Reducing Carbon Emissions by Households: The Effects of Footprinting and Personal Allowances

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Submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

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May 2009.

Abstract

Nearly half of Britain's carbon dioxide emissions result from the activity of households, both within the home and from personal transport. This research examines how the carbon dioxide emissions of households can be reduced, particularly through the calculation of carbon footprints and testing the public's reaction to the concept of personal carbon allowances (PCAs). Two data collection stages were used - a postal survey providing quantitative data, followed by semi-structured interviews producing mainly qualitative data. The research was carried out in a largely rural district which is run by a council noted for its work on sustainable energy, Newark and Sherwood. The survey looked at PCAs as well as a variety of contemporary issues that might influence household footprints such as energy efficiency grants and information, as well as relationships with gas and electricity suppliers. Each interview involved the calculation of a household carbon footprint, the identification of measures to reduce it, and the gathering of attitudes about personal carbon allowances, in order to identify challenges and opportunities with respect to reducing household carbon emissions. Support for PCAs was higher than anticipated, and tended to be associated with those who were prepared to use public transport or cycle more, or were supportive of renewable energy in homes. Interviewees had much to say about individual carbon reducing measures. Opposition was associated with those who envisaged that they would be unlikely to sell carbon units. Regarding personal transport, long commutes were common, and the cost of public transport was of concern. Specific findings were made about domestic heating, insulation, lighting, refrigeration, water use, commuting, public transport, and rail as an alternative to short-haul flights. There was more interest in monetary savings than carbon savings. Recommendations about policy and regarding further research are made.

Contents

List of tables

List of figures

Acknowledgements

There are many people I need to thank for their help and support in conducting this research and writing this thesis, and I can list only some of them here.

Considerable thanks go to David Pickles OBE and his team at the energy agency at Newark and Sherwood District Council, who have done much to inspire and support this research, as well as to obtain financial support. This project was a EPSRC CASE studentship, organised through INREB (Integrating New and Renewable Energy in Buildings) scheme, based at BRE, with Pilkington Energy Efficiency Trust providing financial support.

Obviously I am very grateful to Professor Paul Fleming, Dr Andy Wright and Dr Katherine Irvine for their dedicated supervision of the process (and Dr Nick Eyre, Dr Mark Lemon and Dr Birgit Painter for their examination of my work).

Many of my current and former IESD colleagues (and friends) could be mentioned and I give here only a small number of them. I am indebted to Andrew ‘Reevesie’ Reeves for a variety of things, including helping me find somewhere to live and introducing me to a network of great people. Graeme Stuart deserves a mention for encouraging me to keep going. The establishment of PRSA (Postgraduate and Research Students’ Association) came at a very important time for me, and I thank those involved from all parts of De Montfort University, with particular thanks to Maria ‘Masha’ Mogilnaya.

Needless to say I thank my mother, father and siblings for their encouragement, love and support on my long road to achieving a ‘fiddly-D’.

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1 Introduction

This thesis describes a research project, known as RedHENS (Reducing Household Emissions in Newark and Sherwood). This introduction gives a background to the research and then sets out the research objectives.

1.1 Carbon emissions - the international context

Most energy demands are satisfied by burning fossil fuels (coal, oil and gas) which results in the emission of carbon dioxide. The Intergovernmental Panel on Climate Change (IPCC 2007a) states that the international understanding of human-induced influences on climate has improved, leading to very high confidence that the global average net effect has been one of warming. The concentration of carbon dioxide in the atmosphere has increased markedly as a result of human activities since 1750. It now far exceeds pre-industrial values, as determined from ice cores spanning thousands of years. This is due primarily to fossil fuel use and land use change. IPCC conclude that warming of the climate system is unequivocal, as evidenced by increases in average air and ocean temperatures, melting of snow and ice, and rising sea levels. Most of the increase in global average temperatures since the mid-twentieth century is very likely to be due to the increase in human-induced greenhouse gas concentrations. The measurable human influences extend to ocean warming, continental average temperatures, temperature extremes, wind patterns and other aspects of climate (ibid).

Most countries have joined the international treaty known as the United Nations Framework Convention on Climate Change (UNFCCC) to consider what can be done to mitigate and adapt to climate change. Some nations have approved an addition to the treaty known as the Kyoto Protocol, which sets binding targets for 37 industrialized countries and the European Union to reduce greenhouse gas emissions. These amount to an average 5% reduction against 1990 levels by the period 2008-2012. The Conference of the Parties (COP) meets regularly to discuss what should be done beyond that time (UNFCCC 2008).

1.2 The UK's role in causing and mitigating carbon emissions

The United Kingdom has taken a leading role in raising awareness of the need to mitigate climate change. In 2000, the Royal Commission on Environmental Pollution

recommended that UK carbon dioxide emissions be reduced by 60%, of the then current level, by 2050 (RCEP 2000), an idea that was groundbreaking, both nationally and internationally, at the time. It set a precedent which was to dominate the thinking on climate change mitigation for several years. The most significant aspect of the debate about this recommended target was that it might be insufficient, and that an 80% cut was necessary to avoid dangerous climate change. In 2006, the Treasury published the Stern Report, which projected the economic effects of climate change. It concluded that failing to tackle climate change would have serious economic consequences, but that the cost of mitigating climate change was low in terms of effect on economic growth (HM Treasury 2006). In November 2008, the Climate Change Act became the first legislation anywhere in the world to oblige a government to comply with legally-binding reduction targets regarding a nation's greenhouse gas emissions.

Almost simultaneously, the Climate Change Committee (CCC) advised the government that, under the Act, the long term target (to 2050) should be for a cut of 80% in greenhouse gas emissions, rather than the original recommendation of 60%. This more ambitious target translates into 77% below 2005 levels. The target for 2020 is to reduce emissions by 31% relative to 2005, or 21% in the absence of an international agreement. Additionally, the CCC has advised the Government on the first three 'carbon budgets' to 2022, including suggested contributions from the traded and non-traded sectors (CCC 2008). The non-traded sector is that outside the EU Emissions Trading Scheme (see section 2.7) which generally covers heating as well as transport, whereas the traded sector covers large users of energy, with electricity generation being of particular significance. The government's 2009 Budget announced that it will set the reduction, against 1990 levels, across the first three carbon budget periods, at 34% (HM Treasury 2009). A target of a 16% reduction of greenhouse gas emissions (by 2020 against 2005 levels) has been proposed by the European Commission for the non-traded sector, and 21% for the traded sector (DfT 2008b).

Carbon emissions by households, from the home and in personal transport, constitute almost half of all carbon emissions in the UK, with emissions from homes being about one and a half times of those from personal transport (DEFRA 2007d, Hillman and Fawcett 2004, ONS 2004)

1.3 The role of homes in producing carbon emissions

The contribution of residential buildings to climate change is internationally recognised (IPCC 2007b). The age and type of a home have a strong influence on its energy efficiency and thus carbon emissions. Older housing tends to be less fuel efficient, and around a fifth of Britain's dwellings were built before 1918 (BRE 2006a: p.10). Due to improved building standards, energy efficiency is better in newer housing (Verbeeck and Hens 2005). Current standards of construction for England and Wales are defined in Part L of the Building Regulations (CLG 2006a) which are applicable where new homes are built or existing homes are modified. Fuel consumption varies (and therefore carbon emissions vary) according to home tenure (owner occupied, social housing, etc) and built form (such as detached house, purpose built flat, etc). It also tends to rise with floor area (BRE 2005b). Other contributory factors are household income, occupant age and region (BRE 2005c).

Tackling home carbon emissions gives economic, social and environmental benefits, thus addressing all three branches of sustainable development (Goodacre et al 2002). Socially, reducing fuel poverty (DEFRA 2008d), thus making homes warmer and mitigating health problems, is a major consideration. Economically, if fuel costs are lowered, the household income situation will improve, generally leading to more spending locally. Employment is also created through making energy efficiency improvements in homes (ACE 2000).

The energy efficiency of homes is improving, but only slowly (DEFRA 2008g, BRE 2005c: p.13, ODPM 2005: p.8). A variety of energy efficiency measures are used to increase the energy efficiency of homes and thereby reduce carbon emissions. The cost and payback (in both carbon and financial terms) of these measures are often documented (CLG 2006d) but the availability of 100% or partial grants complicates the calculation of financial savings. The measures generally considered to be cost effective and worth subsidising for homes include cavity wall insulation, loft insulation, draught proofing of doors and windows, and installation of hot water tank jackets and low energy (compact fluorescent) light-bulbs.

Research has shown that higher subsidies will improve the take up of energy efficiency measures (Shorrock 1998). The main energy efficiency grant schemes in England for private sector housing, are WarmFront and the Carbon Emissions Reduction Target

(CERT). One of the key challenges in the field of home carbon emissions reductions is how to find the people and properties, especially in the owner-occupied and privately rented sectors, that need energy efficiency improvements (EST 2004b) and how to persuade occupants to take improvements (Armstrong et al 2006). There is a variety of methods of referral.

1.4 The role of personal transport in producing carbon emissions

Although the number of domestic transport journeys has not risen greatly since 1970, the average length of a journey has (DfT 2008b: p.12). Trends in bus use are not positive, with growth in London but decline elsewhere in England, meaning that the government is likely to fail against its 2010 targets as set out in the Ten Year Transport Plan in 2000 (NAO and Audit Commission 2005). The MARKAL model (DfT 2008b: p.109), as used in projections for the Energy White Paper (DTI 2007a), shows opportunities for emissions reductions from transport in excess of those for the residential sector, if long term plans for transport technology and the transport system are put in place soon. However the DfT projections for the period to 2020 show a domestic transport emissions reduction of 5% at most (DfT 2008b: p.107).

The policy of the UK government on aviation is accused of being at odds with policy on climate change, and emissions from flying are projected to rise. Bows and Anderson (2006) found that in 2004, the UK's aviation industry emitted an estimated 9.8 mega-tonnes of carbon (MtC), and that this is projected to rise to 16 to 21 MtC by 2030. They questioned whether projected aviation growth can be reconciled with the UK Government's carbon-reduction target (which, at that time, was 60%, rather than 80%, by 2050) and concluded that the Government must urgently address the problem.

Oxford ECI (2006) drew attention to the fact that the Aviation White Paper supports a major expansion in air passenger movements from about 200 million in 2003 to about 470 million in 2030. The report concluded that the Government needed to explore policies for managing demand for air travel including challenging the expansion of UK airport capacity. For the longer term, more 'radical' solutions, such as personal carbon allowances, were suggested.

1.5 Local authorities and the work of Newark and Sherwood District Council

The Nottingham Declaration, launched in 2000, recognises the potentially significant role of local authorities (councils) in leading the response to climate change. By signing the declaration councils pledge to address the causes of climate change (EST 2008e). However progress on the issue is variable and the role of local authorities is still largely undefined. The Centre for Sustainable Energy (CSE) found that progress of 386 local authorities on domestic energy efficiency was not impressive, with 45% classified as weak and 45% as fair. On transport, including local transport plans, 25% were weak and 55% were fair regarding climate change (CSE 2005).

This research (RedHENS) was conducted mainly in Newark And Sherwood District (NSD). In 1997, Newark and Sherwood Energy Agency (NSEA) was established by Newark and Sherwood District Council (Association of UK Energy Agencies 2008). An important activity for the agency has been to evangelise on the household emissions within the district. An average Newark and Sherwood household was modelled in a project known as ‘Newark & Sherwood District householder global warming liabilities’. It covered carbon emissions resulting from energy use in the home, from car and airline use, water and sewerage, and solid waste (NSDC 2004b). Such an expression of carbon emissions is known as a ‘carbon footprint’.

1.6 Information, attitudes and behaviour

The Australian Greenhouse Office recognises that energy saving behaviours are influenced by one or more of a number of drivers including attitudes, money, information, other people, and market manipulation (AGO 2000). However, Kollmus and Agyeman (2002) find that there is a gap between attitudes and actions (behaviour) on environmental matters, and comment that no definitive explanation has yet been found for it.

There is a variety of information sources for the public to use to help reduce the carbon emissions by their households, including the Energy Saving Trust and its local outlets, the government’s DirectGov website and its national journey planning tool Transport Direct (2008), local authorities (councils), gas and electricity suppliers, various retailers and the energy labels on the products they sell (such as cars, fridges and lightbulbs).

However, Demos and Green Alliance (2003) state that information does not necessarily lead to increased awareness, and increased awareness does not necessarily lead to action. In examining how behaviours can be influenced, LogicaCMG (2007) found that while consumers are environmentally conscious, costs are more important when it comes to influencing energy consumption.

Reduction in carbon emissions are not always fully realised from energy efficiency improvements. There are various possible reasons for this. Regarding heating, measures may not be installed properly (the predictions assume perfect installation). The predicted improvements also usually assume that the home was adequately heated in the first place. Some beneficiaries will spend some of their 'savings' on increased comfort take-up (Martin and Watson 2006). This is an example of the 'rebound effect' (POST 2005, UKERC 2007a). Some effects are direct, in that if energy effectively becomes cheaper (as a result of having a more energy efficient home), more of the service that the energy provides will be consumed (the home is heated for longer or to a higher temperature). The same effect can occur when a more fuel efficient car is driven further than a previously owned less fuel efficient one. Other rebound effects are indirect, and result from the savings made on heating or other fuel bills being spent in ways which involve carbon emissions, such as holidays involving flying (UKERC 2007a). Thus a household's overall carbon emissions may not be lowered significantly, or lowered at all.

Reducing a household's overall carbon emissions - or 'footprint' - faces another challenge. People may assume environmental behaviours and measures are equivalent, and pick one or two easy ones to do and then consider their environmentally obligations satisfied (CAT 2007a).

1.7 Carbon footprinting and allowances

The concept of a 'carbon footprint', as an expression of the total carbon emissions of a person, household, company, product or other entity, is becoming more widely known. The summation of emissions caused in a variety of ways (from energy use in buildings, fuel used in cars and aircraft, etc.) is usually implicit in the term. In the Spring of 2007, the UK government launched an on-line carbon footprint calculator called Act On CO2 (DEFRA 2007b). The calculator allows users to calculate their footprint in tonnes of carbon dioxide, as a result of home energy use, and journeys by car and airlines. Act

On CO2 was a relative latecomer, as there were already a number of UK and international on-line calculators (Bottrill 2007).

The concept of personal carbon rationing is receiving more attention. Variously called domestically tradable quotas (DTQs) and later tradable energy quotas (TEQs) (Fleming 2007), or personal carbon allowances (PCAs), such a system would encourage individuals to attempt to keep their carbon footprint within a per capita allowance of emissions, which would reduce year by year. Every person would receive an equal allocation. Excess units would be sold to those who exceed their allowance. The allowance would cover carbon dioxide emissions from household energy use, fuel for cars and airline flights (Bottrill 2006, Tyndall 2005). From here onwards in this thesis, the term personal carbon allowances (PCAs) is generally used.

There are a number of existing and proposed schemes which can be considered alternatives to a system of personal carbon allowances. Most of the proposals do not cover all the sectors that PCAs would, i.e. home energy use, car use and flights. Even where there are complementary systems for these different sectors, no account is taken of the overall footprint of an individual or a household. Taxation, which can be described as carbon taxes, already exists on home fuel and car fuel but only to a very limited extent on airline flights.

1.8 Research objectives

With mounting evidence as to mankind's effect on the climate, and the UK taking a leading role in setting future ambitions to reduce carbon emissions, the potential role of households in mitigating emissions, both from the home and in personal transport, is significant. There are a variety of measures to reduce personal and household carbon emissions. However, as provision of information and the influencing of attitudes have only weak effects on behaviours and the actual carbon emissions of households, carbon footprinting and rationing appear to be viable means of achieving reduced emissions. In the light of the work by Newark and Sherwood District Council on householders' global warming liabilities, the aim of this research was to address the question "How can carbon emissions by households be reduced?" and the objectives of the research were as follows:

- To identify the opportunities for people to reduce their household carbon footprints, and the barriers that prevent them from doing so;

- To understand how organisations such as councils and energy suppliers can help people to reduce their carbon emissions;
- To explore people's attitudes towards personal carbon allowances (PCAs).

The research, which was multi-disciplinary in nature, was conducted primarily in a rural area of Nottinghamshire in England. It was supported, influenced and sponsored by the local authority for that area, Newark and Sherwood District Council (NSDC). NSDC and its energy agency are noted for work on sustainable energy.

1.9 Structure of this thesis

The structure of this thesis is as follows. Following this introductory chapter, chapter 2 gives further background to the project, reviews the relevant literature, and provides additional justification for the research. Chapter 3 examines the range of data collection methods available for the research. The fourth chapter describes the methodology of the first data collection stage, a postal survey of residents, and Chapter 5 gives the results, which are discussed. There are then three chapters describing the second data collection stage, semi-structured interviews of householders in their homes. Chapter 6 describes the methods used in interviewing, Chapter 7 gives an overview of the results, and Chapter 8 gives the results in detail. Chapter 9 discusses results from both stages of data collection. The tenth and concluding chapter re-iterates the main research findings, reviews the success of the research, and summarises the policy recommendations and recommendations for further research.

2 Literature review

This chapter sets the context for the RedHENS research by reviewing literature in the field. Literature on methods is reviewed in the next chapter and then in more detail in the relevant data collection methods chapters. The reader will also find detailed examination of relevant literature in later chapters, where results and findings from the RedHENS project are compared with other research. This thesis covers a rapidly developing field. Every attempt has been made to make it up-to-date as of April 2009.

The chapter starts by looking at the extent of carbon emissions caused by the activities of individuals and households. Emissions from homes are then examined in detail, including policy and legislation, actors in the field of work, local authority activity in the area (especially that by Newark and Sherwood District Council), gas and electricity suppliers, energy efficiency measures and grants, and new homes. The next section looks at carbon emissions from personal travel, both surface transport and flying, followed by a section looking at sources of information that individuals and households can use to find out how to reduce their carbon emissions. There are then sections on attitudes and behaviours relating to reducing carbon emissions, on carbon footprinting and calculators, and on personal carbon trading. Finally, the research questions are given, and the research methods are introduced.

2.1 Carbon emissions by households

This thesis concerns itself with carbon emissions by households. The term ‘household’, as used here, refers to the occupants of a home and their carbon emitting activities beyond it, not just the emissions occurring within the physical structure that is the home itself. Electricity use in the home generally causes emissions of carbon dioxide to take place elsewhere, in power stations, but in this context the emissions are assumed to take place in the home. Emissions by households outside the home are dominated by personal transport.

The UK’s carbon dioxide emissions fell from 582 million tonnes in 1990 to 554 million tonnes in 2005, with estimated figures showing a small rise to 561 MT in 2006. Of these, the figure for emissions from the home was virtually unchanged (157 MT in 2005, up from 154T), reflecting a greater number of homes which are each emitting

less carbon dioxide on average. However transport (including freight) was up from 134 to 153 million tonnes. In the same period, emissions from industry fell considerably from 192 m tonnes to 155 m tonnes, and ‘other end users’ from 112 to 99 m tonnes (DEFRA 2007d: pp. 28-29). The DTI Emissions Projection (2005-2020) estimates the domestic sector will not have radically different energy demand by 2020 but transport energy demand is predicted to grow by around a quarter (Lords 2005: pp. 20-22).

Various figures are available quantifying greenhouse gas emissions by households and their occupants. At the individual level, Hillman and Fawcett (2004: p.155) indicated that ‘carbon emissions’ in 2002 approximated 10.7 tonnes of carbon dioxide per person per annum, assuming all adults and children are treated equally. Of those 10.7 tonnes, 50%, or 5.4 tonnes, are considered direct personal emissions, i.e. those which are as a result of energy use in the home and from personal transport, including public transport. This includes non-carbon greenhouse gas emissions from aircraft expressed in carbon dioxide equivalent terms. The other emissions are those caused by manufacturing, services, the public sector and all other aspects of the economy.

The Office for National Statistics (ONS 2004) gives statistics for greenhouse gas emissions by whole households, giving a UK average of 24.6 tonnes per annum in 2001. It defines greenhouse gases as carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. Per person emissions have been calculated, for carbon dioxide only, at 4.483 tonnes p.a. (DEFRA 2007b: p.20).

The ONS greenhouse gas emissions figures vary by region, but the East Midlands, at 24 tonnes, upon which this thesis is focussed, is very close to the UK average, with the lowest being Yorkshire at around 22 tonnes and the highest Northern Ireland at about 31 tonnes per household. It is notable that the East Midlands figure breaks down into about ten tonnes for transport and home energy use (about four tonnes for the former and six tonnes for the latter) and fourteen tonnes for ‘final demand for other goods and services’. This proportional breakdown is reflected in most regions of the UK but is derived from spending analyses from other government sources, rather than direct measurement (ONS 2004).

Thus ONS consider a higher proportion of emissions are not directly from households, and are instead caused indirectly through purchases, and through the activities of government and business, etc., divided amongst the population. Part of the explanation is that water vapour emissions, which are considered a greenhouse gas if emitted by aircraft at a high altitude, are excluded (from the 'transport' heading), and that carbon emissions from public transport are included under the 'final demand for other goods and services' heading rather than the 'transport' heading.

There is much variety in the quantification of emissions by households. Firstly there are the two physical substances used for measurement, and figures for all greenhouse gases are frequently converted to equivalents in these substances - either carbon equivalence or the more common carbon dioxide equivalence, both typically measured in kilograms or tonnes. Emissions expressed in tonnes of carbon equivalent can be converted to tonnes of carbon dioxide equivalent by multiplying by 3.67 (Hillman and Fawcett 2004: p.147). Some figures are for all greenhouse gases whereas some are for only carbon emissions, in other words, carbon dioxide, and methane, thus excluding other greenhouse gases like nitrous oxide. More specifically, some figures are for carbon dioxide only, particularly in the context of the use of fossil fuels or electricity or in the context of surface transport. A very common exclusion from emissions figures is of water vapour from aircraft at altitude. Sometimes aircraft emissions figures exclude all greenhouse gases other than carbon dioxide, partly because of the continuing uncertainty as to the relative effects of these other gases in carbon dioxide equivalent terms (Oxford ECI 2006: pp.16-17). As the ONS statistics show, emissions are often divided between direct personal (or household) emissions and indirect emissions. A key reason for this is that at an individual or household level, it is easier to measure direct emissions, as quantities of fuel such as gas, petrol and electricity can be easily converted to quantities of carbon dioxide.

This thesis is confined to consideration of direct carbon dioxide emissions by households. The lack of available information, research and methodologies regarding the 'embodied' energy or carbon emissions of the products and services that individuals and households buy (other than gas, electricity, oil, petrol and diesel, and airline flights) precludes its inclusion in the RedHENS project.

Methane is a potent greenhouse gas, and a molecule of methane containing one atom of carbon has approximately twenty one times the climate change or global warming potency as a molecule of carbon dioxide, also containing one carbon atom (ONS 2004: p.7). Methane is produced primarily in agriculture, which is outside the domain of direct personal or household emissions. A notable 'personal' source of methane is (solid) waste, produced by households, being disposed of into land-fill sites. The subject of waste reduction receives extensive policy attention, particularly the recent growth by English local authorities, of kerbside collections of recyclable wastes, as well as composting schemes, methane recovery from landfill sites (for electricity generation), and incineration of waste (in some cases used to generate heat and electricity). Thus methane emissions are not directly covered by this thesis, although related contemporary issues, such as recycling, are inevitably a pre-occupation of the public (Carbon Neutral Newcastle 2005: p.18, DEFRA 2007a: p.29).

One can conclude that radical policy measures are required in tackle carbon emissions by individuals and households, while climate science and emissions targets point to the need to reduce emissions drastically.

2.2 Carbon emissions from homes

Thermal insulation levels and the efficiency of heating systems have a strong influence on home carbon emissions, especially from heating. In England and Wales, a home's energy performance is calculated using the SAP or Standard Assessment Procedure (BRE 2005a) and expressed through a number of indicators, the most important being the 'SAP rating'. The indicators are based on energy used for space and water heating, ventilation and lighting, minus savings from energy generation technologies. The main rating is adjusted for floor area and expressed on a scale of 1 to 100, the higher the rating, the lower the running costs). The National Home Energy Rating (NHER) ranging from 0.0 to 10.0, is also commonly used to express the energy efficiency of homes (NHER 2007).

The policies on household energy efficiency and carbon emissions vary to some extent between the nations of the UK, and this thesis focuses on England. It is a challenge to describe the policy and legislation in this area, as it has recently been in a state of flux and development. White papers, such as the Energy White Paper (DTI 2007a), are used to express the government's intentions, these often being preceded by public

consultations. Policy often requires little or no legislation in order to implement it, with Acts of Parliament often only providing specific legal powers at the detail level.

Domestic carbon emissions can be viewed somewhat differently according to whether a household is fuel poor or fuel rich. A UK household is defined as fuel poor if it needs to spend more than ten per cent of its income on fuel for use in the home (DEFRA 2008d). For fuel poor homes, the emphasis is upon social inclusion such as reducing impacts on health, and upon economic issues such as increasing as much as possible occupants' limited spending powers, although environmental considerations are also present. Climate protection and reducing carbon emissions are of greater importance when dealing with everyone else, referred to as the 'fuel rich'.

In the Autumn of 2008, a new government department, the Department of Energy and Climate Change, was created. It absorbed the relevant functions of the Department for Business Enterprise and Regulatory Reform (BERR, previously known as the Department of Trade and Industry or DTI) and Department for the Environment, Food and Rural Affairs (DEFRA). Before the merger, a key aim for DEFRA, agreed in a public service agreement with the Treasury, was to lead global efforts to avoid dangerous climate change, assisted by BERR and the Department for Transport (DfT). DEFRA also managed the Climate Change Programme (CCP) (DEFRA 2006a), which had specific coverage of carbon emissions from the domestic and other sectors. Meanwhile BERR had overall responsibility for energy policy, and had a departmental strategic objective (DSO) to 'ensure the reliable supply and efficient use of clean, safe and competitively priced energy'. They conducted the Energy Review (DTI 2006) and later published the Energy White Paper (DTI 2007a) which covered such energy policy issues as saving energy, heat and distributed generation, transport, and energy security.

A variety of carbon reduction and related targets exist in different forms in government policy, in addition to those discussed in section 2.1. The Energy White Paper featured a goal of a 20% reduction in carbon dioxide emissions on 1990 levels by 2010. The UK Energy Efficiency Action Plan 2007 (DEFRA 2007c) featured a 9% energy saving target, by 2016, in response to European Union's Energy End-Use Efficiency and Energy Services Directive. BERR's DSO contained a target to reduce carbon dioxide emissions by 60%, from 1990 levels, by 2050. Later two closely related and historically

significant events were to overshadow all previous targets - by the beginning of December 2008, the Climate Change Bill had received its Royal Ascent, and the Committee on Climate Change published its targets (CCC 2008).

Communities and Local Government (CLG) is the government department that has responsibility for local government and housing, which are two key channels in tackling carbon emissions from homes and households. Local government has responsibility for providing a large proportion of social housing, usually referred to as council housing. Other 'social housing' is provided by housing associations, for which CLG also has responsibility. CLG is also responsible for the Building Regulations which are enforced by local authorities, and which affect the energy efficiency of new buildings and of buildings being extended or refurbished (CLG 2006a). CLG commissions the English Housing Survey (EHS) (CLG 2008a) which collects information about the state of the housing stock, including its energy efficiency.

The Energy Saving Trust (EST) is the public's source of free advice on saving energy and choosing greener ways of travel, as well as on conserving water, reducing waste and generating renewable energy, with the intention of reducing carbon dioxide emissions (EST 2008f). EST also assists local authorities, housing providers and the building trade. It has numerous publications including extensive best practice guides (EST 2008g). The trust has a network of regional Energy Saving Trust Advice Centres or ESTacs which act as outlets for their services (previously there were sub-regional Energy Efficiency Advice Centres or EEACs).

The Energy Efficiency Partnership for Homes is based at the Energy Saving Trust and is a network of over 400 organisations from the public, private and voluntary sectors, working to reduce the energy consumed in UK homes. It does not provide advice directly to the public but "is the only body that pulls together all the stakeholders in the supply chain to drive forward the effective delivery of energy saving products and services to household consumers UK-wide" (EEPH 2008a).

2.2.1 Local authority work on household carbon emissions

The role of local government in the reduction of carbon emissions by households is multi-faceted. In 1995, the HECA or Home Energy Conservation Act (OPSI 1995) set a target for local authorities to reduce energy consumption from homes against 1990

consumption levels. Every year local authorities that are designated Energy Conservation Authorities (ECAs, i.e. the districts in shire counties, and all London, metropolitan and unitary authorities) are obliged to report progress against a target of improving the energy efficiency of pre-1995 constructed private housing by 30%, by 2010.

Many local councils have active household energy efficiency teams, encouraging householders to take up energy efficiency grants. Until recently, many EEACs were run by local government albeit with Energy Saving Trust funding. Most of these have been replaced by ESTacs, which local authorities still have a significant involvement in. Local authorities also have powers under the Housing Health and Safety Rating System (HHSRS) which has relevance to home energy efficiency (SWEA 2006).

Local authorities directly or indirectly own much social housing, and as part of the Decent Homes programme, have improved its energy efficiency. They also have many responsibilities in highways and public transport (covered in section 2.3), spatial planning, and enforcing building regulations, all of which effect carbon emissions by households.

Given the generally unimpressive progress by local authoritative on climate change issues (CSE 2005), the Centre for Sustainable Energy responded to the situation by providing tools for local authorities in the form of management matrices, two of which are relevant to household carbon emissions - domestic energy efficiency, and transport (CSE 2006). A likely explanation for the lack of local authority activity in the area is shortage of funding, as well as the lack of legal obligation to act. The Energy Saving Trust summarised funding opportunities but overall they are not substantial (EST 2007a).

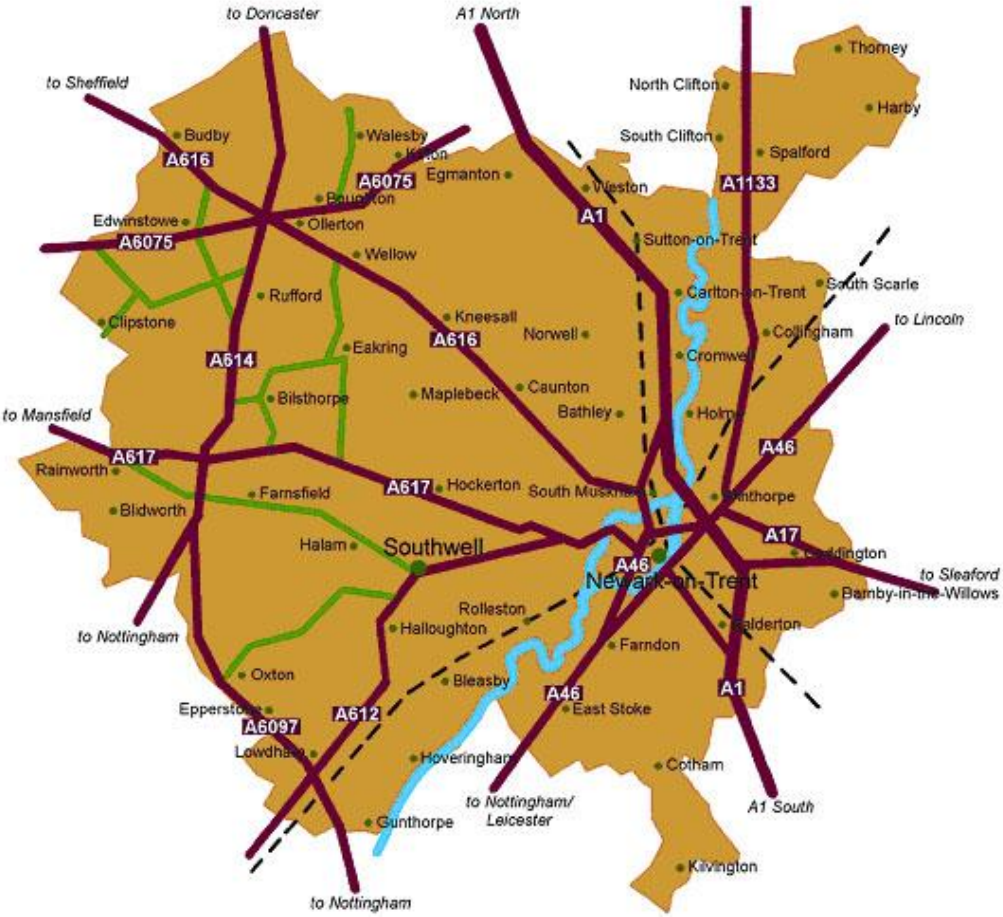
Local authorities are not lacking general powers to make progress in this area. Wade et al (2007), in looking at the energy actions of local government, describe how the Local Government Act 2000 gives councils powers relating to well-being of the public in all three aspects of sustainable development, namely economic, social and environmental. Allman et al (2004) found that local authorities that lead on climate change tend to face different problems to other councils, the former facing problems such as lack of appropriate powers, whereas the rest fail to find motivation internally.

The launch by the Local Government Association (LGA) of its Climate Change Commission will go some way towards countering such inertia (LGA CCC 2007). Local authorities may now have some motivation to act on climate change, through the local authority national indicators (NIs) enshrined in the new performance framework (CLG 2007c). Councils chose 35 from the 198 NIs including to be measured on. The two most relevant to carbon emissions from homes are NI 186 which measures per capita carbon dioxide emissions in an authority's area, and NI 187 which relates to tackling fuel poverty and measures the number of people receiving income based benefits who are living in homes with a low energy efficiency rating.

2.2.2 Newark and Sherwood District Council's work on household carbon emissions

All the survey respondents and most of the interviewees for this research (RedHENS) live in the Newark And Sherwood District, a map for which is given in Figure 2.1. NSD, has an area of 652 square kilometres and a population of 106,366 (EST 2004b). It is a rural but poor area of Nottinghamshire, and was formerly dominated by coal mining. Most of the mining was in the area adjacent to the Borough of Mansfield to the west and north of the district. Newark-on-Trent (generally known as 'Newark') is the main town and is in the east of the district, and there are more affluent areas along the valley of the River Trent in the south of the district (for example the small towns of Southwell and Lowdham), towards Greater Nottingham. There are some notable energy efficient housing developments in the district including Hockerton Housing Project (HHP 2008) and Sherwood Energy Village (SEV) (Beadle 2008).

Figure 2.1 Map of Newark & Sherwood District



Source: EST (2004b).

