financial, social and cultural constraints in the area, if energy advice is to be effectively delivered. In

essence, the impact of policy interventions on people's energy consumption behaviour will inevitably make the difference between promising policy, and policy which in fact delivers on its aims for energy efficiency and sustainability.

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Appendix F: Aspley Super Warm Zone: Case Studies

aspley super warm zone

Nottingham City Homes
Secure • Warm • Modern

Case Study

Lisa Booth, 68 Harwill Crescent

Home improvements:

1) Internal solid wall insulation
2) New kitchen
3) New bathroom
4) Solar electricity panels

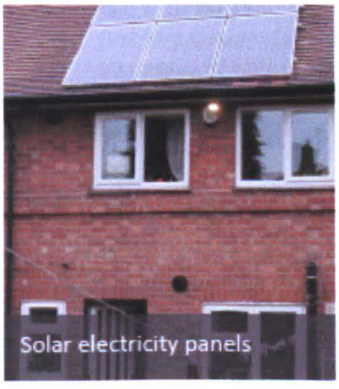
The Finished Product


New Bathroom with SWI

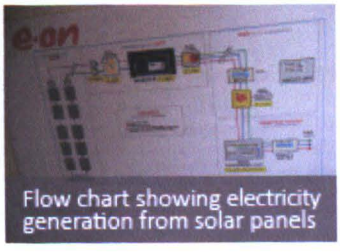

New Kitchen with SWI


Internal SWI with extended window sill.


Lisa enjoys gardening.


Solar electricity panels


Solar electricity panels



Flow chart showing electricity generation from solar panels

SWI = Solid Wall Insulation

How does Lisa feel about her whole house energy makeover?

1. **Before your home had solid wall insulation installed were you given a good explanation of how it would make a difference to your home?**
A Liaison Officer came over and talked me through the process and told me that there would be a lot of disruption having so many improvements at the same time. Obviously, I was a little worried but the way I see it, is that I've waited four years for this so I wasn't going to say no! To hear I'd be having the walls done as well was a bit of a shock but after hearing how it would help lower my heating bills I was on board.

2. **What was your house like before the whole house energy makeover?**
I'm very house proud and make the most of what I have so although my bathroom and kitchen were due an upgrade they have always been looked after. The house has always been quite cold downstairs due to the draughty back door.

3. **What difference has the solid wall insulation made to your home?**
My heating is not on a timer, so I just put it on as and when I need it. I don't seem to need it on as much anymore as the house keeps it's heat better which is great. It's definitely a lot warmer up stairs. I'm on an electric meter and since having the insulation don't need top it up as much.

4. **What does your family think about the work?**
One of my three sons still lives at home - he made himself scarce throughout the building work, so he didn't see it develop. He likes the finished product and finds our new solar panels interesting, we're looking forward to seeing a drop in our electricity bills because of them.

5. **Are you doing anything differently now you have the insulation?**
I'm already very energy efficient and believe in sustainable living, I think it's important for everyone to do their bit for the environment.

6. **Would you recommend having the work done?**
Yes, definitely. Although only in homes where people will look after it. I also think it would be very difficult to have this kind of disruption in homes where there are small children.

7. **Do you feel like you've had a whole house energy makeover?**
Yes, I am very happy with my new kitchen and bathroom and appreciate that I am one of the first to receive solar panels. You can't really tell that I've even had the solid wall insulation done as the rooms don't seem any smaller and I like the deeper window sills.

"A big THANK YOU to everyone who has made this possible, I am so grateful".

aspley super warm zone

aspley super warm zone

Nottingham City Homes
Secure • Warm • Modern

Case Study

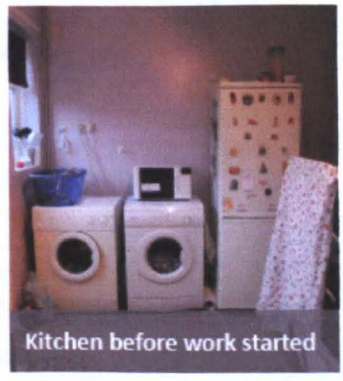
Sue Stevenson, 139 Seaton Crescent

Home improvements:

1) Internal solid wall insulation
2) New kitchen
3) New bathroom
4) Energy Monitor

Before & After


Kitchen before work started


Kitchen before work started


Graphic of Sue's new kitchen


New kitchen with SWI


New kitchen with SWI


New bathroom with SWI


SWI with extended window sill

SWI = Solid Wall Insulation

How does Sue feel about her whole house energy makeover?

1. **Before your home had solid wall insulation installed were you given a good explanation of how it would effect and make a difference to your home?**
Yes Lynne, (project Liaison Officer) came round and explained everything, I also attended a client induction event where I chose the style of my kitchen. Lynne said that there would be disruption, almost to the extent that I would be living in a building site. But because the improvements would make such a difference to my home and health I just kept thinking about the end product. As my home was the first to be done it has attracted a lot of people who are waiting for there's, they are all surprised at how normal the walls look, and how lovely my new kitchen and bathroom are.

2. **What was your house like before the solid wall insulation?**
My house was very draughty and cold before, which was not good for my health and made me feel lethargic.

3. **What difference has the solid wall insulation made to your home?**
It's made a huge difference, before I was always cold and had to use my gas fire as well as my central heating. Now I only need my central heating on, and for shorter amounts of time.

4. **Have you been able to turn your heating down at all?**
I haven't turned it down but I have been able to adjust the timings so it is not on for so long as the house keeps it's heat better now.

5. **Have you seen a difference in your fuel bills?**
I'm on a six monthly direct debit so I have not received a bill since I had the solid wall insulation, I will keep you posted though.

6. **What do your friends and family think of the work?**
My house altogether feels more homely and looks a lot smarter, because of this I enjoy entertaining more, I feel very lucky to have a space this is so comfortable and warm.

7. **Are you doing anything differently now you have the insulation?**
Having such a large energy efficient improvement makes you want to be more energy efficient yourself. I never leave things on standby and I'm much better with my lights. I've even bought some small battery powered kitchen spot lights so I don't need to use my big kitchen lights as much.

8. **Would you recommend having a whole house energy makeover?**
Oh yes, absolutely. You may find it hard when you've got workmen coming in and out but it really is worth it, I've never been so proud of my home and look forward to the money I'll save on my heating bills.

"This work has made a world of difference to me, I'd recommend it to anyone, the end product is fabulous".

aspley super warm zone

Appendix G: Pilot Survey

Dear Sir/Madame,

The **Aspley Super Warm Zone** is one of only a handful of CESP (Community Energy Saving Programme) schemes across the country. Consequently, a clear understanding of the impact upon both properties and their residents will provide valuable information, both locally and nationally.

This questionnaire is designed to develop an understanding of residents' attitudes and behaviour prior and post works. This will help develop appropriately tailored approaches that support and maintain effective delivery of current and future policy schemes.

The questionnaire should only take 15-20 minutes and will be extremely useful in this research project. The research project main partners are: *Nottingham City Homes*, *Nottingham Energy Partnership,* and *University of Nottingham*.

Your responses will be confidential and will be used for research purposes only. No individual will be identified as a result of completing this questionnaire.

If you have any questions or comments about this questionnaire, please use the contact details below. Your comments will be greatly appreciated.

Yours Sincerely,

Mrs Heba Elsharkawy
PhD researcher, Architect (BSc, MSc)
School of Architecture and Built Environment
University of Nottingham
Email: laxhe2@nottingham.ac.uk
Mobile: 07846791555

SURVEY QUESTIONNAIRE
Users' energy consumption behaviour (Part A)

Section 1: Home information

1. Tenancy situation

☐ Private ownership ☐ Social housing
☐ Other (please specify)

2. How long have you lived here?

☐ <12 mths ☐ 1-5 yrs
☐ 5-10 yrs ☐ 10-20 yrs
☐ >20 yrs

3. What rooms do you have here? (number of each)

☐ Porch ☐ Hall ☐ Living room ☐ Dining room
☐ Kitchen ☐ Utility room ☐ Bedrooms ☐ Bathroom+wc
☐ Bath/shower w/o wc ☐ Separate wc ☐ Balcony/sunspace ☐ Conservatory

4. Main heating system

☐ Gas central heating ☐ Electric storage
☐ Gas fire ☐ Electric fire
☐ Oil ☐ Wood
☐ Coal

5. Other secondary heating

☐ Gas wall heaters ☐ Solar panel
☐ Electric portable ☐ Liquid petr. gas
☐ Other

6. Glazing

☐ Single ☐ Ordinary double ☐ High e-double ☐ Triple

7. What improvements have you made to your home? (tick all that apply)

☐ New kitchen ☐ New bathroom ☐ Interior redecoration ☐ External rendering
☐ Double glazing ☐ Loft insulation ☐ Heating upgrade ☐ None
☐ Other (.....)