Newark and Sherwood District Council (NSDC) is ranked 248th of 434 UK local authorities on estimated carbon dioxide emissions from homes and vehicles (EST 2007b). Although indexed at 110 overall (100 being average), it ranks at 102 (just above average) for home emissions whereas for vehicles it is indexed higher, at 125. Regarding carbon dioxide emissions purely from energy use in the home, it has an average figure per dwelling (based on actual consumption figures for 2003) of 5,779 kg. The average for the East Midlands is slightly lower at 5,743 kg and for Great Britain slightly lower still at 5,595 kg (Best Foot Forward 2006).

NSDC's activities in home energy efficiency were established in 1986 as the result of tenants' action. A Damp Action Group (DAG) was formed to challenge the council about the cold and damp state of council housing, which was leading to health problems, high heating costs and other issues (NEA 2003: p.62). Thus NSDC was a pioneer in improving the energy efficiency of its social housing (ibid: p.20). In later

times, once the social housing had been improved, the emphasis switched to private housing, especially with the launch of HECA responsibilities after 1995. As a result of their work, NSDC developed the concept of holistic cost-benefit analysis. This takes into account secondary benefits when making energy efficiency investments, such as reduced health treatment costs or reduced repair costs, as well as direct savings on energy bills.

In 1997, Newark and Sherwood Energy Agency (NSEA) was established (Association of UK Energy Agencies 2008). Although this did not necessarily result in extra funding, it gave international recognition to the activities of the energy team at NSDC. In 2003, NSDC was awarded 'Beacon Status' by the government, recognising the agency's activities in fuel poverty (NEA 2006b). See Figure 2.1 for logos associated with the council and the energy agency. In tackling fuel poverty, NSEA has used the concept CODAE, meaning 'capable of delivering affordable energy' (NEA 2003: p.41, NEA 2006b). Thus the emphasis is upon making all homes capable of being heated and powered for less than 10% of minimum income, where the minimum income is that received by a single old-age pensioner living on the basic state pension and pension credit.

Figure 2.2 Newark & Sherwood logos

Source: NSDC.

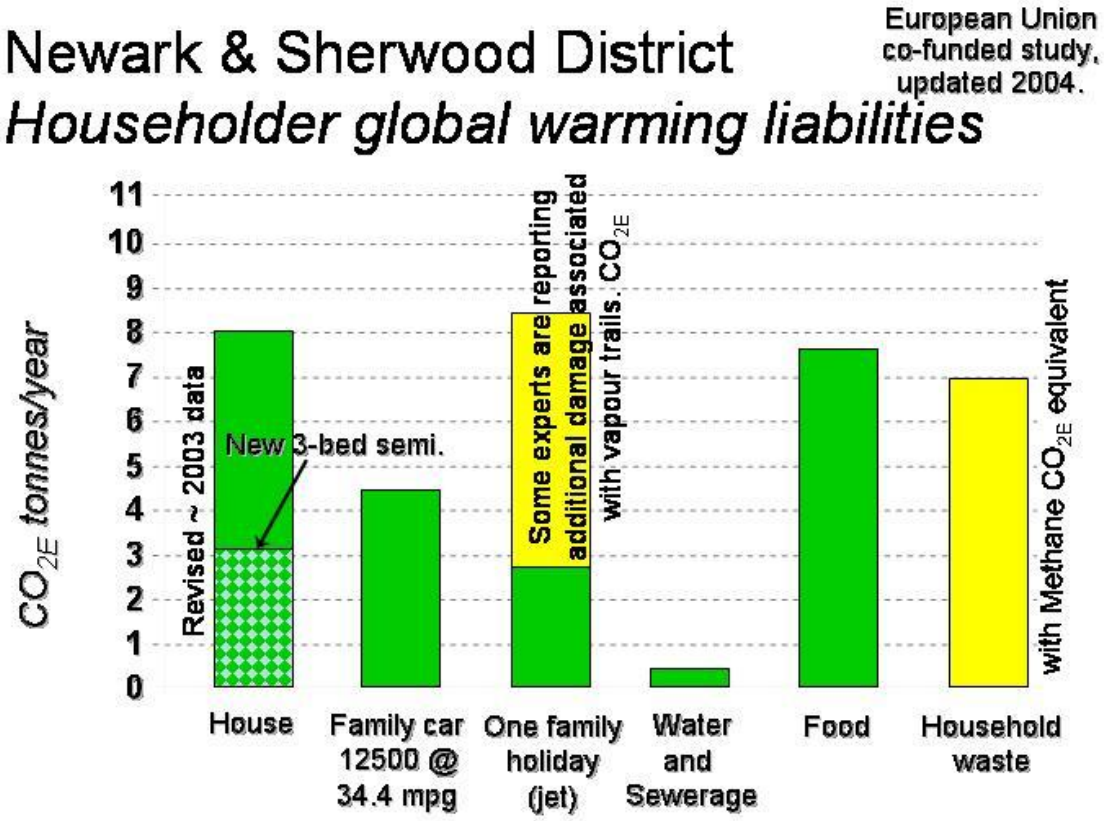
In order to monitor progress under the Home Energy Conservation Act, Newark and Sherwood Energy Agency conduct the council's HECA monitoring (HECAmon) survey by post every January. They mail out a simplified Home Energy Check (HEC)

questionnaire to at least 4,000 owner occupied and privately rented households (see appendix 12.1). A response rate of around 40% is achieved, helped by a prize draw (NEA 2005: p.55). The data received is stored in a home energy efficiency database known as Uno. Unlike in other local authority areas, every respondent receives a package of energy efficiency information, appropriate to their circumstances, such as about particular energy efficiency measures, or available grants. In the past, the data were passed to the Nottinghamshire and Derbyshire Energy Efficiency Advice Centre, which provided a bespoke advice letter on energy efficiency improvements.

NSEA provides a variety of services relating to sustainable energy (NSEA 2008). It has a team of four council employees who work on these issues full-time. Joint work with other public services, such as the Pensions Service, is a successful part of the work (NSDC 2006, NEA 2003: p.20), reflecting the fact that energy efficiency or fuel poverty alone is often not enough to motivate some beneficiaries to take up the grants available to them. European funding has been of benefit to the energy agency, and has resulted in the agency's work being cited as best practice to a wide audience (NSDC 2000, 2004a, 2005a). Within the UK, The Energy Saving Trust has drawn considerable attention to Newark and Sherwood, using it as a case study for best practice (EST 2004b).

NSEA has investigated overall household emissions within the district, especially by so-called 'fuel rich' households to complement the work on fuel poverty. European funded work on household carbon footprinting started in the late 1990s. The modelling of a fictional but typical Newark and Sherwood household, in the project known as 'Newark & Sherwood District householder global warming liabilities', was graphically represented in a number of publications and presentations (NSDC 2000, 2005). It is shown in Figure 2.3 (from NSDC (2004b)).

Figure 2.3 Newark & Sherwood District householder global warming liabilities



2.2.3 Energy suppliers to homes

From the late 1980s onwards, Britain's gas and electricity industries went through a period of privatisation and unbundling of vertically integrated utilities into separate generation, transmission, regional distribution and supply companies, with the eventual implementation of competition between retail suppliers (Vine et al 2003). The majority of these component organisations are now owned by one of the 'big six' energy companies, these being Npower, Centrica (known to the public as British Gas), EDF Energy, Scottish Power, E.ON UK and 'Scottish and Southern Energy' (trading with the public as Southern Electric, Scottish Hydro Electric, SWALEC and Atlantic Electric and Gas) (Commons 2008b). The supply (retail) divisions are obliged to subsidise energy efficiency measures for householders (see section 2.2.5). In response to many calls to increase funding for energy efficiency, the generating divisions have also been given this obligation since Autumn 2008 (DEFRA 2008e). As regards dealing with the competitive regime, particularly where customers are vulnerable or in fuel poverty, the National Association of Citizens' Advice Bureaux conducted research which

documented the problems customers experienced especially when switching suppliers (NACAB 2002).

In 2006, electricity was generated in the following proportions: coal 41% (in 1990 it was 65%), gas 31% (1%), nuclear 21% (20%), oil 2% (11%) and other 7% (2% in 1990). Note the drop in the use of coal, contributing to major reduction of carbon emissions (DEFRA 2007d). 'Other' sources include renewable or 'green' sources which do not cause net emissions of carbon dioxide. In 2002, the Renewables Obligation was introduced. This requires suppliers to source an increasing proportion of electricity from renewable sources, such as wind. Where suppliers fail to source sufficient 'green' electricity, they can trade with suppliers who have an excess of supply, using ROCs (Renewables Obligation Certificates). There is a UK government target of 10% of electricity to be generated from renewables by 2010 (note there is an EC mandated target of 15% of all energy to be produced from renewable sources by 2020). The UK currently generates 5% of its electricity from renewable sources, more than double the capacity in 2002. It is not yet clear whether the 2010 target will be achieved (Commons 2008c).

Renewable energy is not confined to large scale electricity generation. In the context of homes, it can take the form of biomass for heat, solar hot water, photo-voltaic panels for the generation of solar electricity, and so on. In Spring 2009, the government will rationalise targets in this area and publish its Renewable Energy Strategy (Commons 2008c).

In rural areas like Newark and Sherwood District, fuels other than gas and electricity are commonly used for heating and occasionally for cooking. Oil is the commonest fuel where gas is unavailable, followed by solid fuels, especially coal. The suppliers of these fuels are often independent local firms or well known oil companies.

2.2.4 Energy efficiency measures for homes

Measures for reducing carbon emissions from homes involve using energy more efficiently, or occasionally generating energy. Most of those described here are 'low cost' or 'cost effective' unless otherwise stated, in that their cost is recovered in savings on bills within five years (David Pickles (Head of NSEA), personal communication,

September 2005). The savings figures quoted are those from the Energy Saving Trust as published in 2007 (EST 2007c).

Installing insulation and draught-proofing is usually a very cost effective way of reducing heat loss and therefore carbon emissions and energy bills (NIA 2008). To insulate the roof of a house (or in some cases, a small block of flats), a blanket (also known as a 'quilt') of mineral wool (e.g. Rockwool) or fibreglass is laid in the loft, above the ceiling of the top storey, between and over the joists. The recommended depth, depending upon the material used, is 25 to 30 cm. Any exposed pipework will also need to be insulated. Installing insulation to the depth of 27 cm where there was no insulation before will save 1,500 kg of carbon dioxide per year, or around 25% of the heat loss from an uninsulated home. Increasing the depth from 5 to 27 cm will save 410 kg. Alternative blanket products include those made from waste sheep wool and from recycled plastic bottles. Loose fill insulation is also available, typically polystyrene beads or cellulose (for example, recycled newspaper). Loft insulation is often installed by homeowners themselves, but it is also commonly installed professionally.

In many lofts, the joists are boarded over to provide flooring for storage purposes, limiting the depth of the blanket insulation to around 10 cm, although the boarding itself will have some insulatory effect. This situation acts as a barrier to topping up insulation to around 27 cm. Polystyrene boards are available for use on top of existing boards, or under new boards (B&Q 2007). In some situations, home owners wish to have a 'warm loft' and insulate between the rafters, immediately under pitched (sloping) roofs. This is usually achieved by using foil-backed EPS (expanded polystyrene) slabs, multi-foil products, or batts of mineral wool or fibre glass (made from the same basic materials that blanket insulation is made from, although denser, and with greater insulatory properties) (B&Q 2008). There are also sprayed-on foam solutions. The boarding and pitched roof types of solution are not generally covered by grant schemes.

Cavity wall insulation can save around 1,000 kg of carbon dioxide emissions per annum, and is a very common form of home insulation, although it must be professionally installed. Homes built prior to 1930 tend to have so-called 'solid walls' which cannot be insulated in this way. Homes built after 1930 usually have cavity walls although the transition date was nearer 1950 in Newark and Sherwood District and most of the rest of the East Midlands.

Insulation for solid wall homes is relatively expensive, taking the form of external cladding or (internal) insulated dry lining, both of which are generally only installed when major refurbishment of a home takes place. The former will save around 2,250 kg of carbon dioxide and the latter 2,400 kg per annum, and takes around seven to eight years to give a full return on the investment. Flexible wall insulation, which comes in the form of a thick wallpaper, can be used for internal insulation, although without the performance of insulated dry lining. Radiator reflectors, designed to be used behind radiators on external solid walls, provide modest benefits.

Draught-proofing is a commonly offered insulation measure which has grant coverage. If all windows and doors are draft stripped, and the gaps between skirting boards and floors are sealed, then a saving of around 265 kg of carbon dioxide per annum can be achieved.

Low energy lightbulbs, otherwise known as compact fluorescent lightbulbs (CFLs), provide on average a 47 kg saving p.a. (DEFRA 2007b).

Regarding gas central heating and hot water systems, a new boiler, which by law is A or B rated (i.e. of condensing technology) will typically save 810 kg of carbon dioxide per annum. When a boiler is replaced, it is usual for heating controls to be upgraded, including the fitting of thermostatic radiator valves on each radiator, and a timer-programmer. This will save 490 kg. A hot water tank jacket will save 150 kg.

Double glazing is a relatively expensive energy efficiency measure, and typically provides about 680 kg saving of carbon dioxide per annum, and is thus not cost effective from the carbon reduction point of view, taking around a hundred years to pay for itself. Heavy curtains, if drawn at dusk, can often provide a more cost effective energy efficiency measure. Double glazing is however considered cost effective if windows need to be replaced, and is also required by the Building Regulations (CLG 2006c).

Insulation of the ground floor of a house (where there is a void below) can typically save 340 kg of carbon dioxide per annum. The insulation can be placed above or below the floor. Netting can be suspended below the floor to hold insulation quilt in

place. Alternatively, flexible padded floor insulation can be placed on top of the floorboards. Grants are not usually available for floor insulation.

Replacing an old ‘cold’ device with a modern high efficiency replacement refrigerator (‘fridge’) or fridge-freezer, rated A+ or A++, can save 80 kg in the case of a fridge and 185 in the case of a fridge-freezer. There have been grant schemes to replace refrigeration devices with modern ones at heavily subsidised prices, although they are generally aimed at the fuel poor, and require the old device to be given up.

There is a wide variety of savings that can result from behavioural changes, such as turning off standby on multiple devices (173 kg p.a.), not tumble drying in spring or summer (99 kg p.a.), not overfilling a kettle (this would save 27 kg p.a. if not done four times a day), and lowering a central heating room thermostat by one degree Celsius (80 kg p.a.) (DEFRA 2007b). Other behavioural changes include turning off lights in unoccupied rooms, putting lids on pans, and using the appropriate size ring when putting a pan on a stove.

The range of home renewable energy generation measures includes solar electricity generation (photovoltaics), wind turbines, small hydro, solar hot water, ground and air source heat pumps, bio-energy, renewable and micro CHP (combined heat and power), and fuel cells (LCBP 2008a).

2.2.5 Energy efficiency grant schemes

The main grant schemes for energy efficiency in England, for private sector housing, are WarmFront and the Carbon Emissions Reduction Target (CERT). Most public funding of household energy efficiency comes from WarmFront, a national scheme for eradicating fuel poverty (NAO 2003). It is aimed at households with children, the over 60s, the disabled and long-term sick. WarmFront is funded by the government, and provides grants for insulation and heating to homes in the owner occupier and private rented sector. Potential beneficiaries qualify for the grants by receiving certain social security benefits, known as ‘passport’ benefits (EAGA 2007).

CERT, funded by the major gas and electricity suppliers, replaced the Energy Efficiency Commitment (EEC) in April 2008. CERT schemes are aimed at a wider set of beneficiaries, not just those in fuel poverty (as were EEC schemes). It requires

suppliers to invest in domestic energy efficiency improvements, although not necessarily their own customers. Targets, in terms of carbon emission savings, are set by the Office for Gas and Electricity Markets and are regularly exceeded (OFGEM 2009). Spending is not just limited to private housing, as social housing providers and their tenants also benefit. The proportion of CERT funding spent on the ‘priority group’, which is used as a proxy for identifying the fuel poor, is 40%. The priority group is similar to that which qualifies for WarmFront grants. Grants to this group tend to be ‘full’, in other words the beneficiary has nothing to pay, whereas grants to non-priority customers tend only to cover part of the cost of the measure.

Some CERT marketing is aimed at rented properties. EAGA, the managers of WarmFront, have a special landlords’ helpline but this only covers situations where the occupants are on benefits. There is no obligation upon landlords to take up grants, whether 100% or not. However, landlords can also exploit the LESA (Landlord's Energy Saving Allowance). This is not a grant scheme, but an allowance against the income tax of private landlords. It gives an allowance of £1500 per property for capital expenditure on loft and cavity wall insulation in rented accommodation (EEPH 2008b).

The Low Carbon Buildings Programme grant scheme will fund a number of renewable energy technologies on domestic and other buildings (LCBP 2008a). However homes must have energy efficiency in place first (LCBP 2008b).

2.2.6 Referrals to grant schemes

Recipients of energy efficiency grants are located in a number of ways.

Many CERT schemes are self referring, in that they are operated by or for gas and electricity supply utilities and find customers through direct contact with customers, usually a leaflet enclosed with a quarterly bill. WarmFront also does direct mailing.

The Energy Saving Trust, as part of their service to consumers, provides advice about schemes and grants via the internet and over the telephone, for any location in the UK. This relies upon the customer contacting a scheme directly.

Some referrals come via public sector or sometimes voluntary organisations. Local councils sometimes have energy teams specifically for integrating and targeting grants

programmes (CSE 2005). In some cases these have been designated ‘energy agencies’. Advice may be made available through libraries and other local government buildings, and sometimes at public events such as festivals.

Warm Zones are locally focussed predominantly ‘door-knocking’ initiatives, usually based on a single council’s borough or district, with an emphasis on fuel poverty. Initially there were five pilot Warm Zones (EST 2006) with the later zones learning from their experience. Gas and electricity suppliers both support Warm Zones and also operate their own localised schemes which aim to visit as many households as possible in a designated area. Examples include HeatStreets operated by Powergen and Spreading Warmth operated by NPower. In some cases insulation installers find the customer through leafleting homes, door-knocking or newspaper advertising and through their agreements with gas and electricity suppliers obtain a CERT grant to subsidise an installation.

2.2.7 The rented sector

In the short term future, tenure is likely to be a strongly influencing factor. The private rented sector presents a major challenge. The English House Survey (CLG 2008a) shows that the energy efficiency of it is significantly below all other sectors (Wilkinson and Goodacre 2002). The energy ratings of social housing are overtaking those in the private sector (NSEA 2005). There are benefits to landlords to installing energy efficiency measures, but they are often unconvinced and market barriers provide further disincentives to installing them. Research has shown however that local schemes can overcome these issues (Wilkinson and Goodacre 2002).

2.2.8 New homes and building regulations

Since April 2007 the developer of any new home in England could choose to be assessed against the Code for Sustainable Homes (CLG 2007a), a national standard for sustainable design and construction of new homes. It replaced the EcoHomes scheme (BRE undated), and measures the sustainability of a new home against categories of sustainable design, rating the sustainability performance of the whole home as a complete package. Energy efficiency accounts for a significant part of the rating. A one to six star rating system is used, with minimum energy and water use standards at each level. It provides information to home buyers, and a means by which homebuilders can differentiate themselves in sustainability terms. There are plans to

make the Code for Sustainable Homes mandatory. Eventually, by 2016, the government wants all new homes to be carbon neutral (CLG 2006b).

2.2.9 Carbon emissions from homes - the future

The 40% House project (Oxford ECI 2005) suggested how carbon emissions could be reduced by 60% by the year 2050, in the housing sector, even if many of the homes existing at that date already exist now. Natarajan and Levermore (2007) have used an object-oriented model to examine the feasibility of the 60% reduction and routes to it (all of which will require considerable shifts in practice) concluding that they are technically feasible.

To reflect the increasing calls that a 60% cut in emissions was insufficient, Johnstone et al (2004) explored the technical feasibility of achieving carbon dioxide emission reductions of over 60% in the housing stock by 2050. A physically based bottom-up energy and emissions model was developed, covering both energy demand and supply sides. Three scenarios were used. The results suggested that 80% may be achieved, using current known technology but that strategic shifts in both energy supply and demand side technology would be required. Further evidence that an 80% cut is possible over the same period has been presented (Boardman 2007). As an interim target, the Office of Climate Change has shown how a pro rata cut can be achieved by 2020 (OCC 2007).

2.3 Carbon emissions from personal transport

After a period during which it was criticised for its alleged lack of substantial action on climate change issues relating to transport, particularly regarding the obtaining of substantive projections of carbon emissions (Commons 2006, Transport2000 2006), the Department for Transport commissioned work on a variety of scenarios or ‘pathways’ to help with generating a carbon reduction strategy for the sector (DfT 2008b). These projections are provided by journey purpose, by mode and by journey length as well as accounting for the split between domestic and international journeys. However the DfT work has no analysis as to the distribution of these emissions amongst the population. Brand and Boardman (2008) found that, in transport terms, the top 10% of emitters in the population are responsible for 43% of emissions and the bottom 10% for only 1%.

There are no specific targets for reducing carbon emissions from transport (DfT 2008b: p.107). The target proposed by the European Commission for the non-traded sector is 16% (by 2020 against 2005 levels). The Committee on Climate Change (CCC 2008) has advised the government regarding the first three 'carbon budgets' for the UK, which cover the period up to 2022. They follow the same pattern, with suggested contributions from the traded and non-traded sectors.

The sub-sections below look first at carbon emissions from land transport, followed by air travel.

2.3.1 Carbon emissions from land transport

In addressing carbon emissions caused by land transport, there are additional benefits to be taken into account. These 'co-benefits' include reduced accidents, congestion, noise, and pollution (from pollutants other than carbon dioxide). There are benefits from increased social inclusion for non-car owners and non-drivers, greater community cohesion through broader use of transport system by all social classes, and reduced disruption by traffic of communities (IPCC 2007c, DfT 2007). Higgins (2005) points out the benefits to health through exercise when influencing choice of transport mode. Fewer resources would be used for car manufacturing and less land would be used for road building. Thus in cost benefit analyses, governments can take the co-benefits into account when considering the transport and fuel pricing (IPCC 2007c).

There are a number of schemes which are designed to reduce carbon emissions from personal transport use. The Renewable Transport Fuel Obligation (RTFO) programme puts an obligation on transport fuel suppliers to ensure that a percentage of their sales comes from biofuels. By 2010, 5% of all fuel sold is to come from a renewable source (DfT 2008c).

The Tyndall Centre, based on their survey of householders, paints a pessimistic picture about vehicle technology reducing emissions from transport and puts emphasis on behaviour change especially modal switch to public transport alternatives (Tyndall 2004a). Ironically, the same organisation found that there are opportunities to use other technologies to reduce the demand for car use and associated emissions, including the use of Information and Communication Technologies (ICT) to assist tele-working and tele-shopping (Tyndall 2004b).

A relatively new technique is to pursue 'soft' solutions to encourage people to get out of their cars, such as workplace (and school) travel plans; individualised travel planning, awareness campaigns, marketing of public transport information, car sharing, tele-working and home shopping. The Department for Transport refer to this as 'Smarter Choices'. Their research into this (DfT 2005) found that considerable reduction in car use (and by implication carbon dioxide emissions) might be possible if a scenario of high emphasis on such measures was adopted, although such a change emphasis has not occurred. However, DfT now promotes its own version of Act On CO2 (DfT 2008e), the carbon reduction campaign originally developed by DEFRA (described in more detail in section 2.6).

'Harder' solutions to reducing carbon emissions from car use include financial measures and investment in public transport schemes. Over the last few years, the government has changed the way vehicle excide duty (VED, the annual tax on motor vehicles) is charged, so that it reflects the emissions from cars (Lane and Potter 2006). Changes have also been made to the way employees are taxed on cars provided by their employers (company cars).

In 1999 the European Commission obliged major car manufacturers to enter into a voluntary agreement to reduce average emissions from new models by 25%, down to 140 g/km of carbon dioxide by 2008-09. Average emissions of new cars in the UK declined to 169.4 g/km by 2005, a reduction of 10.7%, since 1997. At this rate of progress, the UK would not achieve the EU target of 140g/km until around 2022 (Commons 2006). The voluntary EU agreement are to be replaced by mandatory limits The EU has ruled that from 2012 the average new car should not emit more than 130g/km, with the intention is that average emissions from new cars do not exceed 120 g CO_2/km (EST 2008h, EC DGE 2008a).

2.3.2 Local transport policies

Local transport policies are expressed through local transport plans (LTPs). The LTP covering Newark and Sherwood was produced by the county council which performs the role of the local transport authority (LTA). It covers all of north Nottinghamshire (Notts CC 2006). This 330 page document has less than one page specifically covering climate change. It asserts that plans to tackle congestion, and to facilitate bus use,

walking and cycling, along with education and awareness measures, will contribute to reducing car use. It even claims that improved vehicular flow will reduce emissions within the area. Although acknowledging that these will probably not reduce emissions, the plan expresses the view that this is realistic in the current political climate and with the likely levels of funding available. An interesting statistic from the plan is that 29% of travel to work distances in Newark and Sherwood were more than six miles (ibid: Ch. 2 p.9).

Hull (2008) finds, while investigating local transport policies, and the relationship with climate change and sustainable development, that policies are still dominated by the car. There tends to be a disconnect from other policy areas such as health, planning, education, social services and regeneration. Several causes are identified by Hull. One is the internal organisation of councils. Another is the contradiction of government policies on airport expansion and climate change (as discussed in section 2.3.3) filtering down to, and negatively influencing, local transport authorities.

2.3.3 Carbon emissions from air travel

Following their criticism of the UK government's seemingly contradictory policies on climate change and aviation, Oxford ECI (2006) recommended a communication strategy building on public support for addressing aviation's environmental impacts. They also recommended a fiscal package to make flying less attractively priced, including such financial measures as the addition of VAT to domestic air tickets, and raising APD (air passenger duty), as this would not require international agreement (unlike other measures such as aviation fuel tax). The report points out that for every pound that an overseas visitor spends in the UK, a UK resident spends £2.32 abroad.

Work on financial measures for aviation includes that by Mayor and Tol (2007). They modelled tourist behaviour in relation to various scenarios, including various levels of APD, the Conservative Party's 'Green Miles' proposal and the effects of a carbon tax. 'Green Miles' would exempt the first 2000 miles of flying for UK residents, allowing for one EU flight a year untaxed, and after that flights would be taxed at £11 for EU and £44 for non-EU flights. Using a number of assumptions, they found that increased APD has the perverse effect of increasing carbon dioxide emissions slightly, because it reduces price differences between near and far holidays. The government responded to a consultation on this matter by creating four bands for APD to commence in late

2009 (HM Treasury 2008). Nevertheless, Mayer and Tol found that emissions would decrease under ‘Green Miles’ if the same revenue, as raised from APD, was raised with a carbon tax.

EC DGE (2005) surveyed the public across Europe on financial measures to deal with the climate impacts caused by flights, and about information on carbon emissions. 68% fully agreed with including the cost of climate change impacts in the price of air transport. When asked to consider the negative impacts of restricting flights, 46% completely disagreed with avoiding an increase in the price of air transport despite any alleged effect on jobs and growth, with low levels of agreement with the concept. 50% completely disagreed, and 29% rather disagreed, with the idea of avoiding increasing the price of air transport despite the allegation that fewer people could afford to fly. Regarding the use of aviation taxes 86% thought they should be used to reduce the environmental impacts of aviation. 54% said they would be influenced a lot by the provision of information comparing the emissions per passenger of different airlines on a route. 82% fully agreed with the concept of including aviation in efforts to mitigate climate change. An important step in that direction is aviation's inclusion in the EU Emissions Trading Scheme. The process for this is well advanced (EC DGE 2008b).

Brand and Boardman (2008) found an urban to rural divide on flying. Those living in large urban areas travelled 31% further by air than the average for their survey. The distance travelled by those living in small urban and rural areas were 23% and 30% lower than average.

In the light of projections for large increases in aviation volumes, as outlined in the 2003 Air Transport White Paper, the Sustainable Development Commission and the think-tank Institute for Public Policy Research (IPPR) held a stakeholder assessment (SDC and IPPR 2008). It brought out a range of views from businesses, industry representatives, government, academia, citizens’ groups and NGOs. The stakeholders were frustrated that much of the basic evidence on which policy was based is in dispute. There was enthusiasm for on-going constructive dialogue, and all wanted more sustainable air transport policies to tackle climate change. It was recommended that a special commission be charged with undertaking major independent review of UK aviation policy.

Somewhat more technical solutions have been considered for the airline industry. Akerman (2005) used back-castings method to look at three scenarios of sustainable air travel in 2050. It examined refined turbofan aircraft as well as more radical aircraft configurations. High-speed propeller aircraft with lower cruising speeds in combination with weakened emphasis on economic growth and less hectic lifestyles might make it possible to meet demanding targets.

There is uncertainty about the additional climate impacts of aviation over and above those of carbon dioxide emissions. The total emissions effect (including water vapour at a high altitude and nitrous oxides) is currently estimated to be between two and four times the effect of carbon dioxide (Oxford ECI 2006). As part of the research into this issue, Williams and Noland (2006) compared carbon dioxide emissions and contrail formation from short and long haul air traffic routes from London's Heathrow Airport, as well as the substitution of shorter air trips by high-speed rail. The issue of building new high speed rail lines in Britain was later taken up by Britain's trade union for transport workers (RMT 2008).

2.4 Information sources on reducing carbon

The most important sources of information sources for the public to help them to reduce their carbon emissions are described here. The emphasis is on sources towards the informational rather than motivational end of the scale. Many sources in the media are more motivational, and the public would be unlikely to search them out if otherwise prompted to do something about saving energy or reducing carbon emissions, not least because most media articles are available only for a short period. Thus such sources, such as television and radio, newspapers and magazines, are not covered here, other than to acknowledge that they may encourage householders to act.

The Energy Saving Trust and its local outlets, the Energy Saving Trust Advice Centres, give advice and information on reducing emissions from the home as well as from cars. There are other public sector sources. The government's DirectGov website, which acts as an information source on a wide variety of issues, has advice on the environment and greener living (DirectGov 2008a), which includes coverage of saving energy in the home and from car use. The Department of Health publishes an annual guide to keeping warm and well but this covers a wide range of issues such as fuel

poverty, safety and diet, and only gives brief coverage to energy efficiency (DoH 2008). As discussed earlier in sections 2.2.1 and 2.2.6, some local councils have energy teams providing information and advice, as do energy agencies in some localities. Council building control and planning departments also act as sources of advice, due to the fact that building regulations affect extensions and major alterations to existing homes (CLG 2006c).

Under the UK implementation of the European Union (EU) Directive on the Energy Performance of Buildings (EST 2004a, BRE 2006b), when any home is constructed, sold or rented, it is required to have an Energy Performance Certificate (EPC) as part of a Home Energy Report. The certificate, compiled by a domestic energy assessor, describes the features of construction, heating and hot water. It includes energy and carbon ratings from A-G, similar to that used for white goods and lightbulbs, and recommendations for energy efficiency measures.

Gas and electricity suppliers provide energy efficiency advice, not least because they need to find recipients of CERT grants (as described in section 2.2.5) as well as customers for new heating systems and showers, etc. This advice is typically provided with quarterly bills, via telephone helplines (generally resulting in brochures being sent out) and on their websites (Scottish Power 2006a, 2006b, NPower 2007, Powergen 2005). Some of the literature produced by the suppliers is oriented towards the priority groups - customers who are disabled or vulnerable, and may be in fuel poverty (NPower 2004).

Service engineers are now obliged to advise on the efficiency of boilers that they service or repair, when customers ask (CLG 2007b). The Consumers' Association provides advice but some of this is not available to non-subscribers (Which 2008). There are retailers providing advice. In some cases these are stores selling a wide range of building materials such as insulation, lighting and heating systems (B&Q 2007, B&Q 2008, Homebase 2007) and in other cases they may only sell a limited range of products such as compact fluorescent lightbulbs (Tesco 2008a) or slightly more specialist devices such as plug-in meters (Maplin 2008) but also give more general advice (Tesco 2008b).

Labelling of products is a key method of giving information about energy efficiency. The European Community Energy Label is displayed on a wide variety of energy using products at the point of sale. These include refrigeration devices, washing machines, tumble dryers, dishwashers, lamps, electric ovens and air conditioners (DEFRA 2005b). Home computer equipment is not covered by the European Community Energy Label so the EU uses an adapted form of the United States' EnergyStar rating system (EU Energy Star 2008).

Searching using an Internet search engine for advice on home energy efficiency, or reducing household carbon emissions, will locate many other sites which are too numerous to list here, but are often associated with local councils or manufacturers and retailers of energy saving products.

As regards information sources for the public wishing to reduce their carbon emissions from transport, there is a variety of resources, but few of them are marketed as 'carbon saving'. One exception is the national journey planning tool Transport Direct (2008) which covers public transport car and plane use, and includes a tool for calculating carbon emissions (there is more coverage of this subject in section 2.6). For international travel, the website The Man in Seat Sixty-One (2008a) gives prominence to carbon savings by avoiding flying and using surface transport (mainly rail) instead. The Department for Transport (DfT) encouraged the motor industry to introduce efficiency labels for cars, like those for electrical goods, but based on the new VED bands. DfT claimed that these were available in most UK showrooms (Commons 2006).

2.5 Linking attitudes and behaviours

This section examines whether people's attitudes (and awareness, knowledge, etc.) can be influenced in order to change their behaviours (or actions) and thus reduce their carbon emissions.

Recent research by the Department for Transport (DfT 2008a) indicates that a majority of people believe transport emissions contribute to climate change. Approximately 70% of those surveyed by DfT selected emissions from road transport as a cause of climate change, without being prompted. 40% blame flying for having the greatest climate change effect, with road transport blamed by 51%. This is a complex areas for people

to follow, but clearly large proportions of people recognise the threat of air travel and car use to the climate. It may be easier for the public to make the link between climate change and transport, as compared with other sectors such as energy use in the home (Anable et al 2006). Nevertheless, Poortinga et al (2003) found that there is a preference for making energy savings in the home rather than in transport.

There is a large amount of literature relating to getting people out of their cars but it is not necessarily related to reducing carbon emissions. Hagman (2003) found that car users present arguments on the advantages of car use in unquestionable and absolute ways, whereas scientific facts about the negative effects of car use (such as environmental degradation) are presented as relative and negotiable, and argues that this is a possible explanation as to why people, although saying car use ought to be limited in general, do not reduce their own car use.

45% of adults believe that air travel should be limited for the sake of the environment. However only a third of people, who travel by plane more than twice a year, have the same view (DfT 2008a). A flying culture seems to have become well established in British society (Anable et al 2006, Carbon Neutral Newcastle 2005). There are variations within society, however. Brand (2006) finds that those from urban areas of Oxfordshire fly more than those from non-urban areas. This may be partly explained by Holden and Norland (2005), who observed that overall energy use by households, including within the home, in cars and in flying, is affected by factors such as access to a garden, the size of the urban area in which the subjects live, and the closeness of that location to centre of the urban area.