8. What would be your next priority for your home improvement?

☐ New kitchen ☐ New bathroom ☐ Interior redecoration ☐ External rendering
☐ Double glazing ☐ Loft insulation ☐ Heating upgrade ☐ None
☐ Other (.....)

Section 2: Home use and performance

9. How much of the house do you heat?

☐ Only the living room when in the house
☐ Only the living room when in the house, and other rooms as I/we occupy them
☐ Most of the rooms when in the house
☐ Most of the rooms most of the time
☐ All rooms

☐ Don't know

10. Do you have any of the following problems in your home? (1 is least likely, 5 is most likely)

	1	2	3	4	5
Damp	☐	☐	☐	☐	☐
Mould	☐	☐	☐	☐	☐
Cold	☐	☐	☐	☐	☐
Drafts	☐	☐	☐	☐	☐
Condensation	☐	☐	☐	☐	☐
Other (.....)	☐	☐	☐	☐	☐

11. What heating control(s) do you have? How often do you use them? (1 is never, 5 is always)

	1	2	3	4	5
Radiator valves	☐	☐	☐	☐	☐
Thermostat	☐	☐	☐	☐	☐
Boiler	☐	☐	☐	☐	☐
Wall thermostat	☐	☐	☐	☐	☐
None	☐				

12. Do you use your heating controls?

☐ Never ☐ Sometimes ☐ Always ☐ Don't know how to

13. At what temperature do you set the wall thermostat? (If applicable)

☐ <18 ☐ 18 ☐ 19 ☐ 20 ☐ 21 ☐ 22 ☐ 23 ☐ 24 ☐ >24 ☐ N/A

14. Average amount of monthly bills paid:

(a) for gas **(b) for electricity**

15. How do you pay your bills?

☐ Prepayment meter ☐ Direct debit ☐ When it arrives

16. Do/did you receive any energy advice?

☐ Yes ☐ No

17. If yes, who from/ what about?

18. Would you like help/advice on how to cut energy bills more?

☐ Yes ☐ No

19. If yes, what format do you prefer to receive energy advice?

☐ Written e.g. leaflet
☐ Visual e.g. pictures, video
☐ One to one support/visit
☐ Electronically e.g. email, website

20. Home appliances owned (number of each)

☐ Electric cooker	☐ Gas cooker	☐ Fridge	☐ Freezer
☐ Tumble dryer	☐ Dishwasher	☐ Washing machine	☐ Fridge/freezer
☐ Electric heater	☐ Boiler	☐ Electric kettle	☐ Toaster
☐ Television	☐ Sat/cable	☐ Microwave	☐ DVD player
☐ Computer/laptop	☐ Hi/Fi stereo	☐ Games console	☐ Energy saving lamps
☐ Hair dryer	☐ Slow cooker	☐ Power down	☐ Vacuum cleaner

21. As part of your lifestyle, do you do any of the following?(1 is never, 5 is always)

	1	2	3	4	5
Watch TV more than 3hrs/day	☐	☐	☐	☐	☐
Use your laptop/pc	☐	☐	☐	☐	☐
Go for a walk	☐	☐	☐	☐	☐
Sports/exercise	☐	☐	☐	☐	☐
Go cycling	☐	☐	☐	☐	☐
Read a book	☐	☐	☐	☐	☐
Attend church (or other)	☐	☐	☐	☐	☐
Environment volunteering	☐	☐	☐	☐	☐
Community work	☐	☐	☐	☐	☐
Help at the local school	☐	☐	☐	☐	☐

22. Would you be interested in volunteering to help improve your local community?

☐ Yes ☐ No

23. Do you do any of the following actions?(1 is never, 5 is always)

	1	2	3	4	5
Try using less gas and electricity	☐	☐	☐	☐	☐
Turn down heating	☐	☐	☐	☐	☐
Make more use of programer	☐	☐	☐	☐	☐

Heat occupied rooms only	☐	☐	☐	☐	☐
Turn off unwanted lights	☐	☐	☐	☐	☐
Use fluorescent light bulbs	☐	☐	☐	☐	☐
Unplug unused equipment	☐	☐	☐	☐	☐
Replace inefficient equipment	☐	☐	☐	☐	☐
Wash clothes at lower temp.	☐	☐	☐	☐	☐
Set hot water thermostat lower	☐	☐	☐	☐	☐
Boil only water needed in kettle	☐	☐	☐	☐	☐
Recycle your home waste	☐	☐	☐	☐	☐
Use compost bins	☐	☐	☐	☐	☐
Cycle more	☐	☐	☐	☐	☐
Drive less	☐	☐	☐	☐	☐
Use more public transport	☐	☐	☐	☐	☐
Avoid travelling by plane	☐	☐	☐	☐	☐

24. If so, what is the reason(s) for taking these actions?

☐ Save money ☐ Save energy ☐ Due to habit ☐ Environment concern ☐ Other (.....)