One of the earliest and still most substantial documents, related to influencing people's attitudes and behaviours concerning their carbon emissions, was produced by the Australian Greenhouse Office. It concentrates on home energy issues but does not cover transport (AGO 2000). As well as recognising that energy saving is affected by attitudes and money and other factors, it also recognises a difference between 'curtailment activities' (such as turning lights off in unoccupied rooms) and 'one-off efficiency improvements' (such as installing insulation). Barr et al (2005) also found a split between people who make environmentally oriented purchase decisions (or one-off actions) and those who alter habitual behaviours in order to reduce household carbon emissions. The former believe that the purchase of an energy efficient product

or installation of a measure will avoid the need to change behaviour in the longer term, whereas the latter believe more in switching off or reducing their need for the service that energy consuming products provide. Poortinga et al (2003) found that, overall, the public tends to prefer technical solutions to behavioural change when faced with the issue of reducing energy use. Nevertheless, there is a wide variety of barriers to overcome before the public will accept all home energy efficiency measures (OU DIG 2007). Given the public's apparent preference for technical solutions, Boardman (2004a and 2004b) found the market rarely delivers energy efficiency on white goods and other products, indicating the need for government intervention. Thus the European energy alpha-rating (C, B, A, A+ etc) of white goods (wet systems such as washing machines and dishwashers, and cold systems such as fridges and freezers) has brought about an increased efficiency in these energy consuming devices.

In addition to the split between curtailment activities and one-off actions, there is an important distinction between influencing attitudes and influencing behaviours (or actions). Given that knowledge might influence attitudes, Kollmus and Agyeman (2002) find there are numerous theoretical frameworks attempting to explain the gap between environmental knowledge (and awareness) and pro-environmental behaviour. They describe a few of the most influential analytical models deriving from the hundreds of studies that have been undertaken. All the models have partial validity in certain circumstances. DfT (2007) found that raised general awareness of climate issues did not necessarily result in substantial behaviour change by individuals, and RSA (2008: p.6) highlight that there is no simple link between concern and action. Even straightforward information provision has its limits (Demos and Green Alliance 2003: p.46).

Furthermore, behaviours may not have a great effect on actual household carbon emissions. Gatersleben et al (2002) found that people who indicate they behave more pro-environmentally do not necessarily use less energy. Whereas pro-environmental behaviour is more strongly related to attitudes, household energy use is primarily related to income, household size, and similar variables. On a seemingly contradictory note Brandon and Lewis (1999) find that attitude, more than income, brings about behaviour change regarding energy efficiency. A potential explanation for this contradiction is that behaviours that have changed may not bring about reduced energy consumption.

There may be some levers that have a direct effect on behaviour, however. Research conducted with five thousand consumers across several European countries (UK, the Netherlands, Spain and Portugal) showed the influence of money on the installation of energy saving measures (LogicaCMG 2007). The project found that higher energy pricing is the most important factor to influence people to take steps to reduce the energy consumed at home. When asked why they do not reduce their energy use, over a third admitted that they were concerned about the expense of investing in measures. Overall, the conclusion reached was that a combination of financial incentives, environmental concerns and better information (enabled by technology such as smart meters) would lead to changes in consumer behaviours.

Meanwhile, Carbon Neutral Newcastle (2005) also found, in both a quantitative survey and in group discussions, that money is a key motivator. In fact, their respondents often stated the need for additional financial incentives to change their behaviour in addition to any money saved on reduced fuel spending. These included grants, reductions in council tax, cheaper public transport and cheaper compact fluorescent light bulbs.

Abrahamse et al (2005) emphasise the point that information, as such, does not change behaviours although feedback does, perhaps because it can continuously influence the householder. Interventions that encourage behavioural change can bring changes to awareness but tend to have only limited behavioural effects which decay with time. In the case of the new Home Energy Reports and the associated Energy Performance Certificates (EPCs), early trials showed a disappointing actual level of installation of the recommended measures (Parnell and Larson 2005). The provision to householders of energy consumption information, or smart meter and related energy consumption data, has been shown to be effective at reducing consumption (Darby 1999, 2006, Ueno et al 2006, OFGEM 2006). The government has expressed an intention to give every home smart meters for electricity, gas and water over a ten year period (DTI 2007a). At present, trials of smart metering and other forms of improved energy information to households are underway with four UK utilities (OFGEM 2007).

DEFRA (2005a) looked at ways of changing behaviour through policy. It concluded that policies should ‘enable’ (making the desired behaviours easier) and ‘encourage’ (giving the right signals) and that in some cases policies can change actions without changing

attitudes. Examples include access to kerbside schemes leading to an increase in recycling behaviour but not necessarily changes in attitudes to recycling. Other levers considered included taxes (or other ways of giving price signals), funding and regulation. Other government departments have similar views. The Research for the Department for Transport found that the attitude-behaviour gap is one of the greatest challenges facing the public climate change agenda and that this is true of all attempts to influence individual behaviour, not only travel (Anable et al 2006: p. 62). It argues that transport policies can aim to change attitudes as a route to behaviour change, or they can change behaviour first without necessarily changing attitudes, concluding that a combination of each is desirable.

Other work in the transport arena confirms the low level of linkage between attitudes and behaviours. Drivers of polluting vehicles did not have lower levels of knowledge of emissions or lower levels of environmental concern compared to other private motor vehicle commuters, and train commuters showed no greater concern for the environment (Walton et al 2004). Lane and Potter (2006) found that the purchase of lower emitting vehicles did not correlate strongly with environmental awareness.

In conclusion, it appears that policy interventions need to concentrate on changing behaviour (in particular one-off actions) and to put less effort into changing attitudes and awareness, and interventions should be at least partly financial to provide motivation. The best form of information for influencing behaviour is that which provides feedback.

2.6 Carbon footprinting and carbon calculators

As discussed in section 2.4, households receive, from various sources, carbon-reducing advice, generally relating to individual behaviours or measures. However such advice does not necessarily inform a household as to its total carbon emissions nor the extent to which this will be reduced by each measure. Gatersleben et al (2002: p.337-8) draw attention to the problem that social science research experience errors in measuring pro-environmental behaviour. Furthermore, rebound effects may reduce any carbon savings (UKERC 2007a).

Thus there is an argument for producing an overall figure for carbon emissions from an individual or a household. Research has shown that the term ‘carbon footprint’ conveys

an idea of personal emissions and an individual's impact on the earth (DfT 2007: p.10-11). Social comparison influences behaviour with regards to the environment. While many people identify themselves as being concerned for the environment, results that encourage comparison, either with targets, averages or others, enhance the desire to behave pro-environmentally. This can potentially reduce the gap between attitude and behaviour. Those who had not used a carbon calculator before indicated that they were more likely to make behavioural changes as a result of using one (DfT 2007: p.34-35).

The UK government's on-line carbon footprint calculator Act On CO2 (DEFRA 2007b). allows users to calculate their footprint from energy use in the home, and from journeys by car and air. A calculator to some extent overcomes a disadvantage that some forms of footprint may have, which is that a top-down footprint calculation may not fully take into account variations in behaviour between individuals and households. Dividing a large population's emissions between all the people in the population, perhaps apportioned by sector, is crude (CAT 2007a). Act On CO2 is less prone to the disadvantages of the top-down approach, as it leaves out carbon emissions resulting from the purchase of goods and services, or from government activity.

In addition to a review by Bottrill (2007) of UK and international on-line calculators, Padgett et al (2008) have also made academic comparisons of calculators, though with a US emphasis. The Climate Outreach and Information Network has an online guide to carbon calculators (COIN 2007). The organisations providing carbon footprint calculators now include retailers, energy companies, professional organisations, civil society organisations, governments and environmental campaigners. Some calculators of note include National Energy Foundation's Simple Carbon Calculator which is useful for those having detailed consumption data simply wanting to convert to kilograms of carbon dioxide (NEF 2008), Quaker Green Action's manual paper calculator (Quaker Green Action 2007), and the calculator provided by Resurgence (2008) which features details such as indoor and outdoor temperatures, and areas of walls, floors etc., but no opportunity to enter actual fuel consumption figures.

The Act On CO2 calculator can be accessed from a webpage of the Energy Saving Trust's website (EST 2008i), which also offers the option of doing a Home Energy Check (EST 2008b). Both give recommended measures for reducing energy use and carbon emissions. However the Home Energy Check gives financial savings for the

measures it recommends, whereas Act On CO2 does not. Act On CO2 gives a reduction in carbon footprint for subscribers to green electricity but this is controversial as for 'green tariffs' the proportion of renewable electricity supplied varies considerably and is rarely 100% (ElectrictyInfo.Org 2008). Furthermore, under the Renewables Obligation, suppliers are obliged to source a rising percentage of electricity from renewable sources. If they have only a few customers on a green tariff, those customers may be paying a premium to help the supplier achieve their obligation (Ethical Consumer 2005).

'Act On CO2' is now used as a brand for much of the UK government's awareness-raising relating to climate change.

2.7 Carbon trading and personal carbon allowances

Climate change is an example of a potential 'tragedy of the commons' process. However, the solutions proposed for problems of this nature, such moral approaches, changing attitudes, providing information, changing incentives and (particularly) community management, will not work on a problem which is global in scale (Gardner and Stern 1996). Environmental 'marketable' permit schemes provide a financial incentive to reduce pollution or limit the exploitation of natural resources (Perman et al 2003: pp. 217-231). The concept was first developed in the 1960s by economists, in particular cap and trade systems. The cap is a control or maximum on the total of emissions (or resources used, etc.) thereby providing, along with the level of demand, a unit value. The first implementation of a cap and trade system took place via the United States' Clean Air Act 1990, which intended to reduce sulphur dioxide emissions (which cause acid rain) from power stations burning coal. It was widely considered to be successful (Barnes 2007). There are environmental permit systems around the world, including for release of pollutants into the atmosphere (such as sulphur dioxide and nitrous oxides), release of contamination into rivers, and extraction of water from subterranean aquifers (Perman et al 2003: p.229). Permit systems which include a cap, and use trading, ensure that environmental protection is achieved at least cost to society. Such flexibility allows parties with a per unit marginal pollution abatement cost higher than the traded unit value to buy from the parties that have a per unit marginal abatement cost below the traded price (ibid: p.338).

As regards permit systems for carbon emissions by large energy users, the original UK emissions trading scheme (UK ETS) was incorporated into possibly the most well-known environmental trading system in the world, the European Union Emissions Trading System or EUETS (Carbon Trust 2008b). This declining cap system featured free allocations (grandfathering) to existing major energy users (e.g. electricity generators) in the early years. In 2005 it covered 42% of Europe's greenhouse gas emissions. There are plans for an increase proportion of tradable units to be auctioned (Carbon Trust 2008a). The Carbon Reduction Commitment (CRC) is a cap and trade system which will affect large non-energy intensive organisations in the UK (those not included in the EUETS), covering about 10% of the UK's emissions, by 2010 (Carbon Trust 2008b, DEFRA 2008f). These organisations would include larger local authorities, retail chains, etc. Thus a very large part of the UK economy will shortly be covered by carbon trading schemes, leaving the personal and household sector the next most obvious area for action. However, domestic electricity use is in effect already covered by an 'upstream' carbon trading scheme, the EUETS, and Sorrell (2006) proposes a hybrid scheme, mixing upstream and downstream elements, to avoid 'double-counting' of carbon emissions.

The background context to personal carbon allowances also includes the concept of international contraction and convergence (C&C) (Meyer 2000, CAT 2007b, Hillman and Fawcett 2004). Ayres (1997) is critical of legal, administrative and taxation schemes as regards their applicability to global problems. He suggests tradable individual consumption quotas for commodities at the national level (systems not dissimilar to a system of PCAs), later extended to trading amongst nations. C&C would involve an international agreement to allow different countries' per capita carbon emissions to converge over several years (allowing developing countries to increase their carbon emissions), after which trading between nations would take place, so that higher than average emitters compensate those nations with lower than average emissions.

Undertakings were made in the Energy Review (DTI 2006), and in July 2006 the concept of personal carbon allowances was explored publicly by the then Secretary of State David Miliband. Thus DEFRA commissioned the Centre for Sustainable Energy to carry out initial analysis of personal carbon trading (DEFRA 2006b). The document that CSE produced is perhaps the most readable document of its type. Meanwhile the

Royal Society for the Encouragement of Arts, Manufactures and Commerce (RSA) has ongoing work on personal carbon allowances which it started in 2006. In its interim recommendations (RSA 2007a) it stated that personal carbon trading (PCT) should evolve into a mandatory scheme to deliver a proportion of the emissions reduction targets, and it could operate in tandem with the third phase of the EUETS from 2013. It recommended that the operations of PCT should utilise existing infrastructure and accredited private and public sector providers, avoiding the need for a central government database. However it cautioned that the cost of implementation needs to be balanced against effectiveness at emissions reduction. RSA has also conducted specialist research on various specific aspects of PCAs economics, community, technology and particularly transport.

Considerable interest into the transport aspects of PCAs has been shown by researchers. Albrecht (2001) looked at tradable carbon dioxide permits for cars (and trucks) and found that, when simulated, the introduction of tradable permits could lead to very significant reductions of carbon dioxide emissions (25 to 38% over 15 years). Since 2006, DfT has investigated inclusion of road transport emissions in the EU ETS (DfT undated). This would involve allocating units to private motorists and hauliers, and requiring them to surrender them when they buy fuel. People who wanted to emit more than they had been allocated would have to buy more units on the carbon market, probably via the retailer. The investigation concluded that it might be difficult to arrive at a fair allocation methodology. This suggests that there was no intention to allocate units to the whole population, and to allocate them only to drivers or vehicle users. Proposals for a similar system for Ireland were more explicit about identifying everyone in the population in order to ensure they would receive a transport carbon allowance (Feasta undated). Dresner and Ekins (2004) specifically investigated the equity aspects of PCAs and alternative measures, with a particular focus on transport. They found that the most equitable system would be PCAs that cover car use and flights but excluded household energy use. Raux and Marlot (2005) found that, in their economic evaluation of a tradable carbon dioxide permits system for fuel used by motorists, there would be transfers of surpluses between motorists according to home location. The inclusion of public transport in a system of PCAs was found to be too cumbersome and costly, at least in the early years of a system (UKERC 2006).

One of RSA's interim recommendations was that personal carbon trading should initially be developed as a voluntary scheme. Additionally, Capstick and Lewis (2008) questioned how well behavioural economics would work, concluding that the possibilities for the effectiveness of a system of PCAs, in influencing the public's behaviour, are mixed. Thus the research community has set out the possibility for an experimental trial (UKERC 2007b).

Before the RedHENS research commenced, there was little previous work on public attitudes towards personal carbon allowances. The only known work was a YouGov survey for RSA (RSA 2006) which described a system in only very general terms. RSA later conducted research using a six hour 'citizen forum' with follow-up focus groups, collecting mainly qualitative data while also collecting quantitative data in the form of personal carbon footprints of the participants (RSA 2008). Work by Harwatt (2008), which also took place in parallel with this project, was particularly focussed on transport, giving only brief attention to home energy use. Other work taking place at the same time included that by DEFRA (2008a), IPPR (2008) and von Knobelsdorff (2008a, 2008b), with that by Bristow et al (2008a, 2008b) being closest to the RedHENS research, having considerable quantitative aspects. Howell (2007) highlights the need for such quantitative work. Her research investigated the public acceptability of PCAs using five focus groups but recommended further research involving a larger sample.

2.8 Alternatives to personal carbon allowances

The most obvious alternative to PCAs is carbon taxation. Home fuel is subject to the reduced rate of value added tax (VAT) (HMRC 2008b). Fuel for cars is subject to duty, which constitutes a high proportion of the cost (HMRC 2008a), and VAT at the standard rate. These taxes are proportional - they increase as the volume and value of fuel purchased increases. Flights are subject only to Air Passenger Duty (APD) (HMRC 2008c). At the time of writing there are only two levels of APD related to distance (doubled up by two levels of cabin class), so that tax cannot be said to be proportional to the amount of fuel used, or even to the distance a flight travels. The purchase of flights does not involve the direct purchase of fuel. However the fuel purchased by airlines is not subject to taxation (HMRC 2006), a source of constant controversy. There have been proposals that, instead of APD on each passenger, airlines should pay an emissions charge per flight which would reward flights that were full

(Conservative Party 2007). A minimum EU tax rate on aviation fuel and value added tax on air tickets have been suggested (Liberal Democrats 2008).

Sterner (2007) found that if Europe had not followed a policy of high road transport fuel taxes compared to the US, demand would have been twice as high. However taxes on fuel for homes gives a different picture. Dresner and Ekins (2006) looked at how to reduce carbon emissions from UK housing without impacting on the poorest households. They found that carbon taxes would worsen the problem of fuel poverty. They concluded that the best scheme involved surcharges on council tax and stamp duty for homeowners who failed to make energy efficiency improvements. Grants and loans would assist low-income households so that after a decade it would be practical to introduce a carbon tax. The Sustainable Development Commission proposed a similar scheme (SDC 2006).

Systems requiring members of the public to trade with each other are examples of ‘downstream’ trading schemes. By contrast, an ‘upstream’ cap and trade obligation scheme has been proposed for gas and electricity suppliers (NERA Economic Consulting 2006, Climate Change Capital 2007). This would involve the suppliers trading with each other according to the emissions resulting from their customers, with an allowance per household (or per occupant). Customers would not be required to trade, and their personal transport emissions would be excluded. Such a scheme would be likely to cause suppliers to search out the most energy efficient customers, or those customers most willing to have energy efficiency measures put in place. It might also lead to a rising block tariff. A rising block tariff involves gas and electricity customers paying a higher per unit price as they consume more (CSE 2008b). Currently they generally pay less per unit for units over a quarterly amount. A downstream variation of the gas and electricity supplier trading concept is that proposed by Niemeier et al (2008) for California, which would involve householders trading with each other, as in a system of personal carbon allowances, but only regarding their use of domestic gas and electricity only.

In the Republic of Ireland, due to the involvement of the Green Party in coalition, the government has considered a simpler alternative to personal carbon allowances, this being a Cap and Share System (AEA 2008, Feasta 2007, Cap and Share undated). There would be no trading system for the public to get involved in. A cap on emissions

would require suppliers of fossil fuels, or electricity and flights based on such fuels, to buy credits. Increasing demands would push up the price of the credits and therefore the cost of the fuel as paid for by individuals or households. Revenue from the sale of credits would be distributed amongst the population. Individuals would simply cash-in their allocation but would have to pay more for fuel and flights. Someone with below average carbon emissions would gain overall. A similar system has been proposed for the USA, covering all the carbon emissions in its economy, referred to as ‘cap and dividend’ (Barnes 2007).

2.9 Summary of the literature review

The level of carbon emissions from homes and especially from personal transport is difficult to reconcile with medium and long term targets to reduce emissions, especially when the UK leads on setting climate protection ambitions.

The replacement of existing housing occurs at a very low rate. Despite the range of information sources for advising on how to reduce carbon emissions from older homes, the public perceive barriers to installing energy efficiency measures. Although targets for the grant-funded installation of energy efficiency measures are being exceeded, the improvement in the energy efficiency of households is slow, and expansion of such schemes will see increasing challenges in the recruitment of households and the achieving of targets.

The supply of energy to homes is dominated by fossil fuels. Ambitious targets for the installation of energy efficiency measures in homes have been placed on the gas and electricity companies. These companies are dominated by the ‘big six’ which formed after privatisation and unbundling of nationalised utilities.

Virtually all the supply of fuel for car and airline transport is fossil fuel based. The sources of information about carbon reductions from personal transport are few, and the incentives for individuals and households to address this area are poorly understood. The government appears to be endorsing increased air travel by encouraging airport expansion and failing to tax air travel sufficiently. Meanwhile it is also failing to encourage and fund local transport authorities (LTAs) to encourage reductions in emissions from land travel, such as greater use of public transport. As a result bus use is in decline. Although people do not make significantly more journeys

than in the past, the overall distances they travel have increased. Increases in new vehicle efficiencies are not as great in other EU countries, due to the purchase of larger and heavier vehicles in the UK.

The role of local authorities on carbon emissions is minimal as most obligations are optional. Newark and Sherwood District Council go beyond their HECA Monitoring obligations, and send out information in response to the Home Energy Check forms returned to them. They also have an active energy agency team working in related areas, and have evangelised on household carbon emissions and have modelled them for a typical household in the area.

Thus the prospects for major reductions in carbon emissions look poor, especially in the context of an increase in the target to reduce carbon emissions by 2050 (from 60% to 80%). The literature shows that it is likely that changing attitudes to the environment may not result in sufficient change to behaviours that will bring about reduced carbon dioxides emissions. Therefore it is likely that policies that more directly result in individuals and households changing their behaviours are more productive.

Footprinting is an emerging technique which may go some way to ensure that environmentally oriented behaviours are more productively directed. However, the most successful policies are likely to involve financial levers, as these will work on those people who do not have environmentally-oriented attitudes (or have mis-directed environmentally-oriented behaviours).

Specific levers, such as taxes on certain types of fuel use, do not provide an overall coherent disincentive for individuals or households to reduce carbon emissions. Another emerging concept is that of personal carbon allowances. The government's footprinting tool covers emissions from the same sectors that personal carbon allowances would cover, i.e. home energy use, car use and flying.

2.10 Research focus

The above review of the literature for the subject area, defined by the main research question "How can carbon emissions by households be reduced?", points to the need for research on a number of issues. The wide variety of opportunities for people to reduce household carbon footprints, both within the home and in personal transport,

prompts a subsidiary research question, “What are the opportunities for people to reduce their household carbon footprints, and the barriers that prevent them from doing so?”. Issues such as those concerning energy efficiency grants and the means by which the beneficiaries are located, and concerning people’s understanding of energy efficiency, prompt another question “How can organisations such as councils and energy suppliers help people reduce their carbon emissions?”. There is only limited research into personal carbon allowances, and very little about public attitudes towards them, therefore prompting the third subsidiary research question for this project, “What are people’s attitudes towards personal carbon allowances?”.

3 Methods of data collection

This chapter examines the data collection techniques considered for the RedHENS research project, and how those that were used were selected.

3.1 Attributes of data collection

There are a number of techniques for collecting data from people. In this context, the emphasis is on ‘self reported’ data, in other words information provided by the respondents. It therefore excludes physical data such as that derived from blood samples, or data collected directly by the researcher (such as if the researcher was to measure a participant’s height). The techniques for self-reported data collection can be defined in terms of combinations of basic attributes of the data collection process.

A key attribute of the process of collecting data from people is the interactivity of the data collection process. The interactivity can be either single or multiple. In a single interaction situation, a pre-determined (i.e. scripted) question is posed and the respondent answers it (although they may chose not to answer, or to give a default response). The question is not prevailed upon, in that the respondent cannot provide further information, or interact further with the researcher regarding it. However the response to a question may determine whether or not other pre-determined questions are asked or skipped, and there may be an opportunity for the respondent to make limited further comments, typically towards the end of the data collection process. In a multiple interaction situation, there may be more than one pair of communication flows between the researcher and the respondent regarding a question. The response to a question may lead to further unscripted questions from the researcher, or additional information from the respondent. Note that in longitudinal data collection (Robson 2002: pp. 160-161), the same question may be asked the same question in different data collection sessions on different dates, but, in effect, it is not the same question being developed further.

A second basic attribute of a data collection process is the number of respondents or participants excluding the questioner or researcher. A respondent is generally one person being researched. Data may be collected from a single respondent, or from

multiple respondents simultaneously. In the latter situation, any responses may prompt further responses from other respondents (Robson 2002: pp. 284-285).

A third basic attribute of data collection is the type of data being collected, either quantitative or qualitative. Quantitative data (Bryman 2004: pp. 218-227, Robson 2002: pp. 391-395) is that which is generally associated with a closed style of questioning, where the respondent is forced to give, in answer to a question, a quantity, date, name (or other short textual answer) or, very commonly, a selection or from a list of options. Quantitative data can generally be stored in a data store with a row and column type structure, and much of the data can processed using statistical tools (Field 2005, Pallant 2005). Qualitative data (Robson 2002: pp. 455-457, Bryman 2004: 265-268) is generally associated with open style of questioning where respondents are offered flexibility in how they answer. Responses tend to be transcribed and stored in a free format textual style, such as in a word processing package, and analysed using a ‘qualitative data analysis’ (QDA) tool (Bryman 2004: pp. 398-416). Without at least initial classification, it is unlikely that qualitative data can be directly processed by statistical tools. Data collection is rarely all quantitative or all qualitative. For example, even where respondents are given options to tick on a questionnaire, a question will often have an answer option for an unspecified (‘other’) situation. There will then typically be a free format field allowing the respondent to specify that particular case. The type of data should not be confused with the interaction in the data collection process. It is possible to collect quantitative or qualitative data in a process where there is a single interaction, as well as to collect qualitative or even quantitative data in a multiple interaction situation.

A fourth attribute is the channel through which the questions and responses are transmitted, often known as ‘mode’ (Dillman 2006). The channels include physical, telephone, internet and face-to-face (Robson 2002: p.236, Bryman 2004: p.86). The physical channels are dominated by paper and the postal (mail) system but also includes collection boxes and human collectors (at events, or operating door to door, etc.). Physical data collection channels also require a means of distributing the questionnaire to the respondents, and this is sometimes different from the means of response. For instance, a survey questionnaire can be distributed by door-to-door delivery, but the responses might be sent through the postal system. The telephone is a common form of research data collection. Internet data collection might be via the

World Wide Web (i.e. a website), using software specially installed on respondents' (and researchers') computers, or via email. Face-to-face data collection is another familiar channel of data collection, where the questioner (or researcher) and the respondent (or respondents) are in each other's presence.

A fifth attribute of data collection is its synchronisation. Data collection can be synchronous, in that the questioner (researcher) and respondent must be communicating together in real-time, although not necessarily in the same place. In an asynchronous situation, questions and responses can occur with delays, as long as they occur in a useful order (Giatsi et al 2006, Bryman 2004: pp. 470, 475, 476).

3.2 Data collection techniques

The combinations of the five attributes of data collection give rise to a number of techniques for collecting data from people, as shown in Table 3.1:

Table 3.1 Techniques for collecting data from people - showing attributes

Technique	Technique sub-type	1. Inter-action	2. No. of responses	3. Data	4. Channel	5. Synchro-nisation
Survey	Self completion questionnaire	S	1	N, L	P	A
	Survey by Internet	S	1	N, L	I	A
	Structured interview by telephone	S	1	N [L]	T	S
	Survey by structured interview	S	1	N [L]	F	S
One-to-one interview	Face to face interview	M	1	L [N]	F	S
	Telephone interview	M	1	L [N]	T	S
	Internet interview	M	1	L [N]	I	A [S]
Group interview	Focus group	M	>1	L [N]	F	S
	Group interview by Internet	M	>1	L [N]	I	A [S]

Key:

1. Interaction	Transaction type: single (S), multiple (M)
2. No. of responses	Number of respondents: single (1), multiple (>1)
3. Data	Type of data required: quantitative (N), qualitative (L)
4. Channel	Channel: physical (P), telephone (T), Internet (N), face-to-face (F)
5. Synchronisation	Synchronisation: asynchronous (A), synchronous (S)
[ ]	Square brackets indicate occasional or supplementary use.

Robson (2002: p.223) gives an overview of data collection methods. The three broad types of data collection technique are described below.

3.2.1 Surveys

Surveys generally assume a one-to-one communication model, although in many cases the respondent may be a household or even a group of people, for example, people working for an organisation. Surveys, of all methods of data collection from humans, benefit from the widest range of channels for collecting data (Robson 2002: p.236, Bryman 2004: p.86). These channels comprise the physical or postal type of

channel (self-completion questionnaires), the Internet, telephone surveys and structured interviews. Self completion questionnaires are generally paper based (Bryman 2004: pp. 130-143). They also generally rely on being returned from the public via the postal system but they may also be collected by door-to-door collectors. In a controlled environment, such as a class or meeting, there may be a collection box or someone actively collecting (Bryman 2004: pp. 132). Internet surveys can also be described as self-completion questionnaires although when the Word Wide Web (web pages) are used, the system can highlight erroneous responses, which is not usually possible with paper-based questionnaires. Occasionally Internet-based surveys will use email (Bryman 2004: pp. 480-487), and many use email to reach and prompt respondents even if the response is via the World Wide Web. Telephone based surveys are a common alternative to self-completion questionnaires (Robson 2002: pp. 253-256) and are often considered cheaper than structured interviews (Bryman 2004: pp. 133-135). All the data collection channels for surveys can be used without pre-arrangement with the respondent, even structured interviews (although these are often pre-arranged because they are typically conducted face-to-face, they can also be performed without any long term pre-arrangement, by approaching people at events or public places).

3.2.2 One to one interviews

Interviews divide into one-to-one interviews and group interviews (the latter are covered in the next section). Interviews, in the very general sense of the word, might be deemed to include structured interviews, which are covered under the heading above. This section is rather more concerned with semi-structured and unstructured interviews (Robson 2002: p.270). One-to-one interviews may be conducted face-to-face, via the telephone, or by using asynchronous interview methods (via the internet). Face-to-face interviews are more likely to be pre-arranged than not, especially in comparison to structured (survey) interviews, as they are likely to be longer and more challenging for the respondent. One-to-one interviews may take place in public, at an arranged event or in the home, where they present the opportunity to allow other members of a household to be included, as appropriate. Telephone interviews (Robson 2002: p.282) allow the researcher to save travelling time and associated costs but they are less useful in allowing the researcher to see respondents' body language and environment (especially if they take place in the home), and present challenges in dealing with

interruptions. Online interviews (and focus groups) are compared with the face-to-face equivalents by Bryman (2004: p.477).

Asynchronous interview methods have developed due to the availability of the Internet (Giatsi et al 2006, Bryman 2004: pp. 470, 475, 476). Other forms of interviewing are synchronous (real-time), but asynchronous methods, which do not require immediate responses (or immediate follow-up prompts), offer new opportunities to collect data from people who have busy lives and are perhaps not able to commit to being interviewed in a single session. They also allow the researcher more flexibility in arranging his or her time for data collection.

3.2.3 Group interviews

Group interviews are often known as focus groups although some believe that there are subtle differences, largely to do with the latter's history in the marketing industry (Robson 2002: pp. 283-289). They tend to be pre-arranged because of the challenges of bringing together respondents who are generally not know to each other. The channels used are the same as for one-to-one interviews with the general exclusion of telephone, as multi-party telephone calls are difficult to arrange and to manage. Group interviews offer the advantage of respondents prompting each other to consider and discuss other issues but with the disadvantage that certain participants and opinions may dominate (Bryman 2004: pp. 345-362).

3.3 Sampling

An important aspect of data collection from people is the means by which those people are located, selected and recruited to partake in the research. This is known as sampling (Robson 2002: pp. 260-266). Its purpose, particularly in quantitative research, is to gather data from just a part of the whole population but which represents that whole population. In the context of collecting data from people, the term 'population' does not necessarily refer to the whole population of a nation, place or the world, but to all the people who are relevant to the research. A list or other means of identifying that population is known as the sample frame. For example, in research about the experiences of UK students, the population would be likely to be all students in the United Kingdom(and the sample frame a list of all the students).

There are a number of ways to achieve representation of the population in a sample, including random sampling (Bryman 2004: p.87). In practice, researchers may be limited by budget and time, and may have their sample imposed upon them by circumstance, usually by existing lists, contact details and events. In sampling for interviews (Bryman 2004: p.333), especially for qualitative research, the representativeness of the sample may be of less concern, as it is unlikely conclusions based on statistical significance of the collected data will be drawn.

3.4 Other data collection techniques

There are other techniques of collecting data from people, and they are discussed in this sub-section. Secondary analysis of existing data sources (Bryman 2004: pp. 201-206) is a common means of research. Such data has been previously used, either for research or other purposes.

So far, only those techniques which are for collection of data which can be described as ‘self-reported’ - in other words about people’s declared views - have been described. Direct observation (Robson 2002: pp. 309-313) involves the researcher collecting data from humans, sometimes without their awareness and, within a closed environment, typically with their permission. The data might include details of conversation, behaviour and the surrounding environment. Content analysis (Bryman 2004: p.181) is a very broad style of research but in the context of gathering data about people, documents that are associated with them, such as correspondence they have received or diaries that they maintain, can be analysed.

Note that if a number of techniques are to be used to collect data about a person or group of persons, then the research can be described as people-oriented case studies (Yin 1994), although a case study is more likely to be associated with undertaking research into organisations.

3.5 The chosen methods

This research project (RedHENS) included two data collection stages, the first being quantitative, in the form of a postal survey, and the second being mainly qualitative, consisting of semi-structured interviews. The detailed choice of data collection methods was determined by external factors. Sponsorship by, and the support of, Newark and

Sherwood District Council (and its energy agency) determined that most data collection would occur in its borough. Their existing postal survey data was used as part of the survey (quantitative data), and for sampling (finding candidates) for the interviewing (qualitative data).

The distance between the university and Newark and Sherwood borough, and limited telephone facilities at the university, meant that structured interviews (face-to-face) would have been impractical, particularly when taking into account the sample size. A postal solution was the obvious choice for collecting the survey (quantitative) data. A website for data collection was considered, but rejected on the grounds that it would exclude many participants. Furthermore, most of the survey data was being collected from pre-1995 homes. The participants had already had answered the council's postal questionnaire, so there was an obvious need for a postal survey to follow that up, as the address information was the only means of making further contact with the majority of those households. The university's lack of internal means of charging the project for reply-paid postage also encouraged the use of a self-completion survey returned through the postal system. NSDC were also able to include the RedHENS questionnaire in with their responses to the returned HECAmon questionnaires, thus saving the project outbound postage costs.

The methodology of the second stage was fully defined only after examining the results of the first data collection stage. The choice of qualitative research, after a quantitative research stage, was obvious, in that it allowed the quantitative findings to be explored more deeply. Mixed quantitative and qualitative approaches of the type used in RedHENS are not unusual (Tashakkori and Teddlie 1998). Arksey and Knight (1999) write of the value of mixed approaches in 'triangulation' - in other words, verifying findings uncovered by one technique by using the complementary technique. Research on a particular issue tends to swing back and forth between quantitative and qualitative data collection. Indeed, the need to switch from quantitative to qualitative techniques was suggested as future research for carbon emissions from personal transport use (DfT 2006a: Summary p.3). Cost constraints, which meant that suitable venues could not be paid for, the lack of administrative support which would have provided the means to book candidates, and the remoteness from university of the geographical area of the research, meant that focus groups could not be organised. The benefit of seeing an individual person or family in their own home also excluded focus groups as

a means of data collection. Given that one-to-one face-to-face interviews in the home (albeit with, in some cases, one household rather than one person) were selected, the choice was then between semi-structured or unstructured interviews. Unstructured interviews were rejected on the grounds that the research was intended to further investigate the issues raised in the postal survey.

Similar mixed methods work in this subject area include that by the Open University (OU DIG 2007) and Carbon Neutral Newcastle (2005). In fact the latter research implies that interviews, not limited by time, would be an improvement on the qualitative data collection technique used on that project, which was group sessions (ibid: p.65 and appendix II).

Other data collection techniques were used on the RedHENS project (i.e. other than directly from people. There were elements of content analysis (Bryman 2004: p.181) because the researcher looked at the electricity and gas bills of some interviewees. Secondary analysis featured (HECAmon data fits somewhat with this) (Bryman 2004: pp. 201-206), as data from Newark and Sherwood's own postal survey was used. Direct observation (Robson 2002: pp. 309-313) was unavoidable and indeed intended, when performing the interviews in homes (Robson 2002: p.311), for example observations about the use of washing machines. However this was not structured as Bryman (2004: pp. 164-179) suggests, when used as the primary data collection technique. Lastly, the second data collection stage had elements of case studies of households involved (Yin 1994).

Overall, the approach used was a response to the lack of empirical research in the area, especially regarding personal carbon allowances and related issues. Further details of literature relating to methods are given in the methods chapters for each of the two data collection stages.

4 Postal survey of residents of NSDC - Methods

This chapter describes the first stage of data collection work, which involved a postal survey of residents of Newark and Sherwood District. This stage of the research addresses aspects of all the research questions. The main question “How can carbon emissions by households be reduced?” is broken down into three subsidiary questions. The first subsidiary question, “What are the opportunities for people to reduce their household carbon footprints, and the barriers that prevent them from doing so?” is addressed by examining the survey questions relating to the reach of the energy efficiency grant schemes, the range of information about energy efficiency issues, the effectiveness of those organisations who refer people to these grants, and the extent of home improvements which may be boosting household emissions. The second subsidiary question, “How can organisations such as councils and energy suppliers help people reduce their carbon emissions?” is addressed by the questions that test how effective the councils in Newark and Sherwood District are at referring residents to energy efficiency grants, and that check the state of the relationships between gas and electricity suppliers and residents. The third subsidiary question, “What are people’s attitudes towards personal carbon allowances?” is addressed by a specific set of questions in the survey. The survey questions derived from the activities of Newark and Sherwood Energy Agency, which are broadly similar to those of other practitioners in the field of household carbon emissions. There were three slightly different questionnaires to address three mutually exclusive groups. These groups were people living in pre-1995 private housing, people living in newer private homes, and people living in council housing.

The conduct of the survey and the developments of the questionnaires was influenced by Dillman (2007), Robson (2002), and Scheuren (2004). The survey used quantitative techniques, in that the questions were predominantly ‘closed’ (mainly tick-box options as answers), which could be analysed using statistical techniques (Dillman 2007: p.43). Note that Scheuren’s paper, ‘What is a Survey’, was derived from a series of papers of the same name which he edited for the American Statistical Association.

4.1 Previous work in the field

As a starting point, the survey used questions from Home Energy Checks or HECs. These have been used by the Energy Saving Trust (EST 2008b), Energy Efficiency Advice Centres, WarmZones, local authorities (particularly when carrying out their HECA Monitoring responsibilities), energy agencies and energy suppliers. HECs have taken the form of web pages, paper forms and even telephone call scripts. For more details on the variety of these, see Baker (2007), who refers to them as HEQs or 'home energy questionnaires'. Of particular interest are those used by the Nottinghamshire and Derbyshire Local Authorities Energy Partnership (NDEEAC 2007), and Newark and Sherwood Energy Agency (see 12.1 Appendix - NSDC's HECAmon questionnaire) which is often simply known as the 'HECAmon' (HECA Monitoring) form. The purpose of the HEC questions is to gather basic details about the home (built form and age), household (i.e. number of occupants, whether there is anyone over 60) and details about heating and insulation, as well as changes to these details in the last year. Newark and Sherwood Energy Agency's version of the questionnaire is a slightly simplified version of the versions used elsewhere. NSEA believes that the simplified version gives the high response rates in their HECA monitoring activities.

Carbon Neutral Newcastle (2005: Appendix III) looked at public attitudes to climate change, and motivators and barriers to action in Newcastle and the northeast of England. They collected quantitative (as well as qualitative) data, although this was done face-to-face rather than through the post. The questions they asked of particular relevance to the RedHENS project were those in relation to the actions people were prepared to take to lessen the impact of climate change. These correspond somewhat to the questions in this survey regarding responses to a system of personal carbon allowances. They relate to, for example, using public transport, making one's home energy efficient and cutting down on flights.

A more complete analysis of some of the previous work in this area is hampered by the lack of full information as to the questions asked of the respondents. An example is the analysis of home energy conservation activities of households in Bath by Brandon and Lewis (1999). The constraints of academic journals means that original questionnaires and other research tools are not often included in the published papers. However sufficient details are revealed in the paper to indicate that the questions posed were mixed quantitative (closed style including Likert scale questions) and qualitative (open

style questions). It should be noted however that the closed style questions were primarily used to select respondents for further detailed research, and that they were posed face-to-face as opposed to being part of a postal questionnaire. Their questions explored issues such as environmental attitudes, attitudes to energy conservation, and perceptions about their efficacy in addressing energy related problems, with further questions (a mixture of closed and open-ended) about energy knowledge and current energy use.

Other more recent quantitative survey work exists in this area, but was carried out after the RedHENS survey commenced, for example the Central Office for Information's work for DEFRA on attitudes to climate change (DEFRA 2008c: p.29), which also looked at actions to help limit climate change. The questions looked at issues to do with insulation, reduced car use, flying less, and other means of reducing carbon emissions. Such recent work is cited for comparative purposes in later sections of this thesis, in which results are discussed.

4.2 Development of the questions

This section describes the development of the questionnaires used in the three versions of survey. The emphasis here is on the questions asked in the 'pre-1995 housing' version of the survey. This survey version was covered by two questionnaires - the council's own HECA Monitoring questionnaire (see appendix 12.1), and then the RedHENS project's own 'post-HECA' questionnaire, conducted a few weeks later (see appendix 12.3). Each question can be traced back to activities of Newark and Sherwood Energy Agency, and generally to other practitioners in this field, such as the Nottinghamshire and Derbyshire EEAC (energy efficiency advice centre) based in Buxton, the Energy Saving Trust, and related initiatives elsewhere (e.g. WarmZones).

There were no demographic questions included in the surveys because Newark and Sherwood Energy Agency advised that in their experience it would lower response rates (David Pickles, personal communication, September 2005). Furthermore, there was a lack of space on the survey form, and it was important to keep the survey to a single sheet in order to achieve as high a response rate as possible. In particular questions about occupation type and income bands would have taken up a lot of space. Previous research in the area of energy services also indicates that social class and other demographic variables have little bearing on research results (Cragg Ross

Dawson 2004: pp. 28-29). Most HECs do not have questions of a demographic nature (other than the presence of over-60s or under-16s in the household).

The number of questions relating to fuel poverty issues was constrained by the difficulty of conducting research in this area. Questions about income, the receipt of benefits and fuel spend could have reduced the response rate, even amongst those who would not be classified as fuel poor (David Pickles, personal communication, September 2005). Newark and Sherwood's prominent work in the area of fuel poverty meant that research into fuel poverty issues was actively considered but the above constraints meant that the research would eventually give much more emphasis to the 'fuel rich'.

Early drafts of the questionnaire featured questions about standby, and about how respondents would view, and respond to, carbon taxes on food. They were dropped because they did not adequately address the research questions, were difficult to quantify, and were likely to be addressed by other research.

4.2.1.1 Questions about the household

Questions about the household, or the occupants of the home, appeared on Newark and Sherwood's HECAmon form. They ask for the number of people, and the number aged under sixteen and over sixty. These questions were asked because these issues can have a bearing on qualification for grants. The question about the number of people under 16 was not included on the questionnaires for new homes and council homes, due to lack of space.

4.2.1.2 Questions about the home's basic details

Basic questions about the home appeared on the HECAmon form used by Newark and Sherwood Energy Agency (NSEA). They ask about the built form of the home (e.g. detached house or mid-floor flat), the number of storeys and its age. The question about tenure was used in the new homes and council homes surveys as a check that the questionnaire had reached the correct type of household. All these questions are of the type where the respondent is asked to tick one of a set of options.

4.2.1.3 Questions about the home's energy efficiency

Questions about the home's energy efficiency appeared on Newark and Sherwood's HECAmon form and were also used on the new homes and council homes questionnaires. They fall into three groups, relating to insulation (including glazing), space heating and hot water. The questions about insulation ask about wall type and insulation (e.g. solid wall, or insulated cavity wall), loft insulation (e.g. 50 mm depth, "don't know" or "no roof"), and windows (e.g. wood single glazed, uPVC double glazed). The questions about heating cover the fuel (e.g. gas, electricity or oil), system type (e.g. "central heating with radiators and standard boiler" or "central heating with radiators and condensing boiler"), and heating controls (e.g. "programmer", "room thermostat", or "thermostatic radiator valves"). The questions about hot water cover the method of heating the hot water (e.g. "from central heating", or "off-peak electric immersion"), the cylinder (e.g. "no cylinder", "cylinder with loose jacket") and whether there is a cylinder thermostat. For all these questions, the respondent was asked to tick either only one option per question, or more than one option, as appropriate.

Questions about measures (such as insulation, or a new boiler), that have been installed within the last twelve months, appeared on Newark and Sherwood's HECAmon questionnaire, as this helps with their HECA reporting to government about improvements in household energy efficiency in their area. The questions were not repeated in the new homes and council homes surveys as RedHENS had more emphasis on grant assisted measures over a longer period (see next sub-section, 4.2.1.4).

4.2.1.4 Questions about energy efficiency grants and referrals

The questions about grants were developed from existing sources. The questions about recent energy efficiency measures on a wide variety of Home Energy Check forms (Baker 2007) were used as starting points. One particular source was Newark and Sherwood's HECAmon form, so in effect respondents to the 'post-HECA' survey were asked two similar sets of questions, as those that completed the post-HECA form had already completed a HECAmon form. The measures of interest were confined to those that were likely to have been fully or partly grant funded. Additional questions about the source of the grant, the year it took place, whether there was full or part funding for the measure, and the method of finding out about the grant (i.e. the method of referral), were posed. As appropriate, the respondents were able to select an option

for ‘other’ and specify the details. Regarding the question about the year of a grant, consideration was given to the principle of providing appropriate time referents (Dillman 2007: p. 67, Schwartz and Oyserman 2001). However it was decided to exercise any cut-off year, if required, during data entry, as to ask the respondents not to report on energy efficiency grants before a certain year might have reduced the number of responses to the question, with potentially a significant number of grants being made just before the cut-off.

The question as to whether the grant was fully or partly funded can be used as a proxy for ascertaining whether the grant was primarily to alleviate fuel poverty, or to reduce carbon emissions by the “fuel rich”. The question asking about the method of referral helps to ascertain which organisations and channels are most appropriate for getting people to take up energy efficiency grants. Note that there are several options relating to Newark and Sherwood District Council and other local authorities in the area. Such information helps the energy agency, as sponsors of the research, to ascertain which methods they are using are the best for reaching residents. Asking about the source of the grant allows the comparison of overall data for the district (from this survey) to be compared to NSEA’s own figures for the referrals it makes.

This was one of the set of questions where an explicit ‘skip’ was given to the respondents. If they answered ‘no’ to the questions about having received a grant, they were directed to skip to the next set of questions (Dillman 2007: p.99).

No previous work of this particular nature has been identified (although it is likely that national organisations involved in this field will have conducted unpublished research to check their own effectiveness).

4.2.1.5 Questions about understanding energy efficiency

Newark and Sherwood Energy Agency sends out a variety of printed energy efficiency advice (from sources such as the Energy Savings Trust), as well as having advice on the Council’s website (NSDC 2008). On the post-HECA, new homes and council homes questionnaires, the relevant questions were phrased as being about ‘understanding heating systems and insulation’ in order to avoid using the term ‘energy efficiency’ too often.

There has been a small amount of previous work in this area. Brandon and Lewis (1999) looked at preferred methods of receiving household carbon reduction information, particularly on the use of a computer versus being given leaflets. Carbon Neutral Newcastle (2005: Appendix III Question 22) looked at respondents' choices for 'information on climate change and energy efficiency and what to do about it'. However the question was much more general, offering such options as 'energy efficiency bodies' and 'TV'. The latter is much more likely to be a source of motivation rather than a direct information (or reference) source.

The tick-box options offered to respondents were based on existing information sources. The colour booklets and basic website options stem from the energy agency's own activities, as well as a wide variety of publications and websites offered by energy agencies, councils, gas and electricity suppliers, campaigning organisations and others (for details, refer back to section 2.4). The 'interactive website' option is based on the Energy Saving Trust's own website, which generates advice specific to the user. The telephone helpline option reflects the fact that the Energy Saving Trust, and its local and regional outlets, operate telephone advice services. The DVD option was an original idea but not long after the survey was conducted, National Energy Action's released its multi-lingual DVD, although it was rather more aimed at the fuel poor (NEA 2006a). The retailer B&Q also later produced an inexpensive DVD giving advice on home insulation (B&Q 2008).

Two tick boxes were provided against each option, one for indicating that the respondent would use the facility themselves, and one to indicate that they think the option should be made available for others to use. This was to avoid confusion on the part of respondents, who might be unsure as to how to answer if an option didn't suit them but, in their view, was suitable for other people.

4.2.1.6 Questions about loft conversions and conservatories

Questions were asked about conservatories and loft conversions at the request of Newark and Sherwood Energy Agency. This was because of their concern that these were leading to higher carbon emissions from the domestic sector within the borough. Councils do not have information about loft conversions and conservatories as planning permissions does not always have to be sought for them (Planning Portal

2008). The questions were posed on all three surveys (post-HECA, new homes and council homes).

Regarding loft conversions, respondents were asked whether one was present in the home, the year it was made, the number of rooms, and how it was heated (i.e. whether it is not heated, connected to the main heating system, or has separate heating).

For conservatories, respondents were asked whether one was present, how it was heated (as per the loft conversion options), its area and whether it opens direct into a room.

There is no notable guidance for energy efficiency in conservatories and indeed conservatories were cited in the 1980s and 1990s as being a potential energy saving measure for homes by providing extended living spaces that were heated through solar gain but this was before people began to heat them artificially ('Leicester Ecology Trust' undated). The Energy Efficiency Best Practice in Housing programme has however produced guidance on making loft conversions energy efficient (EST 2005).

No previous research asking questions about these issues could be located, although it is likely that market research aimed at increasing sales of conservatories and loft conversions has taken place.

4.2.1.7 Questions about water usage

The question about water usage was posed because Newark and Sherwood Energy Agency's work on carbon footprinting covered the emissions caused by domestic water consumption and sewerage generation, see section 2.2.2. Furthermore, Newark and Sherwood recommended consideration of water metering in its advice to residents (NSEA 2005b). Given the agency's work on fuel poverty, the advice was given because of the potential to reduce bills. Those paying water rates pay a fixed amount for their water supply, whereas virtually all electricity and gas tariffs are unit based. Switching between gas and electricity tariffs, even combined with implementing energy efficiency measures, is unlikely to achieve as great a saving, proportionally speaking, as some cases of opting for water metering (Uswitch 2008b). Where an occupant is living alone, they have an increased chance of being in fuel poverty but their water usage is likely to be low. For the non fuel poor, water metering is likely to be a means of actively

encouraging reductions in water usage and thus reductions in the consequent carbon emissions, driven by cost savings. Therefore the question was structured to address both the fuel poor and non fuel poor audiences by ascertaining how much money those who had opted for water meters had saved. Note that, as well as generally being more energy efficient, properties built since 1989 are fitted with water meters (Severn Trent Water 2008). Thus the question did not appear in the new homes survey. It also did not appear in the council homes survey, due to lack of space.

4.2.1.8 Questions about personal carbon allowances

The questions on personal carbon allowances (PCAs) stemmed from the European funded projects, at Newark and Sherwood Energy Agency, about household carbon footprints, as explained in section 2.2.2. It is difficult to compose questions about carbon footprinting. At the time, 2006, asking such questions as to whether residents were aware of, or had ever attempted to calculate, their footprint, was likely to result in a very high proportion of negative answers, simply because so few people would have used a footprint calculator. Consideration was given to collecting data sufficient to calculate a carbon footprint but this would have made the questionnaire much longer and would have required extensive testing in a variety of scenarios, as there would be no opportunity for the researcher to help the respondent by asking additional questions once any confusion or complication arose. Such questions could also have reduced the response rate (David Pickles, personal communication, September 2005). However, as section 2.6 shows, work had already been done in the area of personal carbon allowances (PCAs). Furthermore, the concept of PCAs enforces the concept of having an above or below average footprint, as it would lead to financial gain or penalty (Fleming 2007). Thus it was decided to pose questions about support for, and responses to, personal carbon allowances.

The question about attitudes was framed as a one-to-five Likert scale which ranged from ‘support strongly’ to ‘strongly opposed’, in the balanced fashion that Dillman (2007: p.58) recommends. The main challenge was to provide a preamble which explained the context as concisely as possible, including what fossil fuels are, references to nuclear energy and renewable energy, as well as to describe an allowance and the concept of trading.

There were a further ten questions, in three groups, about responses to PCAs. The respondents were asked to put aside their attitude to PCAs (as just expressed) while answering these questions. The intention was to check understanding of the concept of PCAs and to ascertain how respondents would be willing to reduce their carbon footprints. Note that these questions are arranged in boxed arrays, and exploit the Dillman (2007: p.101) items-in-a-series format.

The first group of six questions asked about the actions respondents would take to reduce their footprint. As the rest of the questionnaire was dominated by home energy efficiency issues, only one of the six asked about that issue, and the rest related to transport issues. Three of these relate using a smaller car, using public transport or cycling, and avoiding flying. Another two relate specifically to commuting. They were posed because of a potential shortcoming of the question about using a smaller or more fuel efficient car. This relates to the issue that even if a respondent has a small or more fuel efficient car, if the most regular journey (the journey to work) is long, then emissions will still be fairly high. The proportional difference in emissions across a range of commonly driven cars is small (Directgov 2008b, Lane and Potter 2006) compared to proportional differences in commuting distance. Thus commuting distance is potentially a greater influence on carbon emissions from commuting than vehicle efficiency, especially as average commuting distances are long in the UK (RAC Foundation 2003). Brand (2006: p.198) cites the need for work in this area. Distance was also an issue in framing the questions about using public transport and cycling. Although Carbon Neutral Newcastle (2005: p.44) included walking as a way of reducing emissions from car use, it was excluded from the RedHENS research because the savings in carbon emissions would be small, due to the limited distances that people can walk as a substitute for driving. The response options to the six RedHENS questions were “probably”, “possibly”, “unlikely”, “don’t know” and “already do this”.

The second group of ‘response’ questions consisted of two questions and explored the purposes people would keep personal carbon allowance units for. The questions again concentrated on non-home issues, namely car use and flying. Although useful as separate questions in themselves, they also acted as a means of checking the answers on transport issues in the previous group. The response options for these two questions, and the next two, were probably, possibly, unlikely and don’t know.

The third group of 'response' questions, also consisting of two questions, asked whether people envisaged buying or selling units. These questions were intended to check overall understanding of the concept of PCAs and potentially find out whether respondents viewed themselves as high or low carbon emitters. If respondents ticked 'probably' for both, they could be showing a misunderstanding at the individual level. If the respondents nearly all tick probably to one question and unlikely to the other, that could have indicated a misunderstanding, or strong views, at the population level.

No previous work about support for and responses to personal carbon allowances could be located while the RedHENS survey was being developed.

4.2.1.9 Questions about energy efficiency versus renewable energy

When this survey was being designed, there was controversy about renewable energy (RE) grant schemes like Clear Skies giving grants for properties which did not have all the appropriate energy efficiency (EE) measures in place. Stories of people applying for grants for renewable energy, or even funding it completely themselves, while not understanding that it would be more appropriate to reduce their energy use rather than attempt to generate energy, were commonplace (David Pickles, personal communication, 4th March 2005). When the Low Carbon Buildings Programme grant scheme commenced in 2006, it was thus restricted to households which had the energy efficiency measures in place (LCBP 2008a). However that restriction enforces some so-called 'low cost' energy efficiency measures only. Higher cost energy efficiency measures, such as solid wall insulation, are not included.

Thus a question was generated which set renewable energy against low cost and high cost energy efficiency measures. This question ascertains respondents' attitudes about subsidies of these. To prevent them being constrained in their answer by a lack of knowledge, a pre-amble is given which emphasises the cost of energy from domestic renewable sources (as well as the difference between cheaper and more expensive energy efficiency measures). The text about the high cost of domestic RE could lead to respondents thinking that energy efficiency needs subsidising, or conversely that they should be avoided, so was considered unlikely to cause significant bias in the responses.

No previous survey work about attitudes to energy efficiency versus renewable energy could be located.

4.2.1.10 Questions about gas and electricity suppliers

Questions were asked about gas and electricity suppliers, as they are important with respect to householders' carbon emissions. Competition in gas and electricity supply has lead to NSEA and others recommending switching as a way of reducing fuel costs and as a way of reducing fuel poverty (NSEA 2005b). When the survey was being developed, stories about problems with suppliers, particularly when switching gas or electricity suppliers, were widespread, see section 2.2.3. For most of the questions, two response options had to be provided, for both gas and electricity, although it was recognised that not everyone, especially in a rural area, might have a gas supply.

The first set of questions was about whether the respondent had changed electricity or gas supplier in the last year, and if so, how this had occurred (with respondents advised to skip the secondary question if they answered 'no'). With this question, it was decided that it was necessary to apply the principle of providing appropriate time referents (Dillman 2007: p. 67). It was reasonably likely that the problems experienced during a switch of electricity and gas suppliers would have changed compared to recent years, especially as the suppliers would be likely to respond to the criticisms levelled against them. Thus the respondents were asked if a problem had occurred only in the last twelve months.

The range of answer options to the question about how the transfer occurred was fairly straightforward to specify, with the main interest being in whether a switch was prompted by a sales approach, or by the respondent opting to use a price comparison service. The use of a comparison service was recommended by NSEA (2005), who referred residents to the statutory consumer body EnergyWatch on this matter (the functions of EnergyWatch have now been absorbed into Consumer Focus). A third question asked about whether the respondent was forced to change to direct debit payment when switching. This stems from the fact that there has been controversy about the cheapest tariffs only being available for direct debit payment, which obliges customers to have appropriate bank accounts, which the fuel poor often do not have (Fuel Poverty Advisory Group 2005).

The next (fourth) question looked at whether respondents had experienced problems with the gas or electricity supplier within the last year. Most of the response options for this and the next question, generally relating to customer service problems (especially billing), were influenced by the work of the National Association of Citizens' Advice Bureaux in resolving client problems within the competitive system of gas and electricity supply (NACAB 2002). To avoid confusion between a question not being applicable to a respondent, and the respondent completely ignoring the question altogether, an option worded 'No, everything has gone smoothly' was offered.

The fifth question asked, if the respondent had never switched gas or electricity supplier, why they had not done so. There was the risk that it would be impossible to distinguish between people not filling in an option because they had never switched supplier, and people simply ignoring the question altogether. An extra option, as in the previous question, would have involved very convoluted wording, and Dillman recommends simple wording (2007: p.51). Only an additional question specifically asking if the respondent had never switched would have been a suitable work around for this problem. However this would have repeated much that had been asked in the previous questions. It was thus decided, especially in the light of lack of space on the questionnaire, to avoid trying to allow for all possible situations.

No previous quantitative research could be found for this subject area, although it is likely that individual gas and electricity suppliers may have conducted private market research.

4.2.1.11 Further contact and return instructions

The last question asks whether the respondent would be willing to have further contact with De Montfort University. It is followed by instructions for returning the questionnaire to the university. This, and the structure of the questionnaire as a whole, fits with advice from Dillman (2007: p.120) about having instructions appropriately placed around questions.

4.3 A summary of the types of question

In summary, the questionnaires contained questions for a variety of subject types. The first few questions were dominated by factual matters (or in some cases respondents' perceptions of the facts). These were generally about the home and the household

(occupants of the home), and included questions about the number of bedrooms, the depth of loft insulation, the year the home was built and its built form, and whether there were over-60s in the home. There were questions about attitudes, for example about renewable energy versus energy efficiency, and support for personal carbon allowances. There were questions about past behaviours, for example about whether the respondent has switched supplier in the last twelve months. These could be better described as actions rather than behaviours, as most of the questions relate to one-off events rather than continuous or long term behaviour, although the fact that a respondent has never taken a particular one-off action could be described as a (continuous) behaviour. In addition, there are questions about future behaviours, for example whether the respondent would use public transport more under a system of PCAs.

Most of the questions were multiple choice, i.e. they had tick-box options (known as check-box in US English). The majority of these were categorical, in that no ordering can be implied. An example of this is the question about energy efficiency grant referrals. The options ‘Leaflet with gas or electricity bill’, ‘Presentation at a meeting’ and ‘Energy Saving Trust’ cannot be ordered in a way that suggests that each one is greater or lesser than the others.

Dillman (2007: pp. 63-64) contrasts questions with mutually exclusive answer options with those that have options where more than one can be selected. By the definition given by Field (2005: p.725) many of the questions in the RedHENS survey would not be classified as categorical. Non mutually exclusive questions, such as the question about the type or types of measures that the respondents had received a grant for, generally translate into multiple questions when data entry takes place. In this example, one data field was required for cavity wall insulation, one for roof insulation, one for light bulbs, and so on. In some cases it is necessary to create a compound data field too, i.e. a field to indicate that one or more of the individual options has been selected. For the respondent, it may be the case that they will feel that once they have ticked a few relevant options, they may skip ticking any further relevant ones (Schwartz and Oyserman 2001) although it is unlikely that more than a couple of the options would apply in most of the questions where respondents are invited to ‘tick all that apply’. In contrast, the mutually exclusive questions in the survey generally only required a single

data field to store the result, with perhaps an additional option provided to record that the respondent has not answered the question.

Rather differently, the answer options for the question about attitude to personal carbon allowances can be ranked, for example, in terms of level of support of PCAs, 'Strongly opposed' is lower than 'moderately opposed' which is lower than 'no feelings either way', and 'support moderately' is higher than 'no feelings either way'. The variable produced from such a question is known as 'ordinal' (Field 2005: p.740). Technically, with an ordinal variable, it is not possible to define the size of the gap between the options. However, the design of a 1-5 Likert scale is such that it can be treated as continuous (Grace-Martin 2008, Robson 2002: p.294).

Questions within the RedHENS survey that come under the 'interval' heading (Field 2005: p48) are the ones that ask for year numbers, relating to when energy efficiency grants were installed, or when a loft conversion took place or a conservatory was erected. Furthermore, if one was to subtract these year numbers from the current year (2008), the resultant variable, representing a number of years in the past, could be described as a 'ratio' variable, in that, say, an energy efficiency measure with the value 10 is twice as old as a measure with the value 5 (without knowledge of the current year, the same cannot be said with the values 1999 and 2004). However the best example of a ratio variable within the survey data is that storing the number of bedrooms.

4.4 Formatting the questionnaires

All three questionnaires took the form of a single A3 gatefold sheet, equivalent to four A4 sides. This is described as the 'booklet' format by Dillman (2007: p.82). Newark and Sherwood have been very successful with their HECAmon questionnaire which fitted onto one A4 sheet (printed on both sides). Therefore the evidence was that a single sheet would be less off-putting to potential respondents. Effort was expended on making the questions fit onto the four sides, and making them easy on the eye (ibid: p.108). This had an influence on question ordering (ibid: p.87). However it was possible to put the most complex attitudinal questions in the middle of the questionnaire so that respondents went through a 'warm-up' phase of answering questions about factual issues (or their perceptions of them). Dillman (2007: pp. 87-88) discusses the need to

avoid starting a questionnaire with difficult questions, as once respondents have started to answer the earlier questions, they are less likely to give up.

The questionnaire was developed in Microsoft Word 2002, and a DTP (desk-top publishing) package was not necessary. Tables were used to develop the layout, rather than using frames or other less precise tools within Word. This helped with issues such as vertical alignment, which eases the task of the respondent, as indicated by Dillman (2007: pp. 125-125)

4.5 Reaching the respondents

The processes involved in distributing the three versions of the survey questionnaire varied.

4.5.1 HECA and post-HECA questionnaires (pre-1995 private housing survey)

The survey of occupants of pre-1995 private housing, unlike the other two surveys, took place in two parts. The first part was the council's (or energy agency's) annual HECAmon survey, which in NSEA's case, takes place every January. The HECAmon survey form for 2006 was re-designed by the researcher for the council, and an additional question was added to it, asking whether respondents would be willing to answer a further survey questionnaire from De Montfort University. Those that did so received the additional questionnaire amongst the package of information (giving advice appropriate to the answers the respondent had given) sent out to them by the energy agency, during January to April 2006. This stage was known as the 'post-HECA survey'. The questionnaire was sent out with a covering letter (see appendix 12.2) and a reply-paid envelope. The letter was entitled 'Please help with our research into electricity & gas bills and related subjects' in the hope that this would attract more people's attention than mentioning energy efficiency or climate change. Respondents were asked to complete as many questions as possible, skipping any that they did not feel comfortable answering. A reply-paid envelope was provided so that the questionnaire could be posted to De Montfort University. Therefore the process was not under the complete control of the researcher. Note that every covering letter was signed by the researcher, although it did also feature the names and titles of two senior IESD staff.

4.5.2 New homes questionnaire

The new homes questionnaire can be seen in the appendix 12.4. In this context, 'new private housing' is mutually exclusive (in terms of the year in which it was built) to 'pre-1995 private housing'. The survey form sent to new homes (also gatefold A3) necessarily included most of the questions equivalent to those in the council's HECAmon survey form for the pre-1995 group. However, given the greater energy efficiency of such modern homes, there was little point in including questions about the purpose, source or method of referral of energy efficiency grants. However the method of referral question was converted to a question about energy efficiency publicity, and a very similar set of options was provided to investigate whether such means had succeeded in raising awareness of energy efficiency and grants.

The questionnaires were delivered by hand to new homes within the district. The council advised on areas of new housing and streets were selected on the basis of achieving a good mix of flats, detached housing, terraced housing, etc. The original plan was for four hundred questionnaires to be delivered. Due to a slight print overrun, 429 were eventually delivered in large (A4) white envelopes with covering letters (signed) and reply-paid envelopes, during June and July 2006. The large white envelopes were chosen to make the package seem more outstanding than a manila envelope would. A white sticker, approximately 15 cm by 10 cm, featuring the university logo in red and black, and text in black, was placed in the centre of the front face of the envelope. The sticker announced that there would be a £50 prize draw for those who returned the questionnaire. This is a technique used by NSEA in order to maximise the HECAmon response rates. Scheuren (2004: p.30) recommends this tactic, especially for non-responsive sub-groups, although Dillman (2007: p.16) and Robson (2002: p.250) both suggest that this is not as effective way of increasing response rates as including the reward with the questionnaire, a method that was simply not an option for the RedHENS research, on the grounds of cost. Such were the constraints on funds that another questionnaire, created by fellow PhD student Katharine Wall (nee Beadle), was included in the package (Beadle 2008). It related to respondents' attitudes about the issues they consider important when buying new homes (including environmentally-friendly features). Respondents were obliged to provide their address details twice, once on each questionnaire, but this meant that the two research projects reduced their dependence upon each other.

A fairly low response rate was expected because of the questionnaire packs being unaddressed and because there were two questionnaires (Dillman 2007). Another factor reducing expectations was the perception that new housing contains a very transient, consumer-oriented community, who may be expected to have low concern for public issues and therefore might feel less obliged to complete a questionnaire. For details of the locations delivered to, see appendix 12.6.

4.5.3 Council homes questionnaire

In Newark and Sherwood, council housing may have been built at almost any time in the past, although most of it was built before 1995. The survey form sent to council homes, which can be seen in the appendix 12.5, also included most of the questions equivalent to those in the council's HECAmon survey form for the pre-1995 group. It also included some additional questions about respondents' views of their landlords, and about keeping the home warm and free from damp (given that such homes were more likely to contain vulnerable people such as the elderly). The packages delivered were similar to those as described above for new homes (but without the additional questionnaire).

Over the last quarter of a century, many council homes have been purchased by the occupants under their right to buy. Thus during the first attempt at delivery, questionnaires were unintentionally delivered to privately owned homes. By arrangement with the energy agency, the researcher was provided with a de-personalised list of homes by the council's arms length management organisation (ALMO) for operating the council housing in the borough, Newark and Sherwood Homes. This list was copied to a handheld computer to assist with hand delivery, and overcame the problem of identifying council homes.

Due to the difficulty of reaching housing association properties (only one location could be identified, and access could not be obtained), all the questionnaires were delivered to homes belonging to Newark and Sherwood Homes. For details of the locations delivered to, see appendix 12.6. As with the new homes, the plan was to deliver approximately four hundred questionnaires. In fact 403 were delivered, during September to November of 2006. The survey form was also distributed via the tenants' association, and around eight responses were received by this method. A low response

rate was expected due occupants of council housing often being vulnerable (elderly, disabled, etc.) or likely to feel excluded.

4.6 Costs and constraints

Cost was a major constraint in reaching the survey respondents. Generally, spending was very much restricted. Postal (or 'mail') surveys can be relatively low in cost compared to face-to-face or telephone interviews (Scheuren 2004: p.11, 51) so the choice of a postal survey for the first stage of data collection was straightforward. Email or web surveys were not an option, as the RedHENS research was based in a geographical area, and websites and email addresses have low correlation with geographical factors. This was particularly the case for the new homes and council homes versions, where area based deliveries seemed the obvious option. The 'post-HECA' version was reliant upon the council's HECA survey which was conducted via the post. The council provided postal delivery of the questionnaires effectively for free by including them with their own responses. The 'new homes' and 'council homes' versions of the survey were targeted at specific types of home in particular geographic localities so the argument for a paper based postal survey, with delivery of the questionnaire packs by hand, was also strong. The lack of names meant that personally addressed questionnaire packs were not possible, further justifying the hand delivery technique.

Only the postage costs for those questionnaires that were actually returned had to be paid and because of the way the reply-paid postal facility is handled within the university, it was not directly charged to the RedHENS project. Printing costs were however charged to the project but these were relatively small. Most of the printing was carried out in house by De Montfort University's print department. One cost saving was the avoidance of the need to purchase mailing list data.