25. Would you be interested in learning about other money saving tips?

☐ Yes ☐ No

26. How is your health in general?

☐ Very good ☐ Good ☐ Fair ☐ Bad ☐ Very bad

Section 3: Expectations from Aspley Super Warm Zone scheme

27. Do you know about Aspley Super Warm Zone scheme?

☐ Yes ☐ No

28.33. If yes, how have you heard about it?

☐ Neighbours ☐ Visited show home ☐ Information leaflets ☐ Warmth champions
☐ Other (.....)

29. What do you understand the programme to be about?

The main aim of the scheme is to ensure a significant reduction in household fuel bills and improve energy efficiency by improving the building envelope.

30. What do you think of this kind of scheme? (tick all that apply)

☐ Good to improve my home ☐ Interfering
☐ Good for the environment ☐ Useless
☐ Good to reduce my energy bill ☐ Don't know

31. Are you considering signing up for this programme?

☐ Yes ☐ No ☐ Don't know

32. If yes, what do you anticipate from joining Aspley Super Warm Zone scheme? (1 is least likely, 5 is most likely)

	1	2	3	4	5
Pay less on energy bills	☐	☐	☐	☐	☐
A warmer home	☐	☐	☐	☐	☐
Improved home conditions	☐	☐	☐	☐	☐
Add value to the property	☐	☐	☐	☐	☐
Reduce CO2	☐	☐	☐	☐	☐
Doing sthg good for the env.	☐	☐	☐	☐	☐

33. If not, what is the reason(s) for not considering signing up to the scheme?

☐ Ill health ☐ Don't think it is effective ☐ Have already had home renovations
☐ Don't want the disruption ☐ Other (please specify) .....

34. What would help you change your mind?

☐ More technical info. ☐ More hands-on info. ☐ More physical help and support
☐ Guarantee of workmanship ☐ Other (please specify) .....

35. How are you prepared to pay towards insulating your home to protect yourself against fuel price rises?

☐ Not prepared to pay ☐ Up to £250 ☐ £250-500
☐ £500-1000 ☐ £1000-2000 ☐ More than £2000

Section 4: Basic information

36.English first language?

☐ Yes ☐ No

37.Members of the household

☐ Infants (<3yrs) ☐ Children (3-12yrs)
☐ Teenagers (12-19) ☐ 19-25yrs
☐ 25-35yrs ☐ 35-50 yrs
☐ 50-65 yrs ☐ >65yrs

38.Employment activity (number of each)

☐ FT employment ☐ PT employme
☐ Self-employment ☐ Unemployed
☐ Disability/ill-health ☐ Retired
☐ Full-time carer ☐ Student

39.Total income of household

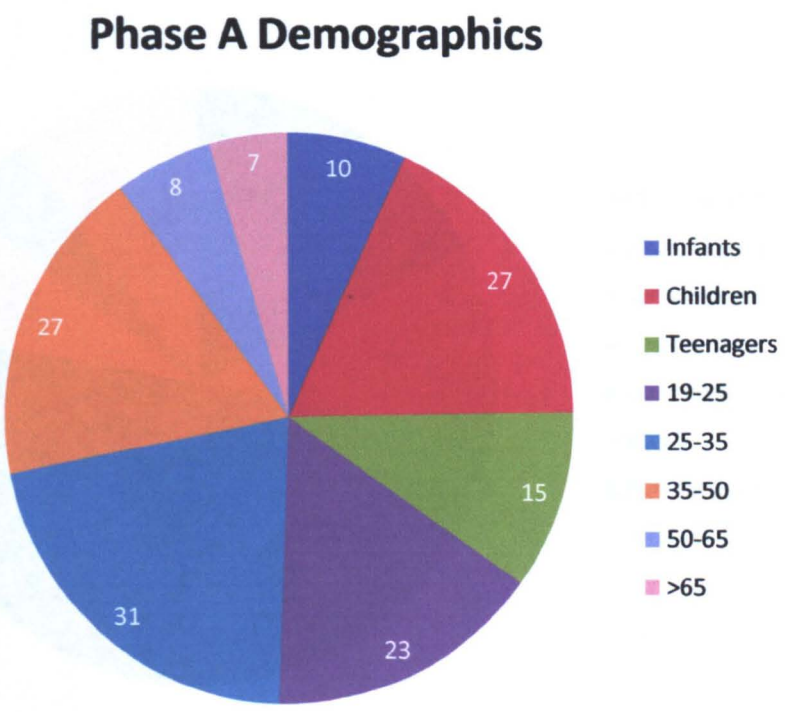
☐ <12K ☐ 12-20K
☐ 20-30K ☐ 30-50K
☐ >50K