Distance was also a constraint. Newark and Sherwood District is a considerable distance (over 35 miles) from Leicester, where De Montfort University is located. This meant that journeys to investigate potential delivery areas, or to make deliveries, had to be carefully planned.

The above constraints meant that use of a technique like the Tailored Design Method (Dillman 2007), in particular the use of follow-up or reminder mailings, was

inappropriate, although individual concepts from within the method, such as for questionnaire design, were used.

4.7 Reviewing and testing the questionnaire

The RedHENS post-HECA questionnaire went through a peer group review with colleagues at the Institute of Energy and Sustainable Development, a process recommended by Dillman (2007: pp. 140-141). In particular the question about personal carbon allowances, especially the part of the preamble relating to nuclear power, was discussed. For example, it was decided, after discussion (Devine-Wright, personal communication, October 2005) to avoid using the word ‘atomic’ and to only use the term ‘nuclear’ in relation to that form of power generation and the associated waste. The RedHENS post-HECA questionnaire, once it was well developed, was compared with the much longer questionnaire used in the Sustainable Urban Form Consortium (SUFC, also known as CityForm) project (Baker 2007), which was twelve pages long (three times the length) but asked many of the same questions. As a result of the comparison, four of the questions from the ‘post-HECA’ questionnaire were added to the SUFC questionnaire, to potentially enable cooperative work in the area of energy efficiency grants. They were the questions regarding the year of the grant, whether the grant covered the full cost, the organisation the grant was given by, and how the respondents found out about it.

The RedHENS questionnaire was then piloted, as recommended by Dillman (2007: p.146), with five people, indirectly known to the researcher, living in various locations around Greater Nottingham, who were asked to both complete the form and make comments about it. No changes occurred as a consequence of this process, the feedback being that it was straightforward to fill in.

Only one change to the questions that appeared in the post-HECA questionnaire was made when they were used in the new homes and council homes surveys. This was to add an answer option to the question about sources of information about energy information (heating, insulation, etc.). The option was to have a personal visit to the home by an expert, which had been indicated by a small number of respondents (by using the ‘other’ option, and writing their suggestion in the space marked ‘Please specify’).

4.8 Processing the data

For each of the three surveys, data were entered into Microsoft Excel 2002 spreadsheet. Field validation was used to make this process easier (thus entering data into a cell in the appropriate column involved selecting from a drop-down list of options). All the Excel datasets were then imported into SPSS (Statistical Package for Social Scientists) version 14.

The survey of pre-1995 homes presented an extra challenge, as the data from the HECAmon forms were stored in the energy agency's proprietary household energy efficiency database, UNO, and needed to be merged with the 'post-HECA' data. It should be noted that UNO contained data which may have been obtained in previous surveys and from other sources, such as walk-by surveys and previous HECA monitoring surveys.

The merging process started by extracting the data from the unknown format used by UNO. An attempt was made to use Microsoft Access 2002 for this, on the assumption that the UNO data might be accessible using ODBC (open data-base connectivity) conventions, even though this was not referred to in the UNO guide. This attempt was successful (had it not been, it might have been necessary to add columns to the Excel spreadsheet and manually re-key data from data viewed on the UNO system). Access converted the UNO data to an Access database table, and the data were exported as worksheet in an Excel spreadsheet. This was then imported into SPSS.

The only common fields which presented an opportunity for joining together the two datasets were postcode and house number (or house name). A reasonable expectation was that all or most of the records on the post-HECA dataset would be matched to records in the HECAmon data. The 'add variables' function of the 'merge files' facility of SPSS was used to join the datasets together. Several attempts were made at the join, as there were several records that could not be matched. Manually checking revealed that postcodes had been mis-keyed or house names had been entered slightly differently, and once the data extracted from UNO, or the post-HECA data, had been corrected, more matches occurred. Eventually there were only twenty records from the 'post-HECA' data that could not be matched with records from the UNO system.

There are two potential explanations for data being missing from UNO. One was that some people who received the post-HECA survey handed it to a friend to complete. This would be confirmed by the receipt of post-HECA questionnaires for neighbouring properties or from outside Newark and Sherwood, as these are two likely locations for 'friends'. No examples of either of these occurred. Other possible explanations were that the UNO data received was not the most up-to-date, or more likely that some HECAmon returns had never been entered into UNO (but had resulted in the sending out of advice and the 'post-HECA' questionnaire). It was decided to keep the 'post-HECA' records as part of the merged data as the data from the post-HECA questionnaire alone provided many opportunities for interesting research.

The three surveys were merged in SPSS by copying and pasting columns from the new homes and council homes survey data files into the pre-1995 data file (an extra column was added to indicate the 'survey source').

Later, in order to run some statistical function in SPSS, it was necessary to use the 'transform' function to convert some variables from string (e.g. 'Switch to RE') to numeric (e.g. 3). They had been automatically created as string variables because they had been originally set up as string variables in Excel drop-down menus. Although a numeric view might seem more difficult to interpret (or to enter), labels can be associated with numeric values in a variable (column), and the user can switch between seeing values and seeing labels in SPSS's data view. The labels provide the same clarity in viewing the raw data, which is held numerically, that can be achieved when viewing data held in strings. For example, the question about support for personal carbon allowances had five response options, which were originally stored (and entered into Excel by means of a drop down menu list) as '1 - strongly support', '2 - moderately support' and so on, could be respectively stored as a numeric 1 associated with a label 'strongly support', or numeric 2 with a value label 'moderately support', and so on. This would suggest that data entry might have been performed directly into SPSS, although Excel (or equivalents) are widely available, and SPSS was not available at the time of data entry.

4.9 Analysis techniques

The statistical analysis work performed in this research was guided by Pallant (2005) and Field (2005), as both provide advice which is strongly oriented towards users of

SPSS. The choice of statistical tools which can be used for the data collected in the survey is dependent upon the characteristics of the data variables and ultimately upon the types of questions asked on the questionnaires. The simplest analysis reports are those that report the number of occurrences of each value in a variable, known as 'frequency', to be found on the SPSS Analyse menu within 'Descriptive statistics'. This type of reporting is very much applicable to the categorical variables which dominated the questionnaires. Frequency statistics are used to present in a straightforward fashion the results held in single variables (i.e. typically answers to single questions), such as support for personal carbon allowances.

For more important questions there will be a desire to check for differences between 'groups' or sub-populations of those answering a particular question (for which the variable is described as 'dependent'). The sub-groups will be defined by values in another variable (i.e. answers to another question) known as the independent or predictor variable (Field 2005: p.734). For this type of statistical analysis, there is a choice between parametric and non-parametric tools. Parametric tests are more powerful but have a greater number of assumptions about the data, particularly whether the dependent variable is normally distributed or not. In this research non-parametric tests were used to check for group differences and then parametric tests were used for detecting the details of the differences, i.e. to ascertain between which groups the differences exist. Chi-square (with its associated cross-tabulation) was used to test for the presence of differences between groups. If that test indicated the presence of differences, assuming there were greater than two groups, the ANOVA ('analysis of variance') was used to find the pairs of groups that the differences exist between. For the reader's benefit, the details of how these tools were used is more usefully explained during the presentation of results, in the next chapter.

5 Postal survey of residents of NSDC - results

This chapter presents the results from the postal survey, and then goes on to discuss them. Later it looks at results for one set of questions in particular, and how this might lead into the next stage of research.

5.1 Response rates and missing data

The response rate for the 'post-HECA' survey is an estimate because the energy agency mislaid the information as to how many people were sent the questionnaire for the initial weeks that they were sending them out. However they did keep details of how many HECAmon responses they received overall, and how many they received per week and what proportion of those indicated willingness to answer the follow-up questionnaire (and thus were sent it), for the later weeks. For those weeks where data are available, 33.9% of the HECAmon respondents indicated a willingness to answer the follow-up survey. It is thus estimated that 524 questionnaires were sent out. The total number of valid responses was 247. Nevertheless, the response rate (as estimated) was high, at 47.1%. This is probably because the respondents were people who had already committed to helping De Montfort University with the research, as they had ticked the appropriate box on the HECAmon form. It is possible that even more would have answered the post-HECA survey but many recipients may have not spotted the questionnaire amongst the other information they received from Newark and Sherwood Energy Agency. Note that the energy agency reported that the HECAmon survey itself achieved a 38.6% response rate, slightly down on previous years.

The other two surveys achieved response rates that were around 10%, a response rate which is respectable and somewhat typical, especially as the original questionnaires were not individually addressed. The new homes survey achieved 45 responses from 429 delivered questionnaires, a rate of 10.5%. The council homes survey achieved 34 responses from 400 delivered questionnaires. Thus the response rate was 8.5%. A further eight responses came via the tenants' association. It is not possible to work out the response rate including the tenants' association responses, as it is not known how many people the association's officer passed the questionnaire to.

In 1995, there were 44,510 homes in total in Newark and Sherwood (NSDC 1996). In 2004, two years before the RedHENS surveys, Newark and Sherwood Homes took control of 5,500 council-owned homes ('Newark and Sherwood Homes' 2008). In December 2008, the council tax department gave the number of residences at 50,366. The first frequency table presented below uses some of these figures for comparative purposes.

5.2 Frequency statistics

This section provides summary statistics for many of the questions asked in the postal survey questionnaires, presenting and analysing the results of the frequency (sometimes known as 'descriptive') statistics.

5.2.1 Survey information

The 334 respondents came from three similar but slightly different surveys. Table 5.1 shows the breakdown, which has already been discussed to some extent above. The 'Homes' columns have been added on the right of the table, to demonstrate the closeness of the response rates for the three versions of the survey and the figures for actual numbers of homes.

Table 5.1 Survey sources

Survey	Survey responses	Responses (per cent)	Homes (number)	Homes (per cent)
Pre-1995 private housing	247	74.0%	38,002	75.5%
New private housing	45	13.5%	6,864	13.6%
Council housing	42	12.6%	5,500	10.9%
Total	**334**	100.0%	50,366	100.0%

Higher response rates for the new homes and council homes surveys would have created a problem, in that these types of household would have been over-represented in the survey data, and corrective weightings would have been required (Scheuren 2004: p.29). Some of the figures used here are from 2004 and 2008, and do not fit perfectly with the fact that the surveys took place in 2006. There is also an assumption that the difference in the number of homes between 1995 and more recently is purely accounted for by the construction of new homes. However only approximate figures are required to check that the number of responses from each survey version are within reasonable limits.

5.2.2 Household information

Respondents answered questions about their household (the occupants), and some of these are given below. Due to the unexpectedly different way that the council's domestic energy efficiency database stored details about the occupants, the pre-1995 private housing survey, quantified in Table 5.2, shows the number of adults, as opposed to number of people (which would include children). It also indicates how many households have a person (or persons) over 60, and how many households have a person (or persons) under 16.

Table 5.2 Pre-1995 private housing: No. of adults (range), presence of over 60s & under 16s

Under 16s present	Over 60s present	No of adults not known	Households with 1 adult	Households w/ 2 adults	HH with 3 or more adults	Total households
Not known		15				15
No	No	6	16	41	20	83
	Yes	5	36	64	8	113
	Sub-total	*(5.6%) 11*	*(26.5%) 52*	*(53.5%)105*	*(14.3%) 28*	*(100%) 196*
Yes	No	3		3	28	34
	Yes				2	2
	Sub-total	*(8.3%) 3*	*(0.0%) 0*	*(8.3%) 3*	*(83.3%) 30*	*36*
	Total	(11.7%) 29	(21.0%) 52	(43.7%)108	(23.5%) 58	(100%) 247

In the pre-1995 private housing survey, there were 117 (i.e. looking at figures in the right-most column, 83 + 34) or 50.4% of households with no person over 60, and 115 (113 + 2) or 49.6% with a person over 60. The 36 households with someone under 16 represented only 15.5% of the 232 households associated with the pre-1995 private housing survey, where the information is available.

The household information for the respondents from the 42 council homes and the 45 new homes differs as shown in Table 5.3:

Table 5.3 Council and new housing, including no of people and presence of over-60s
Questions: How many people live in your home? How many over 60?

Over 60s	Survey source	Households with stated no. of persons					Total
		Not stated	1 person	2 people	3 people	4 or more	
No	New private housing	1	8	10	11	7	37
	Council housing	0	3	6	3	6	18
	Total	*1*	*11*	*16*	*14*	*13*	*55*
Yes	New private housing	0	1	7			8
	Council housing	3	12	9			24
	Total	*3*	*13*	*16*			*32*
	Total (no.)	4	24	32	14	13	87
	Total (%)	4.6%	27.6%	36.8%	16.1%	14.9%	100%

A key difference is that there are no records of the presence of children in the household in these two surveys.

As regards all the surveys combined, 147 of 334 households (46.1% of those where the information is available) contained a person over 60, and 172 (53.9%) did not. Overall, for the households where the information is available, 25.6% contained one person only.

5.2.3 Home information

Basic physical details about the home provided by respondents are included in Table 5.4:

Table 5.4 Built Form

Form		Frequency	Percent	Valid Percent
Valid	Detached	137	41.0	44.6
	Semi-detached	106	31.7	34.5
	End terrace	22	6.6	7.2
	Mid terrace	29	8.7	9.4
	Flat	13	3.9	4.2
	Total	**307**	91.9	100.0
Missing	Not answered	27	8.1	
Total		334	100.0	

It is noticeable that detached properties predominate in the survey data, possibly a reflection of the rural nature of the area, although there were none amongst the council homes version of the survey. Note that 27 respondents did not answer this question (or the data were not available), so two different percentages can be expressed. In most cases in this chapter, the “valid” percentage is discussed. In other words, responses to an option are expressed in percentages of the number of respondents answering that question (or the number of respondents for which data is available), rather than as a percentage of the 334 respondents who fully or partially filled in questionnaires. For comparative purposes, the Energy Saving Trust’s study of household energy efficiency in the district gives the proportion of detached properties as 48%, compared to 44.6% of responses to the RedHENS survey being from detached homes (EST 2004b). For semi detached and end terraces, EST’s figure was 42%, which fits well with 41.7% of RedHENS responses coming from these types of property.

Table 5.5 Age bands

Age-band	Frequency	Percent
Pre-1900	33	10.8
1900-1929	20	6.6
1930-1949	31	10.2
1950-1965	83	27.2
1966-1976	48	15.7
1977-1981	13	4.3
1982-1989	24	7.9
1990-1995	7	2.3
Post-1995	46	15.1
Total	**305**	100.0

Regarding Table 5.5, the age bands used were determined by the Newark and Sherwood's domestic energy efficiency system and are not all the same size (i.e. not the same number of years in a band), so it is difficult to comment upon the figures except that the households responding predominantly lived in homes built after the Second World War.

The number of bedrooms is shown in Table 5.6. Clearly three bedroom properties are common, which is reflected in the average (mean) of 3.02 (SD=0.851).

Table 5.6 Number of bedrooms

Bedrooms	Frequency	Percent
1	11	3.6
2	55	18.0
3	173	56.5
4	56	18.3
5	8	2.6
6	2	.7
7	1	.3
Total	**306**	100.0

With respect to the question about the thickness of loft insulation, only twenty respondents did not answer. Of those that did answer, around a sixth did not know the depth, as shown in Table 5.7.

Table 5.7 Loft Insulation thickness

Loft insulation depth (mm)	Frequency	Percent
No loft	2	0.6
Don't know	51	16.2
0	8	2.5
50	36	11.5
75	33	10.5
100	59	18.8
‘at least 100’	43	13.7
150	32	10.2
200	26	8.3
250	24	7.6
Total	314	100.0

Only eight respondents said they had no insulation and only 36 had 50 mm. Thus a total of 14% would qualify for grants that allow top-up from 50 mm or less of insulation. At least 18.8%, and up to around 30%, would benefit from doing a ‘do-it-yourself’ top-up, for which insulation manufacturers and retailers stock rolls of 170 mm thick mineral wool, to top up to the recommended 270 mm. The 51 who responded “don’t know” were almost equally divided between the council housing (25) and new housing (26) respondents. Most of the rest of the new housing and council housing respondents had a scattering of responses, suggesting a lack of knowledge - all new housing would have the maximum loft insulation, or close to it (CLG 2006a). The same should be true of almost all of Newark and Sherwood’s council houses (EST 2004b).

The information in Table 5.8 (collected via the council’s HECAmon questionnaire) is only for pre-1995 private housing. This is not a problem as post-1995 housing should have insulated cavity walls (CLG 2006a) and most council housing will have had cavities insulated (EST 2004b), the important figures relate to the take-up of cavity wall insulation in older private housing.

Table 5.8 Wall type
Question: Which best describes the walls of your house? Solid brick/stone; Cavity walls (unfilled); insulated cavity walls; Timber frame walls.

Wall type	No.	Percent
Solid wall	55	24.4
Cavity wall	168	74.7
Timber frame	2	0.9
Total	225	100.0

Three-quarters of homes had cavity walls. Of the 168 cavity walls, 112 were insulated, this being exactly two thirds (66.7%).

The data collected in the HECAmon survey included information about heating systems. Of the 226 households for which information was available, fourteen had electric heating. The other 212 had boilers, of which only 41 (or 19.3 %) had boilers estimated to be of at least 75% efficiency. Note that the other 171 (or 80.7%) with less efficient boilers included eight back boilers of unknown efficiency.

5.2.4 Energy efficiency grants and referrals

The next set of questions were about energy efficiency grants, the first being about receipt of a grant or grants, in Table 5.9.

Table 5.9 Receipt of energy efficiency grant
Question: "Have you ever received a grant or grants to improve the energy efficiency of your current home? Check the list (in next question) if unsure. Remember, an installer may have obtained the grant for you".

Grant?	Frequency	Percent
No	195	68.7
Yes	89	31.3
Total	**284**	100.0

All the respondents, that were asked this question, answered it. Nearly a third of the respondents (31.3%) answering it said that they had had an energy efficiency grant. Respondents answering 'no' were asked to proceed to later questions and miss out the remaining questions about grants. The 45 respondents from new homes were not asked this question. Five of those answering 'yes' were amongst the 40 respondents from council housing. Leaving out all these cases, that means 89 of the 247 in private housing had received a grant, a rate of 36.0%.

The next question, documented by Table 5.10, examined the measures which the grants covered.

Table 5.10 Energy efficiency measures assisted by the grants
Question: "What was the grant for? Tick all that apply"

Measure which grant was for	No. of grants	% of recipients	% of grants
Roof / loft insulation	59	66.3	33.9
Cavity wall insulation	49	55.0	28.2
Cheap or free low energy light-bulbs	38	42.7	21.8
Hot water tank jacket	10	11.2	5.7
Draught-proofing	7	7.9	4.0
Central heating installation	6	6.7	3.4
Other	3	3.4	1.7
Replacement fridge or fridge-freezer	2	2.2	1.1
	174		100.0

The total number of responses (174) adds up to more than 100% due to some of the 89 recipients receiving more than one grant (just under 2.0 each). Note that most had received the measures since 2000, with some in the latter half of the 1990s. A very few recalled grants from the 1980s with the earliest being 1976. Grants for loft insulation were the commonest, given to two thirds (66.3%) of all grant recipients. The next most popular grant-funded measure was cavity wall insulation, received by well over half of grant recipients (55.0%). Over two fifths (42.7%) of recipients were given low energy lightbulbs. After this, there is a large gap to the fourth most popular grant funded measure, this being a hot water tank jacket, at a little more than a tenth (11.2%) of recipients.

The next question looked at whether the grants were full (100% grants) or only paid for part of the cost of the measure. 38 respondents said the grant paid for the full cost of a measure, 36 said it paid for part, and 15 of those receiving grants did not answer, leaving a 51.4% 'full' to 48.6% 'part' split.

The organisations (or type of organisation) giving the grant was then investigated, as per Table 5.11.

Table 5.11 Organisations giving grants
Question 4. "Who was the grant given by? (tick one)":

Organisation or type of organisation giving grant	No.	%
WarmFront	34	47.2
An electricity or gas supplier	22	30.6
Council	14	19.4
Other	2	2.8
Total	72	100.0
No answer	17	
Total	89	

The option ‘Council’ has been added to the results table, despite not appearing on the original questionnaire, as a large number of the responses under ‘Other’ referred to Newark and Sherwood District Council. Although Newark and Sherwood has given grants for energy efficiency improvements in recent years, generally in extreme cases where other schemes could not respond quickly enough, it is possible that many of the respondents citing the council actually benefited from a grant from a WarmFront or supplier grant. If the council or its energy agency had referred them to the grant, it may have been perceived as being granted by the council. Setting aside the seventeen who have received a grant and not specified the source, WarmFront has granted 47.2% of the grants received, with suppliers granting 30.6%.

5.2.4.1 Breakdown of grant referral method

Some of the 89 respondents who had received grants did not answer regarding referral method, and others cited more than one method of referral, for cases where they had received more than one grant. The percentages given in Table 5.12 are of the 91 methods of referral:

Table 5.12 Grant referral method
Question: “How did you find out about the grant(s)? Tick all that apply”.

Grant referral method	No.	%
Newark and Sherwood Energy Agency	27	29.7
Leaflet with gas or electricity bill	19	20.9
Other	14	15.9
Another NSDC (Newark and Sherwood District Council) department	13	14.3
From an installer	11	12.0
Presentation at a meeting	2	2.2
Leaflet at a library or other public building	2	2.2
Temporary energy advice stand	1	1.1
Another local council	1	1.1
Energy efficiency advice centre (EEAC), e.g. the one in Buxton	1	1.1
Energy Saving Trust (EST) phone line or website (or radio ad or other ad for EST)	0	0.0
Warm Zone	0	0.0
Through a charity or community organisation	0	0.0
Total	91	100.0

Council referrals, i.e. ‘Temporary energy advice stand’, ‘Presentation at a meeting’, ‘Newark and Sherwood Energy Agency’, ‘Another NSDC (Newark and Sherwood District Council) department’, ‘Another local council’, and ‘Leaflet at a library or other public building’, totalled 43, i.e. 47.3%. While it is the case that libraries and some other public buildings are run by the county council rather than the district, it should be noted that Nottinghamshire County Council are also partners in Newark and Sherwood

Energy Agency, so there is reason to include the public buildings figure within Newark and Sherwood's success story. The same goes for the 'Temporary energy advice stand' which is in fact a trailer operated by jointly by councils in Nottinghamshire and Derbyshire. 'Presentation at a meeting' is highly likely to be the work of NSEA, as outreach of this type is a key role for one of the energy agency's staff. These bring the total to 46 referrals by the council, or 50.5%. It is thought that the 'Another local council' figure relates to parish council activity.

5.2.5 Understanding energy efficiency

This question investigated how respondents would most prefer to receive information about heating systems and insulation. Note that in Table 5.13 those answering 'I would use' were added to those answering 'should be available' to achieve an overall figure as to the number of people who feel a facility should be available (the response was stored in a single variable):

Table 5.13 Preferred methods of understanding energy efficiency

Question: "Household heating systems and insulation can be difficult to understand. Which methods should be made available to inform people about using (and installing) heating systems and insulation for maximum comfort and economy? And which method would you use to learn more? Tick all that apply."	Should be available (%)	I would use (%)
Colour booklets	80.2	60.1
A basic website with text and photos	50.3	32.1
A telephone helpline	52.2	25.5
A DVD or video presented by a television personality	29.6	15.1
An interactive website with video and sound	28.6	14.8
Special facilities for the visually or aurally impaired	44.0	5.7
Other, please specify	5.0	2.8
None	0.6	0.3

318 of the 334 respondents answered this question, ticking at least one option either in the "Should be available" column or the "I would use" column, so percentages are expressed in relation to the 318. The option of obtaining information about heating and insulation that was most popular under "I would use" was 'Colour booklets' at 60%. The next most popular option was just over half as popular, and this was 'Basic website' at just under a third of respondents, closely followed by 'Telephone helpline' at just over a quarter. A 'DVD presented by a television personality' was popular with only 15% of respondents, only just ahead of 'Interactive website'. The lowest scoring option (if 'Other' is excluded) was 'Special facilities' but 44% felt that such facilities should be available for the visually or aurally impaired. This was the highest ratio of the "Should

be available" versus "I would use" columns for any of the options. This was the only option which, when ranked in order of preference, achieved a higher ranking under 'Should be available' compared to 'I would use', possibly indicating respondents concern for the vulnerable (or tendency to make socially desirable responses). Note that removing the 24 respondents who said they would use both an interactive website or a basic website, 39.3% would use the internet in some form to understand energy efficiency.

5.2.6 Water usage

Table 5.14 looks at how users of water meters perceive the size of their water bills, as compared to paying bills based on 'water rates' (i.e. un-metered supply).

Table 5.14 Water metering

Tell us about how you pay for your water supply. Please tick only one option.	**No.**	**%**
The water is paid for by fixed water rates	190	77.2
There is a water meter and the bill is a lot less than on water rates	25	10.2
There's been a water meter in the property for a long time, so can't compare with rates	16	6.5
There is a water meter and the bill is a bit less than on water rates	11	4.5
There is a water meter and the bill is more than on water rates	2	.8
There is a water meter and the bill is about the same as on water rates	2	.8
The water is paid for with the rent	0	0.0
Not sure how the water bill is paid	0	0.0
Other, please specify	0	0.0
Total	246	100.0

All the respondents were from pre-1995 private housing, so for most water meters were not standard. 190 said they paid by water rates. The number indicating they saved by paying water rates, 36 in total, was eighteen times the number saying they paid more (two). Even the number saying they paid about the same was very small, again only two.

5.2.7 Energy efficiency versus renewable energy

Table 5.15 looks at the public's beliefs about energy efficiency and renewable energy, and the subsidies for these.

Table 5.15 Energy efficiency vs renewable energy

Question: "Should government and local councils... (tick only one):"	No.	%
Complete cheaper household energy efficiency measures first and then assist renewable energy	134	44.2
Switch significant resources now from energy efficiency to renewable energy subsidies	83	27.4
Complete cheaper ***and*** more expensive energy efficiency measures first, and then assist renewable energy	73	24.1
Take other actions	13	4.3
Total	303	100.0

It appears that the respondents are in favour of subsidising energy efficiency over renewable energy, with over two thirds in support and just over a quarter taking the opposite view. Even the subsidy of expensive energy efficiency measures such as solid wall insulation is favoured almost as much as renewables.

5.2.8 Gas and electricity suppliers

This section looks at respondents' relationships with gas and electricity suppliers, especially regarding switching suppliers. For each question, the percentages add up to more than 100% as respondents could select multiple options.

5.2.8.1 Switching within the last year

For the question: "Have you switched electricity or gas supplier in the last twelve months?", it was found that 29.1% of respondents (102) had changed either gas or electricity supplier (or both) in the last year. Only four of the respondents did not answer this question. The next question looked at what prompted the change of supplier. Given that Newark and Sherwood is a rural area, more people answered the question about electricity than gas which is not so widely available, so the answers for electricity are given in Table 5.16:

Table 5.16 How switches of electricity supplier occur

Question: "How did your switch of supplier occur? Tick all that apply:"	No.	%
The company approached you (doorstep sales; salesperson in a street or shop; mailshot, telesales, brochure or advertisement etc)	41	46.6
Investigated alternatives through a web or telephone service which advised the best deal	33	37.5
Moving home forced a change of supplier	7	8.0
Friend or relation mentioned or recommended the new supplier	5	5.7
Chose to go to a "green" or environmentally friendly tariff	4	4.5
Other, please specify	3	3.5
Fraudulent transfer	1	1.1
	94	

88 answered this question, giving 94 responses, perhaps because some had switched more than once. The percentage column is a percentage of respondents. Nearly a half (46.6%) of the 88 people have been prompted to switch by a supplier approaching them whereas just over a third (37.5%) had investigated the best deal through a referral service.

Of 102 respondents that said they had changed electricity or gas supplier, 62 answered the questions about whether they had been obliged to (or had chosen to) change to direct debit payment. The details in Table 5.17 are given as a cross-tabulation and show that 21 (very close to one third) indicating that they had changed to direct debit for one or other fuel, or for both fuels.

Table 5.17 Switching to direct debit (gas and electricity)

	Switch to DD (elec)			
Switch to DD (gas)	No answer	No	Yes	**Total**
No answer	272	6	5	283
No	2	33	2	37
Yes	0	2	12	14
Total	274	41	19	334

5.2.8.2 Problems with electricity suppliers

Table 5.18 looks at whether respondents had problems with suppliers in the last year.

Table 5.18 Problems with electricity suppliers

Question: “Have you had problems with your electricity supplier in the last twelve months? Tick all that apply.”	**No.**	**%**
No, everything has gone smoothly	167	66.0
I can’t be sure that I saved money following a switch of suppliers	47	18.6
Wrong amount billed (e.g. estimate too high, charged for someone else’s usage)	26	10.3
Problems occurred that wasted a lot of time or caused me increased phone bills	16	6.3
Had unexpected debit taken from my bank account, or excessive amount taken	8	3.2
Other problems	7	2.8
Billed by two or more companies for the same period, or by no company at all	6	2.4
Things went wrong when moving home	4	1.6
The company did not take fully into account that I am disabled or a “priority” user	4	1.6
Threatened with, or subjected to, debt collection, legal action or disconnection	3	1.2
Total:	288	

253 of the 334 respondents answered this question (giving 288 responses), and of those that did, around two thirds of respondents (66%) said that things had gone

smoothly with their electricity supplier. Of those experiencing problems, the biggest proportion was nearly a fifth who were unsure of the savings, if any, made by switching supplier. A tenth (10.3%) had the wrong amount billed (note that these figures are percentages of the people who answered the question, not of those who had experienced problems with their supplier).

5.2.8.3 Reasons for never having switched supplier

The next question examines why people had never changed electricity and gas suppliers.

Table 5.19 Reasons for never having switched supplier

Question: "If you have never switched electricity supplier, other than when moving, please tell us why. Tick all that apply:"	**No.**	**%**
Not convinced that I / we will save money	80	62.0
Not interested in switching	39	30.2
Have heard about things going wrong when switching	33	25.6
Don't want to pay by direct debit	12	9.3
Other reason	10	7.6
Concerned that my / our budgeting will be disrupted	4	3.1
We are on a pre-payment meter (PPM) and other suppliers aren't interested	4	3.1
I / we didn't know you could change	1	0.8
On a budget plan and other suppliers won't offer that	0	0.0
Total:	183	

Table 5.19 shows that 129 respondents answered this question (i.e. ticked at least one of the options), indicating that at least this number (36.8 % of all survey respondents) have never changed supplier. Clearly being not convinced about saving money concerns nearly two-thirds (62%) of respondents to the question. Also nearly a third (30.2%) of people who have never switched indicate they have no interest in doing so. Just over a quarter (25.6%) of respondents have heard about things going wrong when switching. Nearly a tenth of respondents that haven't switched think that alternative suppliers will push them towards direct debit payment.

5.2.9 Support for personal carbon allowances

The next questions are about personal carbon allowances (PCAs). The first asks how respondents about their support of or opposition to them, while the second question, which constitutes ten separate questions in three groups, explores how they would respond to them. A low number of responses was expected because of the complexity of subject, the long preamble, and the likelihood that few people had heard of the concept of personal carbon allowances. However, of the 334 respondents to the

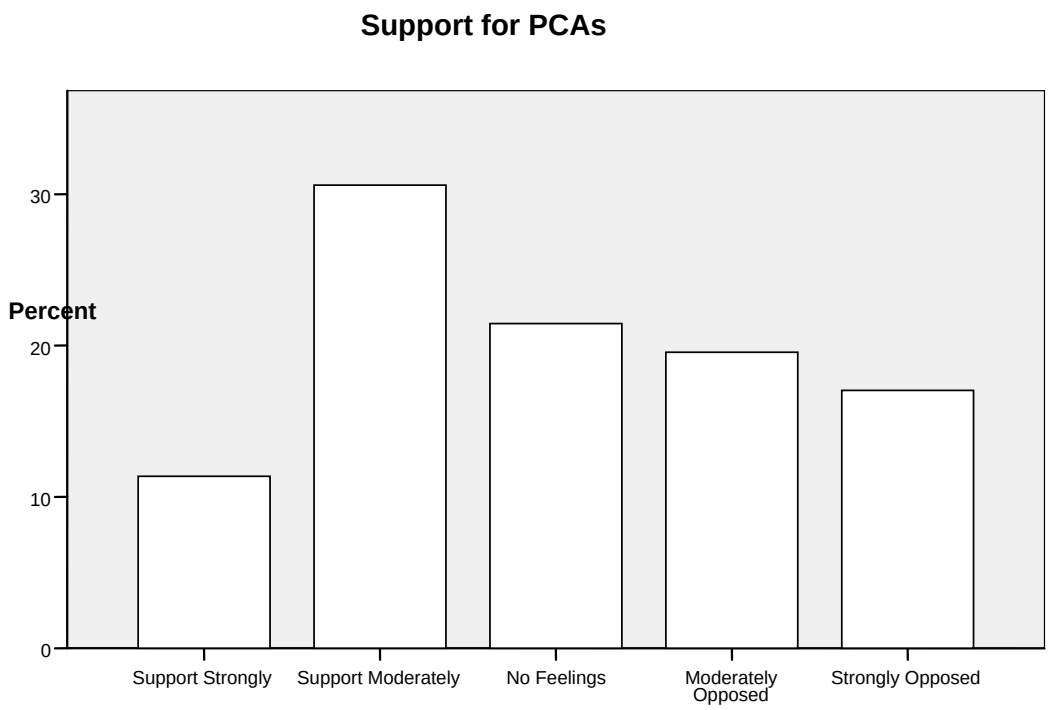
survey, only seventeen did not answer the first PCA question. The breakdown of the responses is shown in Table 5.20 and in Figure 5.1:

Table 5.20 Support for personal carbon allowances

Support for PCAs	No.	%
Support Strongly (1)	36	11.4
Support Moderately (2)	97	30.6
No Feelings (3)	68	21.5
Moderately Opposed (4)	62	19.6
Strongly Opposed (5)	54	17.0
Total	317	100.0

The values assigned to each answer option are given in parenthesis, to facilitate interpretation of the mean, etc.

Figure 5.1 Support for personal carbon allowances - chart



Interestingly, moderate support was the most popular response at 30.6% of responses. If moderate and strong responses are combined, the overall level of support (42%) was greater than the overall level of opposition (36.6%), with about a fifth (21.5%) having no feelings either way. The mean is exactly 3.00 (standard deviation 1.282), apparently indicating that overall, there are no feelings either way about support for personal

carbon allowances. However, the positive skew of 0.157 helps to confirms that support is greater than opposition but support tends to be moderate, whereas opposition is generally more equally divided between moderate and strong viewpoints.

5.2.10 Responding to personal carbon allowances

The questions about responses to PCAs are covered in the next three sub-sections. In the tables below, the highest response rate for each action (row) has been emboldened and the second highest italicised.

5.2.10.1 Actions in response to personal carbon allowances

This sub-section covers the six questions about the specific actions or measures respondents might take if a system of personal allowances was introduced.

Table 5.21 Actions in response to PCAs

Question: "Leaving aside your views on carbon allowances, how would you act if such a system was in place? Tick one column against each action".	Already do %	Probably %	Possibly %	Unlikely %	Don't know %	No. answering question
Use a small or fuel efficient car	**38.5**	20.3	*27.1*	12.4	1.7	291
Use public transport or cycle	*27.4*	13.7	22.6	**33.7**	2.6	270
Make your home energy efficient	**40.5**	*35.5*	21.1	1.0	2.0	299
Take holidays which don't involve flying	*26.3*	7.4	21.8	**40.7**	3.9	285
Live nearer your workplace, or get a job near to home	*31.0*	7.4	14.4	**41.9**	5.2	229
Work at home	15.5	7.1	*15.9*	**56.2**	5.3	226

Table 5.21 shows that a large proportion of people, more than half, responded positively to the idea that they would make their home more energy efficient, with two fifths claiming that it already was, and only one per cent saying the would not do this. This question also had the highest response rate, with 299 of the 334 survey respondents answering it, and the lowest, just two per cent, being unsure. Over a third said they would probably improve their home's energy efficiency, and more than a fifth said they would possibly do this.

Respondents seemed to struggle more with the two questions relating to living near to work or working at home, with the highest number of "don't knows" and the lowest levels of response (below 230 responding, whereas the other questions had more than 270 responding). Part of this is possibly explained by those who have retired constituting a considerable proportion of the sample. It is not possible to ascertain the

number of people who were self employed, who might be already based at home but also in many cases travelling to clients and customers as and when required.

Regarding the other questions in this set, there was a higher level of responses. Over a third (33.7%) would be unlikely to use public transport (or cycle) but even more, over two fifths, would be unlikely to give up flying. Resistance to using a smaller or more fuel efficient car was much lower, with nearly two fifths claiming they already use one.

5.2.10.2 Keeping carbon units

This sub-section looks at two purposes that respondents might keep carbon units for.

Table 5.22 Keeping carbon units

Question: "Leaving aside your views on carbon allowances, how would you act if such a system was in place? Tick one column against each action."	Probably %	Possibly %	Unlikely %	Don't know %	No. answering question
Keep as many units as possible for car use	*30.3*	**33.2**	24.4	12.2	271
Keep as many units as possible for flying	8.2	*20.3*	**60.2**	11.3	256

Table 5.22 uses the same convention as above (most popular answer in bold, second most popular in italics). It tells us that nearly two thirds of respondents would probably or possibly keep units for car use whereas the same figure for flying was less than half that, at under a third. The earlier figure regarding those who were 'unlikely' to take holidays which don't involve flying, was 40.7% (see Table 5.21). There is a gap of over 20% of people who might plan to fly to their holiday destination but have not considered keeping units for that purpose. Note, though, that the response level for 'keeping units for flying' was around 30 lower, possibly accounting for some of the gap. The idea that respondents misunderstood the concept or the question is not so likely when one considers the preceding question, about keeping units for car use, which has been answered completely differently (with a similar level of don't knows and a not dissimilar number of responses). That question is harder to match to the questions about actions in response to PCAs, so it is more challenging to identify any kind of contradiction in the respondents' answers.

5.2.10.3 Buying and selling carbon units

This sub-section looks at whether people would buy or sell units if a system of personal carbon allowances was introduced.

Table 5.23 Buying and selling carbon units

Leaving aside your views on carbon allowances, how would you act if such a system was in place? Tick one column against each action.	Probably %	Possibly %	Unlikely %	Don't know %	No. answering question
Buy other people's units to enable you to use more energy	5.5	*18.5*	**65.4**	10.6	254
Try to use as few units as possible so you could sell them	14.8	*25.2*	**47.4**	12.6	270

Examining Table 5.23 reveals that the response rates to these questions were respectable compared to the other questions regarding personal carbon allowances, with 254 and 270 responses. Under a quarter of respondents (24.0%) stated they would probably or possibly buy more units to be able to use more energy whereas two fifths (40.0%) indicated they would probably or possibly sell units. One might assume that more would want to sell units if so many, almost two thirds, indicated they were unlikely to buy. However the latter question does include the text 'Try to use as few units as possible', which might affect responses.

5.3 Summary of frequency statistics

There were 334 respondents to the postal survey, 45 from new private housing, 42 from council housing (Newark and Sherwood Homes), and 247 in pre-1995 private housing. Where the question was answered, 46% of properties contained someone over 60 versus 54% where there was not. The response rate from homes with children was low, at about 15%. Around 27% of homes contained only one person. The number of bedrooms averaged 3.02. Nearly half of all properties (45%) were detached houses and over a third semi-detached, and one sixth were terraced. Around 70% of homes were built since 1950. Three-quarters of homes had cavity walls and two thirds of those had insulated cavities. 71% of homes with lofts, where the respondent claimed to know the insulation depth, had loft insulation of at least 100 mm depth.

Amongst the frequency statistics (where the question was answered), just over a third of owners of pre-1995 private housing had received an energy efficiency grant. As regards sources for the grants, WarmFront granted almost half of them, with gas and

electricity suppliers providing about 30%. These figures on sources may have been distorted by the statistics about the organisations referring residents to grants. Just over half of all referrals were by the local authorities in the area of the survey, mainly Newark and Sherwood District Council (which may account for why respondents thought that nearly 20% of grants were granted by the council). As regards information on energy efficiency, around 60% of respondents prefer colour booklets, around a third want a basic website and around a quarter want a telephone helpline. Only around 15% wanted a video or DVD, and about the same would use an interactive website. Only just over a quarter of respondents were in favour of switching subsidies from energy efficiency to renewable energy for homes. Amongst those who paid for their water supply on the basis of metered usage, the vast majority believed it saved them money over paying ‘water rates’.

Around 30% of respondents had changed electricity supplier within the last year, half of these being prompted by an approach from the new supplier, and only just over a third investigating the best deal through a referral service. Two thirds claimed to have had no problems with electricity suppliers in the last year but nearly a fifth of all respondents said they were unsure that they had saved money following a switch of suppliers. Of those who had never switched supplier, nearly two thirds said it was because they were not convinced they would save money.

On support for (and opposition to) personal carbon allowances (PCAs), for which there was a five-way choice, support averaged exactly in the middle ground, although the situation was skewed - support tended to be moderate and opposition less so. As regards actions in response to a system of personal carbon allowances, more than half responded positively to the idea of making their home more energy efficient, with only 1% saying they would not do this. Over a third said they would be unlikely to use public transport (or cycle) more, and two fifths would be unlikely to give up flying for holidays. In contrast nearly two thirds said they would keep carbon units for car use and well under a third would keep them for flying. Under a quarter said they would buy units but 40% said they would sell them.

5.4 Group differences in support for personal carbon allowances

It is worthwhile exploring the relationships between the results for *Support for PCAs* with results for other categorical variables, to see if there are any differences in support between groups defined by those categorical variables.

The method by which this can be achieved is influenced by the characteristics of the dependent variable. As discussed in the previous chapter, the dependent variable of interest here, *Support for PCAs*, can be treated either as an ordinal variable or as a continuous variable. This means that it can be tested for group differences on other variables using non-parametric or parametric tests, the latter tending to be more powerful than non-parametric tests (Pallant 2005: p.102). Parametric tests tend to require a continuous variable which has normal distribution, although ANOVA tests, and the associated Post Hocs, are robust to non-normality (ibid: p.198).

There are a number of ways of determining whether a continuous variable has normal distribution. 'Explore' tests were run in SPSS to check the normality of the variable *Support for PCAs*. The significance for the Kolmogorov-Smirnov test was 0.000 suggesting that the variable is not normally distributed. Pallant (2005: p.198) asserts that normal distribution is rare in social sciences and where sample sizes are greater than 30, violation of the assumption of normality should not cause any major problems. Thus the next stage is to investigate whether the variable is significantly non-normal. A visual check of the bar chart in Figure 5.1 shows that the curve is approximately a bell-curve, albeit with a slight positive skew. The mean for *Support for PCAs* is exactly in the middle ground at 3.00 (the minimum is 1 and maximum is 5). The curve shape and mean together indicate a distribution which is not significantly non-normal. Meanwhile, the skewness is 0.157 with a standard error of 0.137, while the kurtosis -1.118, with a standard error 0.273. The skewness value is fairly close to zero, and is within two and minus two times its standard error but the same cannot be said of the kurtosis, as even though it is not a large value, it does not fall within two and minus two times its standard error. This gives mixed evidence as to distribution (UNE 2000). However Field (2005: p.72) points out that these values only matter if the sample size is less than 200, which is not the case with *Support for PCAs*. Even the individual group sizes exceed

the minimum of 30 which Pallant defines for sample sizes in order to treat a variable as normally distributed for the purpose of performing ANOVA tests.

In the light of the above evidence, a cautious approach is to use both parametric and non-parametric statistical tools. The non-parametric Pearson Chi-square (χ^2) test (and associated cross-tabulation) was used to test for group differences. Where a difference was detected, it was confirmed by use of the parametric ANOVA and then identified using the associated Post Hoc tests.

Attempting to identify group differences on categorical variables is likely to be unproductive if the groups defined by a variable is small, as more than an acceptable number of 'expected count violations' is likely to be triggered (Pallant 2005: p.288). In such situations, SPSS's Transform function can be used to collapse the number of categories (groups) in a variable and store it as a new variable. This technique was used in a number of the cases below.

5.4.1 Variables for which group differences were NOT found

The tables below shows the variables which did not have significant effect on support for personal carbon allowances. For all of these variables, the significance test (p-value), when running the Pearson Chi-square test (cross-tabulation), was greater than 0.05, or the expected count violation exceeded 10% (although an expected count violation of between 10 and 20 % of cells, with a p-value of less than 0.05, would have warranted further investigation (Pallant 2005: p.290)). Table 5.24 looks at home and households questions or variables.

Table 5.24 Variables for which no group differences found (re support for PCAs) part 1

Variable	Category	Groups	χ^2	df	p-value	Expected count violation	Notes
Survey source	Household	Council housing, Pre-1995 private housing, New private housing	13.984	8	0.082	13.3%	
Number of adults, in household (range)	Household	'1 adult', '2 adults', and '3 or more'	13.185	8	0.106		See note 1
Over 60s	Household	No, Yes	4.956	4	0.292		
No of bedrooms (range)	Home	2 or fewer, 3 beds, 4 or more	12.796	8	0.119		See note 2
Wall sharing	Home	Detached, Shared walls	5.193	4	0.268		See note 3
Tenure-and-age-band	Home	Council home, Pre-1900, 1900-1949, 1950-65, 1966-1976, 1977-1995, Post-'95	30.737	24	0.162	14.3%	See note 4

Note 1. Number of adults in household (range). This new variable collapsed all values into '1 adult', '2 adults', or '3 or more'. Note that all these groups came from the pre-1995 private housing survey, as the variable upon which it was based, Number of adults, was only recorded for that survey.
Note 2. 'Number of bedrooms' was collapsed into a new variable 'Number of bedrooms (range)' with only three groups - two or fewer bedrooms, three bedrooms, and four or more bedrooms.
Note 3. As regards the variable 'Built Form', nearly half the homes are detached houses, with a mixture of other forms constituting the others. Thus two groups were generated by collapsing it into the new variable Wall Sharing.
Note 4. Due to the small number of homes in some of the bands, an expected count violation was caused. A new variable was created called 'Tenure and age band' which collapsed some of the age bands together. It put new homes into a category called 'Post-1995', and council homes in a group of their own (this was appropriate, as building techniques and styles for social housing have been recognisably different over the decades, the occupants form a distinct social group, the group size fits well with the other groups created).

Table 5.25 looks at behavioural questions.

Table 5.25 Variables for which no group differences found (re support for PCAs) part 2

Variable	Category	Groups	χ^2	df	p-value	Expected count violation	Notes
Received energy effic-iency grant?	Behaviour	No, Yes	6.973	4	0.137		
Ever switched electricity supplier	Behaviour	Have switched supplier, Never switched supplier	2.881	4	0.578		

Lastly, Table 5.26 looks at variables for the questions relating to respondents' reactions to a system of personal carbon allowances.

Table 5.26 Variables for which no group differences found (re support for PCAs) part 3

Variable	Category	Groups	χ^2	df	p-value	Expected count violation	Notes
Making home more energy efficient.	Response to PCAs	Already Do, Probably, Possibly, Unlikely	10.303	12	0.589	25%	See note 5
Would use small or fuel efficient car	Response to PCAs	Already Do, Probably, Possibly, Unlikely	13.954	12	0.304		See note 5
Holidaying without flying.	Response to PCAs	Already Do, Probably, Possibly, Unlikely	12.545	12	0.403	20%	See note 5
Live nearer work or get job closer to home	Response to PCAs	Already Do, Probably, Possibly, Unlikely	25.648	12	0.012	25%	See note 5
Working at home	Response to PCAs	Already Do, Probably, Possibly, Unlikely	17.775	12	0.123	40%	See note 5
Would keep units for car use	Keeping units	Probably, Possibly, Unlikely, Don't Know	11.819	12	0.460		
Would keep units for flying	Keeping units	Probably, Possibly, Unlikely, Don't Know	18.420	12	0.104	26.7%	See note 6
Buying carbon units	Buying and selling units	Probably, Possibly, Unlikely	11.012	12	0.528	40%	

Note 5. The first attempt at producing a cross tab (for 'Would use small or fuel efficient car') produced a table with more than 20% of cells with an expected count of less than 5.0. Therefore it was rerun, having treated the small number of "don't know" responses as 'missing'. This was done for five variables, as the "don't know" proportions were low, ranged between 1.7 and 5.3%.
Note 6. Treating the "don't know" group as missing did not improve the expected count situation greatly.

In summary, household details (number of adults, and presence of a person over 60) do not have any effects on attitudes (support for or opposition to) to personal carbon allowances. The same is true for home details (number of bedrooms, age of home), the three original survey groups, past behaviours (have received energy efficiency grant, have switched electricity supplier), and reasons for keeping carbon units (for car use, for flying). Note that attempting group analysis against variables relating to wall insulation, loft insulation, and heating system details was not possible, due to the data for most of the respondents having passed first through the council's system, and thus not being suitably categorised.

5.4.2 Variables for which group differences WERE found

For two categories (actions in response to a system of PCAs, and buying and selling carbon units), there was a single variable (or question) each which had group differences regarding support for personal carbon allowances, whereas the other variables in those categories had no effect. Additionally, a variable relating to attitudes to an associated matter, renewable energy and energy efficiency, did have an influence on support for PCAs, and the details for that are examined first.

5.4.2.1 Support for PCAs, renewable energy and energy efficiency

As regards the groups represented by the variable *Energy efficiency or renewables*, the small number of persons selecting a fourth option (or fourth group), about taking another action, were removed due to very low actual and expected counts, giving the results in Table 5.27.

Table 5.27 Support for PCAs by Energy efficiency or renewables
Cross-tabulation

Support for PCAs	Energy efficiency or renewables	Expensive EE first	Cheaper EE first	Switch to RE	Total
Support Strongly	Count	10	8	15	33
	Expected Count	8.1	15.2	9.6	33.0
	% within Support for PCAs	30.3%	24.2%	45.5%	100.0%
	% within EEorR	14.3%	6.1%	18.1%	11.6%
	% of Total	3.5%	2.8%	5.3%	11.6%
Support Moderately	Count	18	38	31	87
	Expected Count	21.4	40.1	25.4	87.0
	% within Support for PCAs	20.7%	43.7%	35.6%	100.0%
	% within EEorR	25.7%	29.0%	37.3%	30.6%
	% of Total	6.3%	13.4%	10.9%	30.6%
No Feelings	Count	12	29	19	60
	Expected Count	14.8	27.7	17.5	60.0
	% within Support for PCAs	20.0%	48.3%	31.7%	100.0%
	% within EEorR	17.1%	22.1%	22.9%	21.1%
	% of Total	4.2%	10.2%	6.7%	21.1%
Moderately Opposed	Count	16	30	11	57
	Expected Count	14.0	26.3	16.7	57.0
	% within Support for PCAs	28.1%	52.6%	19.3%	100.0%
	% within EEorR	22.9%	22.9%	13.3%	20.1%
	% of Total	5.6%	10.6%	3.9%	20.1%
Strongly Opposed	Count	14	26	7	47
	Expected Count	11.6	21.7	13.7	47.0
	% within Support for PCAs	29.8%	55.3%	14.9%	100.0%
	% within EEorR	20.0%	19.8%	8.4%	16.5%
	% of Total	4.9%	9.2%	2.5%	16.5%
Total	Count	70	131	83	284
	Expected Count	70.0	131.0	83.0	284.0
	% within Support for PCAs	24.6%	46.1%	29.2%	100.0%
	% within EEorR	100.0%	100.0%	100.0%	100.0%
	% of Total	24.6%	46.1%	29.2%	100.0%

The Pearson chi-square significance $\chi^2(8) = 16.812$, p=0.032, indicates that there are significant differences between the groups. The one-way Anova (analysis of variance), is used to confirm the presence of significant differences between groups, see Table 5.28.

Table 5.28 Support for PCAs by Energy efficiency or renewables - One-way ANOVA
Descriptives

	N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		

Expensive EE first	70	3.09	1.370	.164	2.76	3.41	1	5
Cheaper EE first	131	3.21	1.234	.108	3.00	3.43	1	5
Switch to RE	83	2.57	1.181	.130	2.31	2.82	1	5
Total	284	2.99	1.280	.076	2.84	3.14	1	5

Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
1.797	2	281	.168

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	22.099	2	11.050	7.027	.001
Within Groups	441.887	281	1.573		
Total	463.986	283			

The Levene significance figure, at 0.168, is greater than 0.05, so the assumption of the homogeneity of variance has not been violated. Thus the ANOVA significance in the next box, at 0.001, should be interpreted, and this is less than 0.05, confirming that there are significant differences to be found between the groups. The details are identified in the post hoc tests, shown in Table 5.29:

Table 5.29 Post Hoc Tests - Support for PCAs by Energy efficiency or renewables

Multiple Comparisons - Dependent Variable: Support for PCAs

	(I) Energy efficiency or renewables	(J) Energy efficiency or renewables	Mean Diff. (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Expensive EE first	Cheaper EE first	-.128	.186	.770	-.57	.31
		Switch to RE	.519(*)	.203	.030	.04	1.00
	Cheaper EE first	Expensive EE first	.128	.186	.770	-.31	.57
		Switch to RE	.647(*)	.176	.001	.23	1.06
	Switch to RE	Expensive EE first	-.519(*)	.203	.030	-1.00	-.04
		Cheaper EE first	-.647(*)	.176	.001	-1.06	-.23
Bonferroni	Expensive EE first	Cheaper EE first	-.128	.186	1.000	-.58	.32
		Switch to RE	.519(*)	.203	.034	.03	1.01
	Cheaper EE first	Expensive EE first	.128	.186	1.000	-.32	.58
		Switch to RE	.647(*)	.176	.001	.22	1.07
	Switch to RE	Expensive EE first	-.519(*)	.203	.034	-1.01	-.03
		Cheaper EE first	-.647(*)	.176	.001	-1.07	-.22

* The mean difference is significant at the .05 level.

The notable difference is between those who believe that government and local authorities should switch more resources to renewable energy compared to those who believe that resources should go to energy efficiency. The supporters of renewable energy have lower scores on the *Support for PCAs* variable, i.e. a higher level of support for personal carbon allowances. The difference with respect to supporters of cheaper energy efficiency (0.647) was slightly more pronounced than that for

supporters of more expensive energy efficiency measures (0.519). The significance is also more pronounced between those supporting cheaper energy efficiency and those supporting renewable energy.

Note that a difference of 1.0 would represent the difference between two adjacent answer options (e.g. strongly opposed and moderately opposed, or ‘no feelings’ and moderately supportive), and, reassuringly, that both the Tukey HSD and Bonferroni statistics produce the same difference values.

The effect size (eta squared), calculated by dividing the ‘sum of squares between groups’ by the ‘total sum of squares’ (Pallant 2005: pp. 219, 201) is 0.0476. Thus the proportion of variance on attitude to personal carbon allowances caused by attitudes to subsidy of renewable energy and energy efficiency is on the low side of medium.

5.4.2.2 Support for PCAs and use of public transport or cycling

This correlation test relates to a variable describing one of the potential actions in response to a system of PCAs, describing respondents' preparedness to choose a low-carbon transport mode, see Table 5.30:

Table 5.30 Support for PCAs by Use public transport or cycle
Cross-tabulation

Support for PCAs	Would use public transport or cycle	Already Do	Probably	Possibly	Unlikely	Total
Support Strongly	Count	8	12	5	3	28
	Expected Count	7.5	3.9	6.7	9.8	28.0
	% within Support for PCAs	28.6%	42.9%	17.9%	10.7%	100.0%
	% within WUPTorCycle	11.6%	33.3%	8.2%	3.3%	10.9%
	% of Total	3.1%	4.7%	2.0%	1.2%	10.9%
Support Moderately	Count	22	12	27	24	85
	Expected Count	22.9	12.0	20.3	29.9	85.0
	% within Support for PCAs	25.9%	14.1%	31.8%	28.2%	100.0%
	% within WUPTorCycle	31.9%	33.3%	44.3%	26.7%	33.2%
	% of Total	8.6%	4.7%	10.5%	9.4%	33.2%
No Feelings	Count	13	8	9	18	48
	Expected Count	12.9	6.8	11.4	16.9	48.0
	% within Support for PCAs	27.1%	16.7%	18.8%	37.5%	100.0%
	% within WUPTorCycle	18.8%	22.2%	14.8%	20.0%	18.8%
	% of Total	5.1%	3.1%	3.5%	7.0%	18.8%
Moderately Opposed	Count	9	2	15	26	52
	Expected Count	14.0	7.3	12.4	18.3	52.0
	% within Support for PCAs	17.3%	3.8%	28.8%	50.0%	100.0%
	% within WUPTorCycle	13.0%	5.6%	24.6%	28.9%	20.3%
	% of Total	3.5%	.8%	5.9%	10.2%	20.3%
Strongly Opposed	Count	17	2	5	19	43
	Expected Count	11.6	6.0	10.2	15.1	43.0
	% within Support for PCAs	39.5%	4.7%	11.6%	44.2%	100.0%
	% within WUPTorCycle	24.6%	5.6%	8.2%	21.1%	16.8%
	% of Total	6.6%	.8%	2.0%	7.4%	16.8%
Total	Count	69	36	61	90	256
	Expected Count	69.0	36.0	61.0	90.0	256.0
	% within Support for PCAs	27.0%	14.1%	23.8%	35.2%	100.0%
	% within WUPTorCycle	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	27.0%	14.1%	23.8%	35.2%	100.0%

The Pearson chi-square significance χ^2 (12) = 44.361, p<0.001, indicates that there are significant differences between the groups. The one-way Anova (analysis of variance), as shown in Table 5.31, is the parametric test used to confirm whether there are significant differences between groups.

Table 5.31 Support for PCAs by Would use public transport or cycle - One-way ANOVA

Descriptives

	N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Already Do	69	3.07	1.386	.167	2.74	3.41	1	5
Probably	36	2.17	1.134	.189	1.78	2.55	1	5
Possibly	61	2.80	1.152	.148	2.51	3.10	1	5
Unlikely	90	3.38	1.186	.125	3.13	3.63	1	5
Total	256	2.99	1.285	.080	2.83	3.15	1	5

Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
2.177	3	252	.091

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	40.532	3	13.511	8.950	.000
Within Groups	380.433	252	1.510		
Total	420.965	255			

The Levene statistic is 0.091, greater than 0.05, so the assumption of the homogeneity of variance has not been violated. Thus there is no need to refer to the Welch and Brown-Forsyth tests (two robust tests of the equality of means). Instead the Anova ‘between groups’ significance figure is consulted. This is 0.0, confirming the finding from the cross-tab that significant differences exist between the groups. To identify the differences, the post-hoc tests are run in SPSS, these being shown in Table 5.32:

Table 5.32 Post Hoc Tests - Support for PCAs by Would use public transport or cycle
Multiple Comparisons - Dependent Variable: Support for PCAs

	(I) Would use public transport or cycle	(J) Would use public transport or cycle	Mean Diff. (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Already Do	Probably	.906 (*)	.253	.002	.25	1.56
		Possibly	.269	.216	.598	-.29	.83
		Unlikely	-.305	.197	.408	-.81	.20
	Probably	Already Do	-.906 (*)	.253	.002	-1.56	-.25
		Possibly	-.637	.258	.068	-1.30	.03
		Unlikely	-1.211 (*)	.242	.000	-1.84	-.58
	Possibly	Already Do	-.269	.216	.598	-.83	.29
		Probably	.637	.258	.068	-.03	1.30
		Unlikely	-.574 (*)	.204	.027	-1.10	-.05
	Unlikely	Already Do	.305	.197	.408	-.20	.81
		Probably	1.211 (*)	.242	.000	.58	1.84
		Possibly	.574 (*)	.204	.027	.05	1.10
Bonferroni	Already Do	Probably	.906 (*)	.253	.002	.23	1.58
		Possibly	.269	.216	1.000	-.31	.84
		Unlikely	-.305	.197	.730	-.83	.22
	Probably	Already Do	-.906 (*)	.253	.002	-1.58	-.23
		Possibly	-.637	.258	.086	-1.32	.05
		Unlikely	-1.211 (*)	.242	.000	-1.86	-.57
	Possibly	Already Do	-.269	.216	1.000	-.84	.31
		Probably	.637	.258	.086	-.05	1.32
		Unlikely	-.574 (*)	.204	.031	-1.12	-.03
	Unlikely	Already Do	.305	.197	.730	-.22	.83
		Probably	1.211 (*)	.242	.000	.57	1.86
		Possibly	.574 (*)	.204	.031	.03	1.12

* The mean difference is significant at the .05 level.

The groups that are different as regards support for PCAs are shown by the Tukey HSD test and exactly confirmed by the Bonferroni statistic. Note that in this discussion of differences, one category (1.0) is, for example, the difference between ‘strongly supportive’ and ‘moderately supportive’, or between ‘no feelings’ and ‘moderately opposed’. The table shows that the ‘probably’ and ‘possibly’ groups have no significant differences whereas the greatest differences are between the ‘probably’ group and the ‘unlikely’ group, to the extent that those who would ‘probably’ use public transport or cycle more are, at around 1.2, averaging over one category lower (more supportive) in their attitude to personal carbon allowances than those who would be unlikely to do so. The ‘possibly’ group also has a significant difference compared to the ‘unlikely’, but it is only around half as much, at about 0.6 (with the significance value also not so well pronounced, at around 0.03). Interestingly, the ‘already do’ group are tucked between the ‘possibly’ group and the ‘unlikely’, demonstrating the only other significant inter-group difference by being higher by about 0.9 than the ‘probably’ group.

Note that the effect size is 0.096. Thus the proportion of variance on attitude to personal carbon allowances caused by preparedness to use public transport or to cycle is medium to high.

5.4.2.3 Support for PCAs and selling units

Tests were made to check for group differences on *Support for PCAs* for the questions about buying units and selling units. The buying units question revealed no group differences, but the selling units question was the third variable that was found to be correlated to the Support for PCAs variable:

Table 5.33 Support for PCAs by Selling units
Cross-tabulation

Support for PCAs	Would sell units	Probably	Possibly	Unlikely	Don't know	Total
Support Strongly	Count	7	8	7	5	27
	Expected Count	3.9	6.9	12.9	3.3	27.0
	% within Support for PCAs	25.9%	29.6%	25.9%	18.5%	100.0%
	% within Selling units	18.4%	11.9%	5.6%	15.6%	10.3%
	% of Total	2.7%	3.0%	2.7%	1.9%	10.3%
Support Moderately	Count	17	31	29	9	86
	Expected Count	12.4	21.9	41.2	10.5	86.0
	% within Support for PCAs	19.8%	36.0%	33.7%	10.5%	100.0%
	% within Selling units	44.7%	46.3%	23.0%	28.1%	32.7%
	% of Total	6.5%	11.8%	11.0%	3.4%	32.7%
No Feelings	Count	7	14	24	10	55
	Expected Count	7.9	14.0	26.3	6.7	55.0
	% within Support for PCAs	12.7%	25.5%	43.6%	18.2%	100.0%
	% within Selling units	18.4%	20.9%	19.0%	31.3%	20.9%
	% of Total	2.7%	5.3%	9.1%	3.8%	20.9%
Moderately Opposed	Count	4	11	35	6	56
	Expected Count	8.1	14.3	26.8	6.8	56.0
	% within Support for PCAs	7.1%	19.6%	62.5%	10.7%	100.0%
	% within Selling units	10.5%	16.4%	27.8%	18.8%	21.3%
	% of Total	1.5%	4.2%	13.3%	2.3%	21.3%
Strongly Opposed	Count	3	3	31	2	39
	Expected Count	5.6	9.9	18.7	4.7	39.0
	% within Support for PCAs	7.7%	7.7%	79.5%	5.1%	100.0%
	% within Selling units	7.9%	4.5%	24.6%	6.3%	14.8%
	% of Total	1.1%	1.1%	11.8%	.8%	14.8%
Total	Count	38	67	126	32	263
	Expected Count	38.0	67.0	126.0	32.0	263.0
	% within Support for PCAs	14.4%	25.5%	47.9%	12.2%	100.0%
	% within Selling units	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	14.4%	25.5%	47.9%	12.2%	100.0%

Examining the Pearson Chi-square significance $\chi^2(12) = 38.677$, $p<0.001$, it indicates that there are significant differences between the groups. The parametric test, one-way Anova, is used to confirm and identify those differences, as shown in Table 5.34.

Table 5.34 Support for PCAs by Selling units - one way ANOVA

Descriptives

	N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Probably	38	2.45	1.155	.187	2.07	2.83	1	5
Possibly	67	2.55	1.049	.128	2.30	2.81	1	5
Unlikely	126	3.43	1.242	.111	3.21	3.65	1	5
Don't know	32	2.72	1.143	.202	2.31	3.13	1	5
Total	263	2.98	1.245	.077	2.83	3.13	1	5

Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
2.114	3	259	.099

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	50.575	3	16.858	12.290	.000
Within Groups	355.288	259	1.372		
Total	405.863	262			

As the Levene significance value, at 0.099, exceeds 0.05 (indicating that the assumption of the homogeneity of variance has not been violated) the significance value in the Anova box is examined. The value of 0.0 confirms the finding from the non parametric test above, and prompts the running the Post Hoc tests, documented in Table 5.35:

Table 5.35 Post Hoc Tests - Support for PCAs by Selling units
Multiple Comparisons - Dependent Variable: Support for PCAs

	(I) Selling units	(J) Selling units	Mean Diff. (I-J)	Std. Error	Sig.	95% Conf. Interval	
						Lower bound	Upper bound
Tukey HSD	Probably	Possibly	-.105	.238	.971	-.72	.51
		Unlikely	-.981(*)	.217	.000	-1.54	-.42
		Don't know	-.271	.281	.769	-1.00	.46
	Possibly	Probably	.105	.238	.971	-.51	.72
		Unlikely	-.876(*)	.177	.000	-1.33	-.42
		Don't know	-.167	.252	.911	-.82	.48
	Unlikely	Probably	.981(*)	.217	.000	.42	1.54
		Possibly	.876(*)	.177	.000	.42	1.33
		Don't know	.710(*)	.232	.013	.11	1.31
	Don't know	Probably	.271	.281	.769	-.46	1.00
		Possibly	.167	.252	.911	-.48	.82
		Unlikely	-.710(*)	.232	.013	-1.31	-.11
Bonferroni	Probably	Possibly	-.105	.238	1.000	-.74	.53
		Unlikely	-.981(*)	.217	.000	-1.56	-.40
		Don't know	-.271	.281	1.000	-1.02	.48
	Possibly	Probably	.105	.238	1.000	-.53	.74
		Unlikely	-.876(*)	.177	.000	-1.35	-.41
		Don't know	-.167	.252	1.000	-.84	.50
	Unlikely	Probably	.981(*)	.217	.000	.40	1.56
		Possibly	.876(*)	.177	.000	.41	1.35
		Don't know	.710(*)	.232	.015	.09	1.33
	Don't know	Probably	.271	.281	1.000	-.48	1.02
		Possibly	.167	.252	1.000	-.50	.84
		Unlikely	-.710(*)	.232	.015	-1.33	-.09

* The mean difference is significant at the .05 level.

Thus those that assert that they are unlikely to sell units have significantly higher values on the support for personal carbon allowances (in other words, they have significantly lower support for PCAs) compared to the other three groups (those who would probably or possibly buy units, and those who stated “don’t know” on the matter). The difference for the ‘unlikely’ group was greatest in relation to the ‘probably’ group, at 0.981, almost a whole category (e.g. the difference between ‘strongly support’ to ‘moderately support’) followed closely by ‘possibly’ at 0.876 and then ‘don’t know’ at 0.71. The ‘probably’, ‘possibly’ and ‘don’t know’ groups are so close to each other that the differences between them do not register as significant.

Note that the effect size is 0.125. Thus the proportion of variance on attitude to personal carbon allowances caused by attitudes to selling units is high.

5.4.3 Summary of group differences

No group differences in support for personal carbon allowances could be located for household factors (e.g. number of adults in the home, or presence of someone over

60) or home details (e.g. age of home, number of bedrooms, or whether the home is detached). Nor could group differences in support for PCAs be found for behaviours (e.g. having received an energy efficiency grant, or having switched electricity supplier).

However, regarding group differences for other attitudes, those with more favourable attitudes to household renewable energy (as opposed to energy efficiency) were more supportive of personal carbon allowances.

Regarding group differences in support for personal carbon allowances as regards actions in response to them, none were found for preparedness to use a smaller or more fuel efficient car. Those who would 'probably' use public transport or cycle more had a much higher level of support for PCAs than those who were 'unlikely' to, by a margin of more than one (one being the difference between, for example, 'strong support' for PCAs and 'moderate support', or between 'no feelings' and 'moderately opposed'). Those who would 'possibly' use public transport or cycle more also appeared significantly different to the 'unlikely' group. However their support for personal carbon allowances was not so high as the 'probably' group, the difference being only about half as much. Overall the influence of preparedness to use public transport or to cycle on attitude (support or opposition) to PCAs was greater than influence of attitudes about renewable energy versus energy efficiency, with a greater effect size. For three other actions in response to PCAs, namely holidays without flying, living nearer work or getting a job closer to home, and working at home, no correlation could be found with support for PCAs.