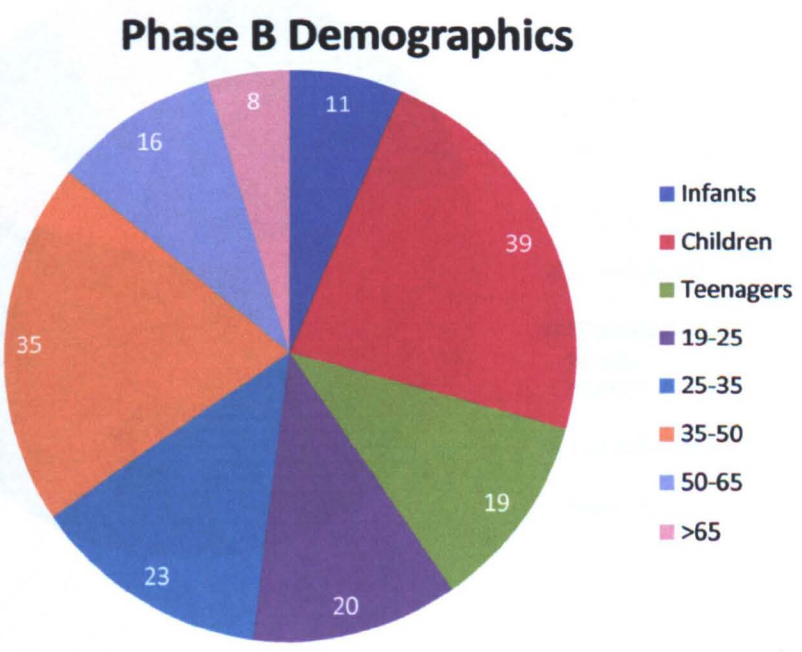
40.Number of cars owned by household?

☐ None ☐ One
☐ Two ☐ More

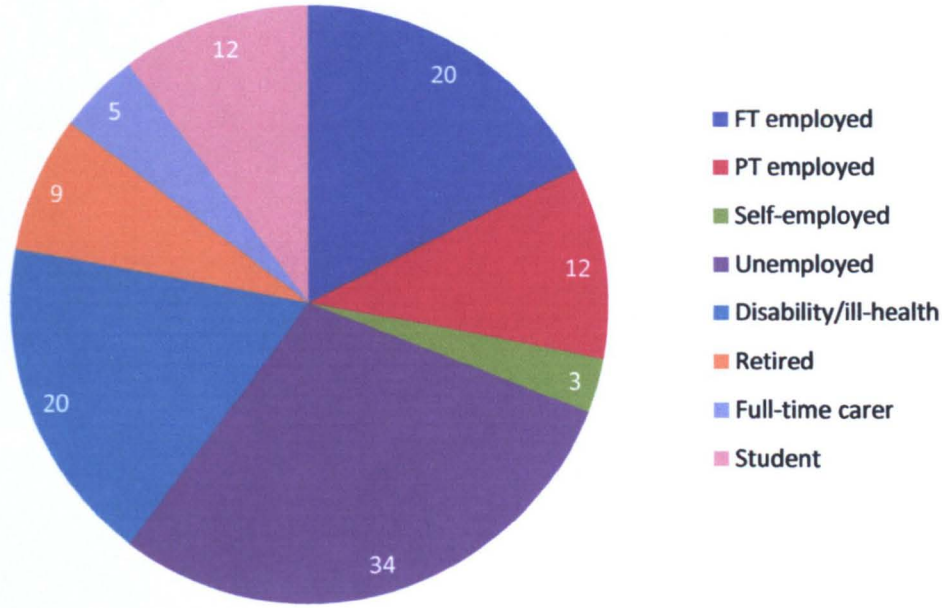
Thank you for your time

Appendix H: Socio-demographics of samples A and B





Phase A Employment activity



Phase B Employment activity