The questions on keeping units for car use or flying revealed no group differences in *Support for PCAs*. Although it was not possible to find correlations between buying units and support for PCAs, there was a clear finding regarding selling units and support for PCAs. Specifically, those who indicated they would be unlikely to sell units had a lower level of support for PCAs. This group difference finding had the greatest effect size.

The table below summarises the group differences that were found. It is worth noting that for samples of this size, 'effect size' is more important than statistical significance (Pallant 2005: p.219).

Table 5.36 Summary of group differences (regarding support for PCAs)

Variable	Max difference	Effect size	Effect size - narrative
Renewable energy vs Energy efficiency	0.647	0.0476	Low to medium
Public transport or cycle	1.211	0.096	Medium to high
Selling units	0.981	0.125	High

Thus it can be concluded that support for or opposition to personal carbon allowances is influenced by attitudes to renewable energy with respect to energy efficiency, and influenced more so by preparedness to use public transport or to cycle, and by views on selling units.

5.5 Review of survey results

This section looks at some of the statistics from the survey and where possible compares with other research in the area. Much of that research has taken place since the survey versions for the RedHENS project were designed.

The project found that in Newark and Sherwood District over half of energy efficiency grants were referred through local authority activities. There appears to be no other published research about the success of various methods of referral to energy efficiency grants. At first sight, the results could be said to be somewhat biased, as respondents to the RedHENS project's survey have already received, a few days or weeks earlier, a council mailing about grants. However the number of grants received in the year the HECA survey took place, was less than 10% of all the grants recorded. These findings emphasise the effectiveness of the activities of Newark and Sherwood Energy Agency and its partners in encouraging people to reduce their carbon footprints by getting them to take up energy efficiency grants. It is clear that local authorities are well placed to encourage residents to reduce their carbon emissions.

As regards information sources and understanding energy efficiency, comparison with Carbon Neutral Newcastle (2005: pp 16, 56-58) can be made. CNN covers both motivators (e.g. TV, radio and the press) as well as information sources (e.g. 'internet'). CNN did not prompt respondents (ibid: App III p.13 Q22), whereas the RedHENS project provided an option list which was purely about preferred information channels (e.g. websites, telephone helpline, booklets, DVD) for energy efficiency information. CNN found that only 11% would use the council as an information source (16% when including libraries), and yet they also found that 26% of people think that local

authorities can have a large influence on limiting climate change, and 35% some influence (ibid: p.36). There was no equivalent option in the RedHENS project's survey, which reflects the fact that it was more about information channels, rather than the organisations from which it could be sourced, so the discussion, earlier in this section, about grant referrals, provides a possible comparison to CNN. As regards some other channels, CNN found 40% in Newcastle and the Northeast would use the internet for advice, and RedHENS found that 39.3% in Newark and Sherwood would do so. Ironically despite that very close match, whereas RedHENS found that 60% would use colour booklets, CNN found only 6% would use 'government publications'. Possible explanations for a factor of ten difference are that the relevant option was listed first in the RedHENS survey questionnaire but not prompted for at all by CNN, and that the CNN survey was attempting to cover sources of motivation (i.e. sources likely to encourage action without saying how to achieve it) as well as of information, and to cover organisations (e.g. environmental charities, energy efficiency bodies) as well as information channels (e.g. booklets). The RedHENS survey shows that a variety of information channels is beneficial. Booklets are the most popular (almost two thirds would use them), and every effort should be made by local authorities, the Energy Saving Trust, etc., to ensure that they are made available in all localities. Websites and telephone helplines are generally available already across the country, particularly those provided by the Energy Saving Trust (and gas and electricity suppliers). However about a sixth of people wanted a DVD, and it may be worth the Energy Saving Trust producing one.

The English housing stock is energy inefficient (CLG 2008b). The RedHENS survey confirms this. It shows that a third of homes with cavity walls do not have them insulated, and that loft insulation is rarely at the recommended level. The fact that only a third of households responding to the RedHENS survey had received a grant would appear to indicate that the grant system could be more successful. Further research, examining the proportion of households receiving grants in other areas, is recommended.

The results for the question relating to attitudes towards subsidising energy efficiency and renewable energy shows that there is almost as much support for expensive energy efficiency measures as there is for home renewable energy installations, even though the latter appears to receive more attention and interest. Therefore, given that

the government already subsidises home renewable energy installations, and that such measures are unlikely to achieve as high carbon savings per pound invested, consideration should be given to subsidising more expensive home energy efficiency technologies, such as solid wall insulation. Further research is required into how such subsidies might operate. For example, whole areas of Victorian terraced housing was improved in the 1960s and 1970s to give them indoor toilets and modern bathrooms, and an area approach might work for external cladding schemes. It will also be necessary to ascertain which measures could be subsidised, and these might include insulated dry lining and external cladding for solid walls, as well as heating improvements and other measures. Sources of funding will also need to be identified, these possibly including the government, gas and electricity utilities, and even oil and solid fuel suppliers.

The findings on water metering are considerably different between RedHENS and those made by DEFRA (2007: p.17). DEFRA asked people without water meters whether they thought a meter would increase or decrease their bills. 8% thought it would decrease ‘a lot’ and 22 % thought it would decrease ‘a bit’. More people thought it would increase, 21% by ‘a lot’, and 19 % ‘a bit’. The remainder, 30%, thought it would stay about the same. In contrast, the RedHENS project found that a majority of water meter users believed they saved money (16.7% of all respondents, versus 0.8% who perceived they paid more). The difference is probably due to more RedHENS respondents having experienced water metering, compared to the DEFRA respondents. The government and water companies need to emphasise the findings from the RedHENS research, as it is a more reliable message than the other findings. Further research into this would be useful, such as asking the same question as in this research, but verifying the figures for metered water bills and payments that would have applied under water rates. It may also help to calculate reductions in water usage by those switching to metering, and the associated carbon savings.

Regarding gas and electricity suppliers, the Welsh Consumer Council (WCC 2007) found in March 2006 that almost three in ten households (28%) had never switched their supplier and would not consider doing so. It appeared that older consumers, and people living in single households or rented accommodation, were the least likely to show interest in switching. The respondents to the RedHENS survey have thus shown a marginally greater propensity (36.8%) to avoid switching supplier, although the

figures are close enough to suggest that for the population as a whole, non-switchers constitute about a third. It is interesting to compare the WCC's approach to that of the RedHENS project - WCC looked at social backgrounds of the non-switchers whereas the RedHENS looked at respondents' stated reasons for not switching.

5.5.1 Review of Attitudes to PCAs

This section looks at the question regarding support for or opposition to PCAs, as well as some of the ten 'response' questions.

As regards the results for support for personal carbon allowances (as shown in Table 5.20), it is worth comparing the results of this research with those of the Royal Society of Arts' Carbon Limited project (RSA 2006). They asked 2465 adults around the UK the question 'Would you support or oppose an initiative to financially penalise those using more than the average amount of energy per person and financially reward those using less than the average?'. This describes a system so close to a system of personal carbon allowances that it is worth putting the two sets of results alongside each other for comparison (the research was conducted as part of a project to research into PCAs and thus the intention of the question is similar). In the case of the responses for the RedHENS project, the strong and moderate responses have been combined (and rounded to the nearest whole percent) for both support and opposition, to facilitate the comparison in Table 5.37.

Table 5.37 Support for PCAs - comparing quantitative research projects

Response	RSA	RedHENS
Support	61%	42%
Oppose	22%	37%
Don't know	17%	22%

RSA's research showed a considerable level of public support for a scheme to penalise high energy use and reward low energy use, much higher than the support for PCAs shown in the RedHENS project. A possible explanation is that once a system is described, with some details of how it might work, support is not so forthcoming, whereas it may be easier to support a general concept which lies behind that system.

There are few examples of similar quantitative work in this subject area. In the work conducted by Bristow el al (2008a), respondents were also asked questions about carbon taxation. Questions about support for PCAs were posed twice during interviews,

conducted at a variety of locations in southeast England, in which participants' household carbon footprints were calculated. The work by Von Knobelsdorff (2008b) did however concentrate more on personal carbon trading. The Von Knobelsdorff figures and the Bristow et al figures - for both the first and the second times that the question was posed - are compared with this research project's figures in Table 5.38. There were 317 answering the question in the RedHENS survey, and 208 and 207 respectively in the Bristow et al surveys, and 152 in Von Knobelsdorff's postal survey (note that her description for 'No Feelings' was 'Mixed Feelings').

Table 5.38 Comparison of projects - support for personal carbon allowances

Support for PCAs	RedHENS	Bristow el al - first time	Bristow el al - second time	Von Knobelsdorff
Support	42%	43%	43%	44%
No Feelings	21%	36%	23%	43%
Opposed	37%	21%	34%	13%
Total	100%	100%	100%	100%

There are strikingly similarities in some of the figures, particularly as regards the level of support, as well for all the figures in the RedHENS survey and the repeated question by Bristow et al. What is clear is that support for PCAs exceeds two fifths, as well as exceeding opposition, in all the circumstances covered in the table.

There has been other recent research into support for personal carbon allowances by DEFRA (2008a) and IPPR (2008). However those research projects were rather more qualitative than quantitative, did not take place until after the RedHENS survey, and compare PCAs with alternatives such as a carbon tax and upstream trading. For these reasons, the DEFRA and IPPR research are considered later in this thesis.

There are few potential comparisons of the RedHENS figures regarding actions in response to personal carbon allowances. The best available comparisons are to research projects where respondents were asked about taking actions in response to the threat of climate change, one of the few being that by Carbon Neutral Newcastle (2005).

The comparison of the RedHENS figures about preparedness to 'use public transport or cycle' with those of CNN (ibid: pp. 44-46) is challenging, as CNN looks at walking and cycling separately from public transport, whereas RedHENS looks at combined figures which exclude walking. CNN find that there is more preparedness to walk or to

cycle than to take public transport. CNN finds that over half of car owners already claim to walk or cycle and 31% are already using public transport, but RedHENS finds only 27.4% are claiming to be already doing one of these carbon reduction activities. CNN found that 22% of car owners were not prepared to consider walking or cycling to cut back on car use, and 34% were not prepared to consider using public transport. The latter figure fits very well with the 33.7% in RedHENS who are unwilling to 'use public transport or cycle'. The differences in the figures, with CNN respondents appearing to be more positive to alternatives to car use, may be accounted for by the fact that the CNN work took place in a group face-to-face setting whereas the RedHENS survey was postal, so participants in the former project may have felt obliged to answer more positively for social desirability. However, whereas the RedHENS looked at actions people might take to respond to a system of personal carbon allowances, a financial motivational factor was absent from the CNN work, which might have led respondents to the CNN survey to respond less positively.

The RedHENS findings about preparedness to make the home more energy efficient were notable. A total of 97% were probably or possibly willing to make their homes more energy efficient including over 40% who claimed they had already done this. CNN (ibid: pp. 40-43) also found a very high level of enthusiasm in this subject area, specifically installing insulation. However a higher proportion (76%) claimed they had already done this. This shows the importance as to the clarity and phrasing of the question. Note that respondents to the RedHENS survey had already been subjected to a series of questions about home energy efficiency, and may thus have responded in a somewhat more positive fashion. DEFRA (2008c: p.29) found that well under 10% of their respondents were prepared to take actions of this type to limit climate change but they had included 'turning down the thermostats' with investment in heating or insulation, thus confusing continuous behaviours with measures. Nevertheless, the high response rate to this question in the RedHENS survey, and more particularly the positiveness of the responses about making homes more energy efficient in both the RedHENS and CNN projects, points to the need for investigation in a later stage of data collection.

Comparing the RedHENS questions about taking holidays which don't involve flying with the question in the CNN project about cutting the number of flights taken (ibid: p.47), there is a closeness of the figures for those who indicate 'unlikely' in RedHENS

(40.7%) and those ‘not prepared’ in the CNN research (43%). However major differences are apparent when looking at those who have given other answers. The ‘already do’ figures are over a quarter in RedHENS but only 6% for CNN, the ‘probably’ and ‘possibly’ options total at 30% for RedHENS but the nearest equivalent for CNN, the ‘prepared’ figure, is only 11%. Even comparing the ‘don’t know’ figure for RedHENS at 3.9% and adding the 39 who didn’t answer (which might give a combined figure of the order of 15%), with the ‘don’t know / no answer’ of CNN (39%) there is a disparity. Furthermore, DEFRA (2008c: p. 29) does not distinguish between those already don’t fly and those who are unprepared to give up flying, meaning that they find only 6% are prepared to avoid flying or fly less. Nevertheless, one can conclude there is a substantial proportion of the population, over 40%, who appear to be unwilling to give up or reduce their flying.

Overall, it is worth looking at all the actions that respondents can take. Here all the figures from RedHENS are given (these are the combined figures for ‘probably’, ‘possibly’ and ‘already doing’ for each action, as previously shown in Table 5.21) , with the percentage popularity for the nearest equivalent actions in the DEFRA research given alongside in Table 5.39.

Table 5.39 Responding to PCAs - actions ranked (RedHENS)

Posn.	Action (RedHENS)	RedHENS	DEFRA
1	Make your home energy efficient	97%	16%
2	Use a small or fuel efficient car	86%	32%
3	Use public transport or cycle	64%	19%
4	Take holidays which don’t involve flying	56%	6%
5	Live nearer your workplace, or get a job near to home	53%	
6	Work at home	39%	

The DEFRA research findings gives more options so they are presented in Table 5.40, in order of popularity, with the rankings for the nearest equivalent actions from RedHENS given in the final column. Two actions from the DEFRA research have been combined for the purpose of the comparison, in both the table above and the one below:

Table 5.40 Responding to climate change - actions ranked (DEFRA)

Posn.	Action (DEFRA)	DEFRA	RedHENS
1	Recycle (more)	59%	
2	Don't drive / drive less often	32%	2nd
3	Switch off lights / appliances	20%	
4	Walk, cycle, use public transport more	19%	3rd
5	Buy A rated / energy efficient products AND Heating / Insulation / Turn down thermostat	16%	1st
6	Use less electricity (generally)	13%	
7	Don't have heating on / use less heating	8%	
8	Don't leave things on standby	7%	
9	Don't fly / fly less often	6%	4th

These DEFRA figures (which were collected in early 2008) are approximate, as that research only presents them graphically. In addition to the difference in the number and the details of the actions specified, note the wide disparity in the ordering (popularity ranking) of the actions and the percentage values associated with each action. Much of the explanation for the higher figures from the RedHENS research will be the fact that respondents were responding in the context of a system that would penalise them financially for failure to take actions. Some of the explanation of the differences may be the lack of standardisation in the research area. Until now, research such as DEFRA's has concentrated on people's beliefs about climate change. While the subject of people's responses to it has received some recent coverage, the data collection has been ad hoc. The basket of potential response actions is as yet undefined. However the Energy Saving Trust 'Green Barometer' programme (EST 2007b, EST 2008d) has since been compiling scores of people's responses across a range of actions, including installation of cavity wall insulation, loft insulation, condensing boilers and energy saving lightbulbs, turning off lights, turning TVs off standby, and walking rather than taking the car. In September 2007 the overall score for respondents' preparedness to take these actions was 1.96 out of 5.0. By early 2008 this had risen to 3.17. The notable external factor over this short time period was the rise in home and car fuel costs, possibly pointing to financial incentives being a strong motivational factor influencing responses to climate change.

Regarding the questions about buying and selling units under a system of PCAs, the idea of buying other people's units to enable one to use more energy appears unpopular. Nearly two thirds said they would be unlikely to do this. It may be better if any proposed system is set up so that the only way people buy the extra units they need is when buying fuel etc. (i.e. generally only when one has none of one's own allowance left). This may make the whole concept more palatable by not unnecessarily

emphasising the buying process. It also removes the concept of speculation on the value of units.

In conclusion, it is difficult to compare the RedHENS research about support for and actions in response to personal carbon allowances due to lack of other research in the area, and the lack of standardisation of questions. This is particularly the case with actions in response to PCAs. There is no other research into this, and even though actions in response to PCAs can be potentially compared with actions to alleviate climate change, the comparison does not work well, due to the different sets of actions. This is a young area of research, and there is a need to move on from an emphasis about beliefs about climate change towards looking at the responses to climate change, not least because people may take actions even without having beliefs about climate change which concur with the science about man-made global warming.

5.5.2 Review of group differences

The fact that the survey found a correlation between support for personal carbon allowances, and support for home renewable energy subsidies over subsidies for household energy efficiency, may appear to be counter-intuitive to those who understand the detailed issues involved. Domestic renewable energy is unlikely to bring about major reductions in home energy use, and less still for household energy use, i.e. when personal transport is taken into account. The information sources used in this research, the Energy Saving Trust's energy savings assumptions (EST 2007c), and the Act On CO2 methodology (DEFRA 2007b), do not even list 'savings' from renewable energy measures. This is particularly the case in the context that many home energy efficiency opportunities have yet to be exploited. The explanation for this group difference may be that ordinary members of the public are much less likely to be informed about the costs of renewable energy efficiency measures in comparison with energy efficiency measures, and their payback in terms of reduced energy costs and reduced carbon emissions. Those who have positive attitudes regarding reducing carbon emissions may therefore be more likely to respond positively to the idea of home renewable energy measures as well as responding positively to personal carbon allowances. This points to the need, in the next stage of the research, to explore people's understanding of the savings due to home energy efficiency measures, and the barriers to implementing them.

Regarding the group differences about support for personal carbon allowances relating to preparedness to use public transport or to cycle, the anticipation of being able to make carbon savings by using public transport or cycling has a greater influence on support for PCAs than the actual use of these transport methods (the 'already do' group). A potential explanation is that those who currently use public transport or cycle may perceive this as being enforced due to lack of money to buy and run a car, or view it as temporary due to the lack of a driving licence. Alternatively they may feel that PCAs would cut into other areas of their life even though they are making savings regarding car use.

A potential explanation about the finding that those who are 'unlikely' to sell units have lower support for PCAs, is that those people that perceive they have high footprints, or perceive that they would have to suffer a drop in the quality of life, would be inclined to be not supportive of a scheme that would penalise them financially.

Overall, few group differences regarding support of (or opposition to) PCAs could be identified. RSA examined different groups, and found no differences at all (RSA 2008: p.4).

5.6 Survey - discussion

A number of conclusions stem from the statistics in the RedHENS survey work. Around half as many more people want to have booklets to explain home energy efficiency to them as compared to using the internet. There is also a need to distinguish between information and motivational sources in future research (although recognising there is an overlap). The uptake of grants, at only a third of households, needs to be improved, and the opportunities are available, as this research shows that a third of homes with cavity walls do not have them insulated. NSEA has demonstrated considerable success in getting residents to take up grants and install energy efficiency measures, and this is a model which should be reproduced within all local authorities. There is a need to explore the apparent wide disparity between perceptions of the relative cost of water metering and water rates, particularly the differences between the two groups subject to these two methods of billing. The biggest problem that people had with their electricity and gas suppliers is having switched but feeling uncertain as to whether they are saving money. This affected around 20% of all households, and brings into question the image of the suppliers.

There were also conclusions about personal carbon allowances. Firstly, the results relating to *Support for PCAs* showed support was at least equal to opposition, and the response rate was high for all the PCA questions, and thus further analysis is worthwhile. Secondly, there is difficulty in comparing surveys about actions in response to PCAs and to the threat of climate change. Part of this has been due to research projects going on in parallel. It is also a new area of research. There is a need for standardisation of the list of measures, actions and behaviours. Third, the concept of buying units under a system of PCAs appears to be unpopular, and thus any system should restrict purchase of extra units to the time of purchase of fuel or airline flights. Fourth, the RedHENS research found that there is very high support for home energy efficiency measures as a means of responding to a system of PCAs.

5.7 The opportunity for further research

The level of response to the questions about personal carbon allowances in the RedHENS survey was very high, despite the long preamble, and the fact that the concept was likely to be new to the vast majority of respondents. The respondents' support for a system of personal carbon allowances was considerably lower than that for a system proposed by RSA, but described in considerably less detail. However, the fact that such a new proposal was met with a balance of opposition and support was notable, as one might expect a new concept to be rejected fairly substantially. In fact moderate support was the most predominant view. This alone indicates the desirability of further research in the subject area.

There were indications that the respondents may have misunderstood the concept of PCAs, at least to some extent. The responses regarding buying and selling units did not fit comfortably with each other. Unless around a quarter of respondents envisaged using approximately the carbon units allocated to them (i.e. not significantly more or less than their allowances), then the low level of enthusiasm for buying units (under a quarter of respondents) did not fit well with the much greater number (nearly half of respondents) who said they were unlikely to sell units. There was a high number of "don't know" respondents to both questions (over an eighth of respondents regarding selling and over a tenth regarding buying). This could account for some of the difference, or it could indicate lack of understanding, or it could indicate that people were unaware of their carbon footprint. Interestingly, similar high levels of apparent

uncertainty prevailed for the questions about keeping units for flying and driving, and yet the questions about actions in response to a system of personal carbon allowances had “don’t know” response rates of under 6%, and as low as 1.7%. Thus the need for this project to conduct further research in the area is reinforced, and the need to help people calculate their personal or household carbon footprints is implicit.

It was also notable that the preference for responses to PCAs varied. There was only a tiny proportion of people who were *unwilling* to improve their home’s energy efficiency. It is clear that many people have not already made their homes more energy efficient this, as a whole industry currently exists to encourage and assist people to do this. It may be that only a system of personal carbon allowances would force people to make their home more energy efficient. There is a counter-argument that improvements could be brought about without a system of PCAs but that there are barriers preventing people from reducing the carbon footprint of their home. Both the identification of the barriers, and the effect of personal carbon allowances, are thus worth exploring.

Regarding the other areas of opportunity to reduce the carbon footprints of households, those relating to transport and travel, there was less enthusiasm for taking steps to reduce carbon emissions. The preparedness to change to a lower carbon transport mode (i.e. to use public transport or to cycle) was associated with enthusiasm for personal carbon allowances. So far, the emphasis of the RedHENS research has been on emissions from within the home, and these findings suggest that transport aspects require more attention.

5.7.1 Research opportunities that were not selected

At the end of the first stage of data collection, there was a number of options for continuing the research. Consideration was given to comparing the results from the survey with those for geographical areas beyond Newark and Sherwood, particularly regarding success at referring residents for energy efficiency grants. To that end, WarmFront grant data was requested from EAGA but the data supplied was at too high a level. Additionally, access to HEED (the Home Energy Efficiency Database system run by the Energy Saving Trust) was obtained but the data held on it was also in a form making comparison difficult. Distributing survey questionnaires in another borough or boroughs was considered. Potential areas for targeting included Broxtowe in Nottinghamshire (where the researcher used to live) and the nearby City of

Nottingham. Due to the findings made about personal carbon allowances, a decision was instead made to use qualitative research to concentrate on exploring those findings further.

6 Interviews of residents in their homes - methods

This chapter, and the following two, look at the second stage of data collection of the RedHENS project. This stage involved interviewing householders of Nottinghamshire (overwhelmingly in Newark and Sherwood) in their homes, with a key aim being the gathering of views about personal carbon allowances. Carbon footprints were calculated for the interviewed households to assist with the process, and means of reducing those footprints were discussed. This chapter gives a background to the interviewing, in particular describing the methods used.

6.1 Justification for this stage of the research

In the second stage of data collection, interviews, assisted by the calculation of household carbon footprints, addressed important issues raised by the first stage of data collection (the postal surveys). The mainly qualitative nature of the interviews complements the quantitative nature of the postal survey's questionnaire data. The emphasis on personal carbon allowances in the interviews allows further exploration of the subject for which there was, in the first data collection stage, apparent public support and yet also some public confusion (particularly over buying and selling units). Furthermore, the actions that people might make in response to a system of personal carbon allowances can be explored, in the light of the survey showing varying levels of enthusiasm for these. For example lower levels of enthusiasm about measures relating to transport can be explored against high levels of enthusiasm about making homes more energy efficient (and current low levels of home energy efficiency).

The primary research question "How can carbon emissions by households be reduced?", breaks down into three key subsidiary questions. One of these, "What are people's attitudes towards personal carbon allowances?", is clearly addressed by this stage of the research. The discussion of measures to reduce the households' footprints ensures that the question "What are the opportunities for people to reduce their household carbon footprints, and the barriers that prevent them from doing so?" is addressed. The third subsidiary research question "How can organisations such as councils and energy suppliers help people reduce their carbon emissions?" is to some

extent explicitly addressed by the interview questions, and is implicitly covered by the process as a whole.

During this research, the Department for Transport called for further research into carbon calculators (DfT 2007). Although not explicitly addressing the issue of the further development of calculators, some of the detailed findings of this second data collection stage of the RedHENS research project may be useful for that purpose.

6.2 Overview of this stage of the research

This part of the research is primarily qualitative as the interviews are semi-structured. However each interviewed household also provided quantitative data in the form of a carbon footprint, and related figures resulting from possible measures to reduce that carbon footprint. A fundamental and unique approach of the RedHENS research is that this second stage of data collection uses the calculation of a household carbon footprint to assist with gathering of views about personal carbon allowances, as the calculation will help to determine whether a household is likely to be in surplus or deficit under a system of PCAs. Above average carbon emitters would lose out financially under such a scheme, and below average emitters would gain. These methods also promoted discussion of the adoption of carbon reduction measures, and the barriers to doing so. Note that the calculation of footprint components which would not be covered by a system of PCAs (e.g. food and drink) was excluded from the RedHENS research.

6.3 Academic background for the methods including approach

The academic influences for this stage of the RedHENS project include Arksey and Knight (1999), Robson (2002), Bryman (2004), Maxwell (2005) and Yin (1994).

Themes and findings from qualitative research can be said to stem from two complementary methods, namely template analysis (King 2007) and grounded theory (Robson 2002), and both have been used in the RedHENS second data collection stage . Template analysis uses an approach whereby the researcher expects to gather results and make findings associated with pre-determined themes. These ‘a priori’ themes, as they are known, are identified by the researcher before data collection begins, and indeed are likely to influence the design of any interview tools (question sheets, etc.). The ‘grounded theory’ approach allows themes and findings to emerge

during the research process, i.e. they are ‘grounded’ in the research findings. Inevitably this occurs when more open style of questioning are used. A result of mixing these approaches is that the themes discussed in the qualitative aspects of this second data collection stage of RedHENS are of both types, ‘a priori’ and ‘emergent’.

Inevitably, in qualitative research, the question of philosophical approach, or research paradigm (Maxwell 2005), is posed. The second data collection stage cannot be said to be following a ‘positivist’ view, sometimes described as the ‘standard view’ of science, since such a view relies upon mainly quantitative data, as well as upon objective knowledge, unchanging facts against which hypotheses are tested, and upon the rejection of invisible or theoretical entities. Given that much of the RedHENS research relates to views of the public about carbon and energy issues, then it follows a relativist approach, in which reality is represented through the eyes of the participants.

One approach which comes under the ‘relativist’ heading is that of post-positivism. This accepts that theories, hypotheses, background knowledge or values of the researcher can influence observations (Robson 2002). The issue of the influence of background knowledge is particularly important to the RedHENS second data collection stage. This is because the researcher encouraged questioning, and asked additional questions in the appropriate contexts, in order to achieve a deeper and more extensive understanding of the participants’ views. The effective and rapid use of the carbon footprinting spreadsheet also required the researcher to have thorough knowledge of the subject area. These techniques constitute interventions. Ideally, all academic research should be reproducible. The researcher’s own experience is a valid source for research design (Maxwell 2005). Reproducing the RedHENS research would require a researcher, who, at the commencement of the second stage of data collection, had a strong knowledge of household energy efficiency, personal carbon emissions and related subjects.

Another approach that the RedHENS project fits with is realism. In particular this encompasses the view that the real world is very complex and stratified into layers at the individual, group, institutional and societal layers (Robson 2002). These layers correspond well with the entities that exist in this research - individual, households, organisations (such as gas and electricity suppliers and local authorities) and the nation.

There are elements of case study research in this second data collection stage, as evidenced by the longer interviews, taking place in the participants' homes. Yin (1994: p.79) describes six sources of evidence for case study research. Four of these are interviews, documentation, direct observations and physical artefacts. Examples of documentation include householders' gas and electricity bills. Direct observations in this research include observing how lighting, washing machines and heating are being used. Examples of physical artefacts noted in the research were vehicles parked on driveways, and appliances and energy efficiency measures within the home. Thus, including the interviews, the four sources of information were present in the data collection stage.

Maxwell (2005) states that no one approach is likely to prevail within a research project, and circumstances may even dictate the approaches used. This data collection phase used a mixture of qualitative approaches to facilitate the interviewing. The RedHENS project as a whole used mixed - both quantitative and qualitative - methods (Tashakkori and Teddlie 1998). However even during this second phase, quantitative data collection was used in addition to the dominant qualitative data collection strategy. Thus the second data collection stage used a mixture of methods and approaches.

6.4 Generating the questions and forms

The main questionnaire for the interviews (which can be viewed in appendix 12.8) defined the questions to be asked as well as the way in which the other interview tools were used. The interview tools (in addition to the main questionnaire were the interview covering letter (see appendix 12.7), interview slide show (see appendix 12.9, and section 6.5 regarding its development), the footprinting spreadsheet (see appendix 12.10 and section 6.6 regarding its development) and the post-interview form (see appendix 12.11).

Other than some of the opening questions of the interview (details about the household, etc.), and the quantitative questions used to calculate the household carbon footprint, the questions in the interviews were 'open'. This is appropriate to semi-structured interviews, the open questions providing the qualitative data necessary to explore further the quantitative findings from the 'closed' questions of the postal survey (Arksey and Knight 1999).

Note that the post-interview form (see appendix 12.11) was for the interviewer's use after each interview, and was not intended for direct collection of data from the interviewees. It was intended to collect data about the success or otherwise of the process, and data that could only be collected at the end of the interview, such as its length and any notes about difficulties and interruptions.

6.4.1 The questionnaire

The questionnaire (see appendix 12.8) begins by posing 'Question Set 1 - Basics'. These are mainly closed questions including basic data (e.g. participants' names) and factual data (e.g. home details such as built form and heating system, and vehicles).

'Question Set 2 - Background' is then asked, these being mainly open questions about climate change, fuel poverty, energy savings measures present in the home and the interviewees' views on which measures are the most effective. The slide show, which describes the research and the concept of personal carbon allowances, is then given.

After this, 'Question Set 3 - Attitudes' are posed. For the first time, interviewees are asked their views on PCAs. This question requires a fairly precise answer but also is open in such a way to collect associated opinions. The spreadsheet is then used for the first time, calculating the current carbon footprint of the household (which obviously involves the collecting of quantitative data), although none of the potential measures, to reduce the carbon footprint of the household, are discussed. Once the current footprint has been calculated, the questions from set 3 continue. The interviewees are asked whether their views on PCAs have changed, and how PCAs might affect the household and family.

'Question Set 4 - Response to PCAs' is then used in conjunction with the Measures sheet of the footprinting spreadsheet. The open questions relate to behaviours to reduce energy use in the home, investment measures to reduce energy use in the home, and changing travel habits. The carbon footprint figure, taking into account measures that the interviewees would be willing to implement, is then available from the spreadsheet. The interviewees are asked for a second time whether their views of PCAs have changed.

The final question, under the heading ‘Question Set 5 - Governance’ is about what government and local councils can do to help.

Citing examples of previous questions of the style used in the interviews is challenging, for the same reason as outlined in the chapter covering postal interviews - that the questions as used are rarely outlined in published work. However Carbon Neutral Newcastle (2005) gave detailed coverage as to the wording of their questions and the flow of their focus groups, in a research topic strongly related to that of RedHENS project. Many of the CNN questions were rather more closed in style than in RedHENS, however.

6.4.2 The interview questions

The interview questions mainly derive from questions in the surveys. ‘Question Set 1 - Basics’ features a subset of the questions asked in the postal survey (for pre-1995 private housing, the questions appeared on the HECAmon form). Perhaps the most unusual question is that about reading meters. This was asked in order to ascertain if the interviewees, or anyone in the household, took a particular interest in energy consumption. It was expected that the answer was that the meters were read when estimated bills were received, and that estimated readings were more common when the meter was indoors, meaning there was less access to it for meter readers. A primary aim was to support the collection of bill data during the later footprinting process.

‘Question Set 2 - Background’ begins with a question about climate change, which was intended as a ‘warm-up’ question, and to ascertain the respondents general attitudes and understanding of the subject. Several options were given as potential answers (although they were rarely used). This question was influenced by a wide variety of sources, the most notable being research conducted in the East Midlands by ICM for the Central Office of Information (COI 2006), which asked a series of questions. The questions included whether climate change was happening, whether it had natural or man made causes, and whether the respondent felt they could have an effect on it. They were combined into the one question in the RedHENS interview questionnaire. The question about spending more than 10% of income on fuel was intended to identify those who may be in fuel poverty. As well as that particular aim, the intention of the question was to prompt for views on fuel costs. This follows from the questions about

relationship with gas and electricity suppliers as featured in the postal survey. There are then the two questions about energy efficiency measures, which stem from the questions about 'understanding heating systems and insulation' in the survey. There is a list of home energy efficiency measures to use as prompts in case the interviewees struggle to come up with any.

'Question Set 3 - Attitudes' starts with a key question which draws directly from a key question in the survey - that about support for personal carbon allowances. In this context however, it is much more open, and the motivations behind interviewees' answers are explored. It is in effect repeated after the footprinting exercise, when the interviewee is asked for whether their support has changed, and again 'why?'. An additional question was asked regarding the effect of PCAs on the household and family. This question is to remind the interviewer and interviewee that the footprinting exercise and the impact of PCAs, is at the household as well as at the personal level.

'Question Set 4 - Your Response to PCAs' uses questions derived from the questions on the survey relating to responding to personal carbon allowances. They cover the same measures and actions, namely household energy use and transport (covering surface and air travel). The household energy use issue is split two ways, such that there are questions about behaviours and about investment measures. There are also supplementary questions which explore the barriers to interviewees installing home energy efficiency measures, or changing the way they travel. These look at information needs of the households, and how systems need to change.

Some questions were dropped after the third interview, as the experience of the early interviews was that there was insufficient time to ask them. They are listed in appendix section 12.8.1. In practice, few results or findings had stemmed from the questions (when it had been possible to find the time to ask them).

6.5 The proposed system of PCAs - and interview slide show

This section looks at how personal carbon allowances were described to the interviewees, and the slide show presented to them. The slide show (see appendix 12.9) was presented after the first two sets of questions had been put to the interviewees (the first set involved basic details of the household, home and vehicles etc.; the second set was about energy efficiency measures in the home and views

about climate change). The purpose of defining the system at this point was, as far as possible, to pre-empt interviewee points that might later distract the conversation, and thus to find out what people really thought about PCAs. Interviewees were also asked to imagine that the system would work. However it was inevitable that such points would still arise, and the interviewer was fully prepared to record them.

Not all the points about PCAs described here were included in the slide show, to make it easier to absorb, but the interviewer had the other assumptions ready should interviewees question a particular aspect of a system of PCAs. It is recognised that the term PCAs is generally used in a generic way but the system description was specific to this stage of the RedHENS project, although based on existing proposals. A primary influence was Domestically Tradable Quotas (DTQs) also known as Tradable Energy Quotas (TEQs) (Fleming 2007). Some specific points included in the definition of PCAs were that:

- All adults would receive an equal carbon unit allocation for home and car fuel, and flying, to cover energy use based on fossil fuels (gas, oil, coal).
- Children might get a full or half allowance (or other proportion), or no units at all, affecting the size of the adult allowance.
- People would be given a ‘carbon card’ to pay for vehicle fuel and for flights.
- People would sell any excess carbon units via a trading system to those who needed more.
- Business would be included in a broader scheme (“parallel business system” on the slide show).
- The system would be implemented as part of an international agreement to reduce carbon emissions based on ‘contraction and convergence’ (Meyer 2000, UEA 2007).
- There would be monthly releases of units within an annual target.
- A ‘carbon trading committee’ would control the release of units to stabilize the price of carbon units although the unit price would be likely to vary and generally to rise.
- The carbon trading committee could vary the size of monthly releases for example to cope with unexpected cold weather, or to cope with a potential big drop of energy consumption within the first year.

- There would be a reducing annual personal allowance with the aim of reducing carbon emissions by society over a number of years by 60 to 80%.
- The first year's allowance would be the previous year's average per capita usage minus the targeted reduction for that year, probably in the region of 5%. There would be similar cuts in subsequent years.
- Carbon units would expire after a reasonable time period (say 18 months) to prevent hoarding (the oldest units in a person's carbon account would always be used first).
- Regarding home energy bills (gas, electricity, etc.), apportionment of carbon unit use would be spread equally between the allowances of all the adults in a home (and pro rata for children, appropriate to the size of allowance they receive).
- An appropriate number of carbon units would be automatically retained for heating, based on previous energy use, home energy efficiency rating, etc. until after the last bill after the end of the heating season. This would prevent people making themselves cold in winter or diverting units to less important uses such as fuelling a low efficiency vehicle (UEA 2007: pp. 18-19).
- For pensioners, or those without bank accounts, etc, units (excluding those retained for heating) could be sold and cash given instead, through the tax and benefits system.
- Purchases of fuel made without using one's allowance would be at a higher price to reflect the vendor's need to buy carbon units to cover the purchase.

Furthermore, the points that the system of PCAs would not be a tax, and that people would still pay for energy or fuel, were made. Emphasis was put on the fact that there were no wrong answers, that a "don't know" could be a helpful answer, that anyone in the home could join in, that the interviewer had no opinions on the subjects as the purpose of the interview was research. Interviewees were encouraged to ask questions in order for the researcher to ascertain what the interviewees did not know or did not understand.

Note that the slides about PCAs were preceded by a slide entitled 'What is climate change?' This slide was skipped over quickly in some interviews who expressed

sceptical views about man-made climate change (the question about climate change preceded the slide show).

6.6 Generating the footprinting spreadsheet

Once the justification for performing a carbon footprint had been established, it was necessary to generate a tool for calculating it. In order to help with on-the-hoof analysis during the interviews, it was necessary to ensure that this was a carbon emissions inventory, rather than just generating an overall footprint figure. In order to avoid delays during the interviews, it was important that it should be automated, i.e. implemented on a computer. Previous work in this area includes a tool used by Tyndall (2004a: p.35). However this was for use by households rather than by the researchers, and was provided with a graphical user interface. The researcher wanted to have manual control in order to cope with the variety of information types and situations that people might present. The obvious method of implementation was in a spreadsheet program like Microsoft Excel.

The tool to be developed needed only to deal with emissions from fuel and electricity use in the home, and from fuel used in cars, as well as from airline flights. This was because it was designed to complement the discussion of personal carbon allowances, and PCAs would be confined to emissions from these sources. It also needed to take into account how carbon reduction measures would affect the current footprint of the household. The development of the spreadsheet had just commenced when the UK government released the first version of its footprint calculating website, Act On CO2 (Directgov 2007). It covers home fuel, car and airline use, but not public transport, nor goods and services. Although not causing any change to the design of the spreadsheet calculator, the methodology used in Act On CO2 was used to source some emissions figures (especially those to do with car and airline use), and to generally check the design (DEFRA 2007b). Act On CO2 was not used directly because there was no certainty as to how it would operate, there was not the means to be on-line while interviewing, it did not allow the researcher to perform pre-determined or ad hoc analyses, and it could not show the reduced footprint that would result from implementing measures.

Most emissions savings figures were sourced from the Energy Saving Trust website during June 2007 (EST 2007c), although later many of them were updated (the carbon

savings were reduced). The savings assumed an average home, and that gas was the heating fuel. Some intermediate or direct physical conversion figures, such as the carbon dioxide emissions resulting from gas , electricity, oil and coal, were sourced from the National Energy Foundation simple calculator (NEF 2008). The valuation placed upon a tonne of carbon dioxide was £40, and this was based on Hillman and Fawcett (2004) as well as upon the Stern Report (HM Treasury 2006). Averaged East Midlands figures from Uswitch (2007) were used for gas and electricity costs. The government's website for basic statistics (ONS 2007) was used to obtain population figures, in order to calculate allowances for the various situations where children receive no allowance, a half allowance, or a full adult allowance.

There were three worksheet to the footprint spreadsheet, see appendix 12.10. The main worksheet, CO2footprint, was supported by the other two, Measures and Constants. The main sheet took the interviewer and user through the process of entering household details (number of adult-equivalent allowances, assuming a half allowance for children), home energy consumption data (split by elec, gas, oil, coal), then car use data and finally data about airlines flights. This created an overall footprint value which was compared with the total value of personal carbon allowances (appropriate to the household), in order to ascertain the surplus or deficit that the household would have under a system of PCAs.

A variety of ways were used for entering data about home energy consumption. For speed, monthly payment amounts were accommodated. The flow of calculation for gas and electricity was, broadly, payment amount converted to energy units in kilowatt hours and then to emissions in kilograms of carbon dioxide, although energy units could also be directly entered. For vehicle emissions, mileage, litres or cost of petrol or diesel could be entered. For the situations where mileage is used, average figures for three sizes of car, both petrol and diesel, could be chosen. A variety of methods for working out carbon dioxide emissions caused by flights were reviewed. A quick method was required, so as not to slow down or distract interviews, so the domestic, short and long haul split, as featured in Act On CO2, was used. As there was a danger that those with below average footprints may lack motivation to consider measures, the main worksheet shows the effect, on the overall footprint, of annually declining allowances, to prompt discussion of potential future measures.

Once the above process had been followed, the second worksheet, 'Measures', was used. On the Measures worksheet, the number that the householder would be willing to install was entered for each measure (or behaviour). In some cases, this would normally only be entered as one, such as for a new boiler; for others, such as compact florescent lightbulbs, any number might be installed. The sheet calculates the total carbon savings from the measures that the householder was prepared to install or to take, and this figure is transmitted back to the main sheet, CO2footprint.

Note that the calculation of savings on fuel bills, resulting from measures, was incorporated, after the fifth interview, as a result of feedback from interviewees.

6.7 Recruitment and selection of interviewees

Interviewees were recruited by two main methods. Initially, one pilot interview took place, although this was not in Newark and Sherwood District. The first set of interviewees was located via responses to the NSDC 2007 HECAmon survey, and for new and council homes, from the appropriate RedHENS surveys. The respondents contacted had ticked a box on the form they had completed, indicating willingness to assist with further research. Due to the forms not asking for telephone numbers, these had to be obtained, where available, from BT directory enquiries (BT 2007). Unfortunately many of those willing to help did not have listed telephone numbers. Where a respondent was listed, the researcher phoned to ascertain their willingness to be involved, and an appointment was arranged. The first few interviews were with older people. After the first few interviews, it was necessary to state that persons of working age were being sought for interview (this avoided asking people their ages). Eventually the list supplied by NSEA was exhausted, with seven interviews having been conducted (eight, if the pilot is counted).

The second method of recruitment was an advertisement on the home page of the NSDC website, arranged through the energy agency (NSDC 2007). The ad offered the calculation of a household carbon footprint, but limited to households where the head of the household was below 50. The researcher's email address was provided. The response rate was low but sufficient. Virtually all the respondents were interviewed and fortunately the seven households interviewed represented a wide range of people (including one household that was outside the district). The original plan was to potentially conduct more interviews but once the number of interviews had reached 15

(and the number of interviewees was 21), it was apparent that a huge variety and quantity of data had been collected, and no new issues were arising, so the decision was made to cease interviewing. This is described by Robson (2002) as reaching 'saturation'.

6.8 Conducting the interviews

The fifteen household interviews were conducted between the 10th July and 24th November 2007. The interviews took place in the interviewees' homes, so there was the advantage to make a wide range of observations about the home (and vehicles). The interviewer wore smart casual clothing. Each interview was driven by the interview questionnaire (see appendix 12.8). This not only included the questions put to the interviewees, it also featured prompts to the interviewer to use the other tools of the interview, such as the covering letter (see appendix 12.7), the slide show (see appendix 12.9) and the footprinting spreadsheet (see appendix 12.10; the development is explained in section 6.6). A laptop computer was used to display the slide show and to run the footprint calculation spreadsheet. During the interview, notes were made on a paper copy of the interview questionnaire. After the interview, notes were made on a paper copy of the post-interview form (see appendix 12.11).

The interviews were semi-structured. So although the conversation was regularly brought back to the questionnaire, if the interviewee brought up a relevant subject of interest, or brought up a subject before it was scheduled to be discussed, the interviewer allowed the conversation to be directed that way. The interviewer also responded to answers and points made by the interviewees. Sometimes this was to provide information to the interviewees (which sometimes would generate further interviewee response), and other times other times to probe (Robson 2002, Bryman 2004) to gather further views, in order to achieve a deeper and wider evidence base. Both these required that the interviewer was knowledgeable in the field.

The interviews were recorded on an Olympus digital sound recorder (model DM-20) which was capable of recording up to nearly nine hours in voice mode. This is a small battery-powered device, making it less obtrusive, and if necessary it could be carried around an interviewee's home.

6.9 Processing the data from individual interviews

After each day of interviewing (a maximum of two interviews), the recordings were transferred from the sound recorder to a PC and played using Microsoft's Windows Media Player. At all times to maintain privacy of the interviewees, they were listened to using high quality headphones. They were transcribed by the researcher into password-protected Microsoft Word documents. It might have been easier to have specific software to make transcription easier, particularly to cope with matching passages of text to the chronological progress of the interview, and especially when 'rewinding' to listen to a passage when it was not clearly heard on first hearing. However, to enable the use of standard software, it was decided to use Windows Media Player and Microsoft Word. Transcription was performed by the researcher. Although it would have been quicker, transcription by a speed-typist would have risked errors, and missed the opportunity to interpret tone of voice, hesitation, etc. It would also have removed the opportunity for the researcher to do a first level of analysis, particularly identifying emergent themes.

The transcriptions missed out long irrelevant passages, which were typically marked with '[snip]' (in general, square brackets were used to indicate editing or to accommodate special remarks). Some semi-relevant passages were summarised. Anonimising of personal details took place during transcription (attributes altered included names, place details, sensitive issues, career details, and ages (slightly). In some cases, additional identifying details were edited later, once they had been discovered.

The forms that were completed during (see 12.7 Appendix - Interview questionnaire) and immediately after the interviews (see 12.11 Appendix - Post-interview form) were transcribed into password-protected ed electronic copies of the same forms. It was also necessary to copy the (password-protected) spreadsheet document created during an interview from the laptop used during it, to the university's computer network.

6.10 Qualitative data analysis including the use of NVivo

The qualitative data analysis (QDA) was performed using the software tool NVivo version 7 (QSR 2008). NVivo was used to import sources (interview transcripts) which were Microsoft Word format, and to make corrections to them. This included

anonimising the data, a process which continued on later occasions, once any potential clues to personal or household identity were identified.

Most importantly, NVivo was used to ‘code’ passages of text (i.e. passages of conversation) to ‘nodes’. The type of nodes used were ‘tree nodes’. These allow a hierarchy of nodes or themes, effectively a taxonomy of the subject area. In effect nodes are ‘themes’. In practice, only two levels of node were used in this project, thus creating ‘main’ themes and ‘child’ themes. In any one transcript, coded passages can overlap. Some parts of conversations may not be coded at all, other parts may be coded to multiple nodes (themes), and NVivo displays these coding using coloured stripes to the right of the text. NVivo allows a researcher to easily change and correct codings and to print out all the text, from different sources (i.e. different interviews) coded to a particular node.

Note that as a pilot, two interviews were loaded from Microsoft Word into NVivo and some basic coding was performed. The result of this experiment was that certain global formatting edits were made to the original transcripts in Word, so that they could be more easily handled in NVivo.

6.11 Previous work in the field

Before the second data-collection stage of the RedHENS project commenced, a number of projects, in similar research areas, and with prominent qualitative research aspects, were identified. The oldest of note was that conducted by Hedges (1991) for the then Department of Energy which looked at attitudes to energy conservation in the home. The data collection, described as ‘unstructured’, included twelve interviews conducted in homes on the subject of domestic energy use. The interviews were guided by loose topic guides rather than questionnaires. Energy audits were conducted for the same homes, which somewhat parallels the calculation of the carbon footprint in the RedHENS interviews. There were also interviews with experts in the field.

Over a decade later, Cragg Ross Dawson (2004) gathered evidence using qualitative interviews to test the public’s reaction to the concept of providing ‘energy services’ (installation by gas and electricity suppliers of household energy efficiency measures, which customers pay back over a period of time). Amongst the earliest research into attitudes towards personal carbon allowances was conducted by Low (2005). Four

focus groups, in two broad categories (car-owners and the environmentally conscious), were run in 2005 to test reactions to PCAs in comparison with carbon taxation. Carbon Neutral Newcastle (2005) conducted focus groups to research public attitudes, in northeast England, to responding to climate change, and to identify barriers to action. Like RedHENS, CNN covered car and air issues as well as household measures and behaviours.

Some key research has taken place in parallel with the RedHENS interviewing. The Open University conducted research into consumers' attitudes towards energy efficient products for homes (OU DIG 2007). Following an online survey with nearly 400 responses there were more than eighty in-depth telephone interviews with the clients of two Energy Efficiency Advice Centres (EEACs). The Department for Transport conducted research which involved interviews of stakeholders, and of individuals with and without experience of using carbon calculators, to assist with the design of these (DfT 2007). At the time of writing, unfinished research by the Institute of Public Policy Research is exploring attitudes to personal carbon trading, particularly using comparison with carbon tax and with upstream trading (also described as 'limits on fuel and energy suppliers') (IPPR 2008). The data collection techniques include a discussion group, an online poll (n=1081), three deliberative workshops in different parts of England, and seventeen stakeholder interviews.

DEFRA have used a similar comparison of options in their research into personal carbon trading (DEFRA 2008a). Similarly to IPPR's discussion groups, DEFRA's research used focus group methodology. There were twelve groups in six areas involving 92 participants in total, although no quantitative data were collected. There was some key differences between the RedHENS and DEFRA methods. On the choice of participants, DEFRA used segmentation profiles, and achieved ethnic variety and socio-economic balance. RedHENS featured no ethnic variety. All participants were white British, due to the population of Newark and Sherwood District. It also had no explicit means of achieving a socio-economic balance although the situation was continuously monitored and action was taken on ages of participants. DEFRA's research examined principles then implementation and finally willingness to change behaviour. In contrast, RedHENS calculated household carbon footprints and discussed carbon-reduction measures whereas DEFRA gave participants a list of "what is likely to happen before a carbon reduction scheme is introduced" and

conducted a quiz about relative carbon emitting activities. DEFRA did not look at costs whereas RedHENS used a carbon price and examined financial savings from measures. Perhaps the most important difference in terms of the definition of PCAs was that DEFRA discussed allowance variations whereas RedHENS only looked at the child allowance issue. RedHENS featured a well-defined PCT scheme, and interestingly DEFRA recognised that theirs was less well defined (ibid: pp. 50-51).

In relation to the quantitative aspects of the second stage of data collection of the RedHENS project, that is the footprinting and carbon reduction measures, one scheme is notably close. The Centre for Alternative Technology (CAT), as part of its Zero Carbon Britain programme, has promoted the concept of footprint calculation in connection with the concept of personal carbon allowances (Slack 2007). They are encouraging members of the public to participate by using the supplied spreadsheet and by submitting their data to CAT.

Related work in the field had a limited effect upon the second stage of data collection in the RedHENS project because much of the most relevant work was going on in parallel. Other work was less relevant due to the subject areas like carbon footprinting or personal carbon allowances being relatively new, although the single most important influence was that of Hedges (1991). The first stage of data collection of RedHENS (the postal surveys) was more influential than other research work.

7 Interviews - Overview of Results

This chapter looks initially at some overall observations about the second data collection phase, and then describes the interviewed households. Next it presents and discusses the quantitative (footprinting and measures) data collected during the interviews, and finally presents the summary results for qualitative data - the frequency with which themes and sub-themes were discussed during the interviews.

7.1 The challenges and opportunities of interviewing

A number of overall observations can be made about the interviews. For example, local knowledge of Nottinghamshire helped the interviewing process. The interviewer had recently lived in Nottinghamshire, and was familiar with the county's waste, transport and other policies and activities. This made asking of probing questions easier.

Interviewing people who live a long distance away from a base office was very time-consuming but attempting to organise more than two interviews per day was unproductive, as it involved considerable coordination of multiple parties, and the risk of being let down. The only time three interviews were arranged for the same day, it transpired that one of the households had double-booked. Short-term arrangements were impossible, especially if they were the same day, due to the distance between the university and the area of research. Even next day appointments proved difficult, due to the requirement to obtain management approval for travel requests (sometimes requiring the booking of a hire car).

The interviews averaged nearly 2.5 hours each. Using a digital recorder helped, as the changing of tapes (or mini-discs) every so often might have encouraged both interviewee and interviewer to consciously or unconsciously terminate the interview sooner. There were surprisingly few incidences of distractions, for example with children or pets.

There was a problem with those households billed jointly for gas and electricity, as the bill often had a combined amount on it, with a lack of clarity as to the proportion applicable to each fuel. A split of one third electricity to two thirds gas was assumed, based on the interviewer's own experience, which appeared to be borne out by those

cases where the households were billed separately for electricity and gas. The problem was completely unexpected because every situation the interviewer had previously been in, or observed, featured separate billing of the fuels (even if supplied by the same company) and because all the gas and electricity referral services (such as Uswitch (2008a)) ask for details of these separately, as does Act On CO2 (Directgov 2007). Not only is the situation a disincentive to switching gas and electricity suppliers, it makes calculating carbon footprints difficult, as the carbon content of electricity is more than twice that of gas.

Another problem with billing amounts was for households which had recently changed supplier or, in particular, had a recent considerable change in monthly billing amount. Establishing a payment amount typical of the households' actual gas or electricity use proved to be time-consuming on some occasions.

Two of the last three interviewees were deliberately selected for being different - one was a new home owned by an employee of a gas and electricity supplier (thus making the interview additionally interesting for two different reasons), and the other was in Greater Nottingham and, being more urban, provided a different perspective on transport issues.

7.2 Descriptions of the interviewees

Fifteen households were interviewed, as summarised in Table 7.1 and Table 7.2. There were 21 adult participants of the interviews. Of these, four participants were not present for the full length of the interview but were instead present for a substantial period (at least half). All but two of the households were in Newark and Sherwood District.

Yin (1994) suggests one method of writing up case studies, known as the 'multiple case report'. The typical report structure in these reports involves starting with individual case narratives, and then examining 'cross-case issues'. This section briefly satisfies the first requirement by describing each of fifteen households in the chronological order in which they were interviewed (and chapter 8 satisfied the other requirement). Names have been changed for privacy reasons.

Household 1 - Pete and his adult daughter Jacquie

The pilot interview was not undertaken in the main geographical area that most of the research was conducted in. Instead of taking place in Newark and Sherwood borough, it was conducted in another borough of Nottinghamshire. Pete, who had recently retired early, lives with his wife in an attractive part of Greater Nottingham. The interview with Pete, which included his 21 year old daughter Jacquie for part of the time, resulted in fewer changes to the process than had been expected, and so was included in the main research results (Pete and Jacquie did not benefit from seeing the PowerPoint slide show which was used in later interviews). The interview was of interest because it covered surface travel to and within the near continent, as well as insulation of a dormer bungalow style roof (both subjects which were to come up in later interviews). Pete was asked additional questions testing knowledge of home designs and energy efficiency. These questions were later removed from the interview plan due to the need to shorten the interviews.

This was the only interview that required a follow-up phone call, to confirm the depth of loft insulation and to check how many compact fluorescent lightbulbs could be installed in the home. Pete was one of the few interviewees to be able to give separate and reasonably certain gas and electricity monthly payment figures. The footprint figures assume that the daughter Jacquie does not any longer live in the home but even so the overall footprint was below average for Pete and his wife. This applies no matter which average is used, i.e. the allowance figure whether children get no allowance (5.796 tonnes per adult), half allowance (5.056 tonnes per adult) or a full allowance (4.483 tonnes per person). This was probably due to Pete being retired, and his wife working locally, meaning that car use was low. Airline use was fairly low too. Meanwhile the level of emissions from the home was fairly low, probably due to active management of heating issues combined with having a condensing boiler. However, the electricity bill could have been reduced greatly by installing compact fluorescent lightbulbs. Reducing gas consumption would be a challenge, involving solid wall insulation and further insulation of the dormer roof.

Household 2 - Helen

Helen was a recently retired professional, living alone in a 1980s two bedroom bungalow in a village near to Mansfield. Gas and electricity monthly payment figures for use on the footprint spreadsheet had to be estimated from previously higher amounts and current amounts, which were recently considerably reduced due to overpayment.

The footprint from the home was lowest of all the interviewed households, with Jim's being the next lowest. Despite the low emissions from the home, Helen had a high footprint only exceeded by two other interviewees (both recent retirees living on their own). This was partly explained by the fact that, like them, she indulged in a lot of flying, although both the other two had not made their homes efficient as she had.

However even if Helen implemented the remaining home energy efficiency measures available to her, she would not be able to achieve a below average footprint (i.e. below 5.056 tonnes per annum) and would have to pay out under a system of personal carbon allowances. The figure of 5.056 assumes half allowances for children but even if children get no allowance and adults would therefore get 5.796 tonnes, she would be in deficit. The explanation is that Helen does a great deal of flying, including long haul flights, and frequent flying to the near continent.

Household 3 - Alfred and Evelyn

Alf and Ev were in the process of retiring and lived in a 1970s three bedroom home in a village near Mansfield. When the home was originally built, there was no gas supply available in the road so oil heating was used. The electricity was paid quarterly, and the latest figure covering three months of spring and summer was rounded up from £108 to an assumed figure of £120 for an average quarter (and thus £40 per month).

Alf and Ev constantly talked about how they weren't extravagant but nevertheless, although exhibiting fairly low levels of flying and car use, had a considerable footprint from the home. The house was not large but came third amongst all fifteen homes in terms of carbon emissions. One of the two homes with higher footprints was likely to reduce the home footprint considerably, as the occupants (Melanie and family) had just moved in and were likely to make considerable energy efficiency improvements in the near future. Thus Alf and Ev's home could be said to have the second highest footprint. They would be unlikely to alter that situation because of their considerable reluctance to invest. They seemed happy to pay out for three or four oil deliveries a year, and put up with uncomfortable conditions, but could not see the waste involved, although they spoke extensively of other people's wasteful behaviour. They also did high levels of clothes washing.

Nevertheless this household came 'mid table' as regards overall footprint, and if allowances were given to adults only it would achieve a small surplus (otherwise they

would have a small deficit). This interview was the longest because of the tendency of the interviewees to go off topic and offer their opinions on a wide variety of issues.

Household 4 - Philip

Philip was a recently retired professional, living on his own in a three bedroom detached home in a village near Mansfield. He paid a joint electricity and gas payment of £82 by direct debit. Both the interviewer and Philip felt the split would be around two of gas to one of electricity, so agreed on assumed figures of £55 per month for gas and £25 for electricity.

Despite viewing himself as a ‘saver’, Philip had the second highest household deficit, presumably caused by an old boiler, a lack of cavity wall insulation, a tendency to fly - and living alone. By implementing carbon saving measures in the home, he would considerably reduce his deficit, and would even achieve an average personal footprint (although only in the situation where only adults received a carbon allowance). Philip was an enthusiastic cyclist who had experimented with public transport and had investigated getting a new boiler, but had been misinformed about alleged problems with cavity wall insulation. He regularly travelled to the near continent.

Household 5 - Jim

Jim was retired and lived on his own in a two bedroom council bungalow in Newark. Jim had a joint monthly electricity and gas payment, at £40. The interviewer and Jim agreed on a split of £25 gas to £15 electricity. Calculating Jim’s footprint involved another complication - his tariff (on both electricity and gas) had been capped for a long period. This meant that any monthly amounts discussed were likely to underestimate his consumptions and footprint.

The first calculation performed generated a lower footprint, although even after recalculating it to take account of the capped tariff, he still had the lowest household footprint and the second lowest personal footprint. Jim holidayed in the UK, did not fly and had no car. The only measure that might be implemented was for the council to replace his boiler. This was likely to occur in the next few years, due to its age. The potential improvement from heating controls was not included, as his home was small enough to preclude anything like the typical savings quoted for heating measures (although better heating controls should and would be installed).

Even if all the interviewees installed all the measures appropriate to their households, Jim would still have the lowest household and home footprints. Interestingly he would not have the lowest personal footprint (Pete and his wife would) and two other couples would have personal footprints close to his, as they all have the advantage of sharing.

Household 6 - Rosemary and her son Tom

Rosemary lived with her older husband in a house in Newark very similar to the one that the interviewer had lived in until recently, a three bedroom detached 1970s property. The husband was not present but her 18-year old son, who had just left school, was around for parts of the interview. The husband's management of the bills was chaotic and it was difficult to work out the monthly payments. Eventually a monthly payment covering both gas and electricity was identified amongst the bills, and after some discussion was assumed to be correct, and split at £70 for gas and £35 for electricity per month.

The overall footprint was the fourth highest amongst the households, and the main reason why the household was not in deficit against the total of personal carbon allowances was that the son lived at home (i.e. there were three adult allowances to absorb the footprint). The situation could have been worse but no-one within the household did any flying. The home had few energy efficiency measures because of the husband's great reluctance to invest, and as with Alfred and Evelyn, there seemed to be an acceptance of large bills. The boiler was very old and there was no cavity wall insulation. There was also a variety of old fridges and freezers. The interviewer estimated that consumption was twice that of his own former home (which was of near identical age and design), which had received all the low cost measures. According to the footprinting spreadsheet, the measures appeared to save over five tonnes from the 8.5 tonne footprint of the interviewees' home.

Household 7 - Cathy

Cathy lived in an early 1990s four bedroom detached house in Newark with her 15 year old child. The combined gas and electricity monthly payment was £106, and an assumed split of £70 for gas and £35 for electricity was agreed between the interviewer and Cathy.

Although Cathy had been on her own with her daughter for the last few years, they still lived in the large home. Consequently they had the third highest household deficit, at

nearly four tonnes, despite no flights being taken, assuming a half allowance for a child. If children were not given half allowances, the deficit would have been far greater (this was the first household with a child under eighteen). There were not many measures that could be applied to the home, except to top-up loft insulation from 10 cm to 27 cm. Cathy was unaware as to whether cavity wall insulation was already installed. It is probable however that it was, which gave little room for manoeuvre on the home's footprint - except to move to a smaller home.

Although Cathy's footprint from driving was by no means high compared to some of the other interviewee's footprints (theirs were generally caused by long commutes), it was notably high for someone who worked locally, rarely travelled further afield, and had a small to medium sized car.

Household 8 - Leonard

Leonard, a recent retiree, lived on his own in a large four bedroom detached house in a village close to Greater Nottingham. He was able to provide actual monthly payment for gas and electricity of £76 and £32, something which not many interviewees were able to do. Unsurprisingly, he had the largest current footprint of all interviewees. Even if key measures like cavity wall insulation were implemented, he would still have a personal footprint around double the national average. However, the savings from the measures would probably be greater than the average figures used, due to the large size of the home. Although an occasional bus user, Leonard's car use was fairly high for a retired person and the emissions were amplified by the car being mid-sized rather than small.

Household 9 - Lynne

Lynne lived with her two children in a remote rural location in a 1930s semi-detached home which was in the process of improvement. It was the only household off the gas network which was not also using oil for heating. As well as peak-rate electricity being used for heating, wood and coal were also used on an open fire and back boiler system, making the footprint calculation interesting. Because there was no gas and thus no combined billing to provide complications, she could confidently state that her payments were £50 a month for electricity. Lynne's home footprint was not particularly high, despite use of electricity for heating. The household's footprint from car use was actually greater, because of Lynne's long commute. Lynne's household would be at a disadvantage if a system of personal carbon allowances for adults only was introduced, although the presence of the children was not a contributory factor to the high footprint.

Lynne was the last of the interviewees located via the council's 2007 HECAmon survey.

After this point, a different method of locating interviews was used, as the interviews so far had featured a high proportion of retirees.

Household 10 - June

June was the first interviewee located through the advertisement on Newark and Sherwood Council's home page. She lived with her husband and two children in a village close to Newark, off the gas network, in a 1980s four bedroom detached home. There were complications caused by a recent change of electricity supplier the previous year, then a sudden increase in monthly payment (from £28 to £60) being imposed. In the end, both daytime and night-time kilowatt hour figures were used to work out actual consumption over a year.

Oil heating contributed to emissions from the home which were the fourth largest of the interviewed households. The home itself was larger than the occupants wanted. An additional contributory factor was the husband's use of a large car to travel to work. He worked overseas for long periods and made mainly solo car journeys to reach his UK departure point which could have been made by train. June had a medium-sized car to transport the children around in.

There were a few measures for improving the situation although the largest of these was a replacement boiler. As with some other households, e.g. Leonard's and Cathy's, this was a borderline situation, whereby the existing boiler was not old enough to justify replacement yet, but in discussing a system of personal carbon allowances which might not commence for several years, one might assume that the boiler would then be old enough for replacement.

This household had a small surplus (although June was disappointed that they were just 'average', as she put it). However if personal carbon allowances were given only to adults, the family would have had a deficit. Meanwhile, if the husband gave up his car, the family would be in surplus in any allowance scenario.

Household 11 - Melanie

Melanie, her husband and her children had recently moved to their very large 1970s detached house in a small town in the borough of Newark and Sherwood. There had been no gas and electricity bills over the winter period as the family had only moved in during the spring. The supplier had set a payment of £60 for gas but Melanie thought this ought to be £80, which the interviewer agreed with, given the size of the home, and the lack of energy efficiency. The payment for electricity had been set at £50 which both felt was a little high but it was left at that level for the footprint calculation.

The overall footprint was the largest of all the households, and the footprints from the home and from car use were the largest too. Measures totalling over three tonnes could have made the footprint from the home smaller than that from the cars, as the former was currently only slightly more than the latter. The high footprint from car use was due to the husband commuting a long distance. The family had moved to attempt to achieve a better education which they anticipated was not available in their old location, but which had been much more convenient for travel to the husband's workplace.

This family would be much worse off if personal carbon allowances were not given to children, and indirectly the children were a contributory factor to the high footprint, because of the parents' choice of place to live based on education priorities, and the purchase of a larger home to accommodate the three children. In fact this household had more children than any other of the interviewees, and would be best off under a system where everyone gets the same allowance (4.483 tonnes for both adults and children).

Household 12 - Janet and Nick

Janet and Nick lived with their two young children (under five years of age) in a dormer bungalow in a village near Newark. Note that 'dormer bungalow' refers to a property with the upper storey incorporated into the roof. Due to previous problems regarding failure to bill for gas and electricity, monthly payments could not be used to estimate annual usage. Instead, cubic metre and kilowatt hour figures were used, which ironically generated emissions figures which were probably more accurate. Janet expressed fairly strong pro-environmental views.

The footprint from the home was, however, not small. There were eight with smaller footprints from the home, two more were only fractionally higher, and two were just higher than those. This was despite Janet and Nick's home being small. Worse still, the emissions from car use were the second highest. Overall the household had the third highest footprint, and this was without any flying. Nick, who joined in the interview later on, often checked bills and tried to analyse consumption. Although a new boiler was not specified amongst the carbon saving measures, recent problems with the existing boiler's reliability might have suggested that the measure was necessary, even if the old device was not yet fifteen years old. On the face of it, the measures cannot do much to help reduce the household footprint. It is possible that much heat is being lost from the upstairs rooms through the dwarf walls into roof voids above the insulated ceilings of the ground floor, and thence out into the atmosphere through the pitched roof. It may well be that a new boiler, and insulation appropriate to a dormer bungalow, could bring home emissions down below those of the vehicles.

Nevertheless a small surplus would exist under a system of half allowances for children. If allowances were only given to adults, this family would be penalised, as they would have a considerable deficit.

Household 13 - Marion and John

Marion and John had recently moved into their three-bedroom solid-wall end-terrace home in a fashionable suburb of Greater Nottingham. Marion responded to the offer of having one's carbon footprint calculated, as advertised on Newark and Sherwood's home webpage. In the light of a low response rate, it was decided to interview this couple, especially as they, along with Pete in interview number one, provided an alternative city view to the rural and small town emphasis of the rest of the interviews. Due to recently moving in, John took a guess at what the monthly gas and electricity payments would eventually be, partly by taking the figures from their old home (which was a similar but smaller property) and increasing them, settling on £50 for gas and £25 for electricity (although lower payments had been agreed with the suppliers).

The home emissions figures were therefore modest, and car emissions were lower in only two other households - one of which was Jim's, the only household with no car. However flying added nearly another two tonnes, which meant that the household's surplus was small (under equal allowances for all adults and children, there would be no surplus, and instead a small deficit). The only substantial carbon-saving measure

available to reduce the footprint was either external or, more likely, internal insulation of the solid walls, although like many households, the replacement of a number of incandescent with compact fluorescent lightbulbs was a cheap option to make a reasonable carbon (and cost) saving.

Household 14 - Susan

Susan lived in a new four bedroom house in a village close to Mansfield, with her husband and two children, both under ten years of age. The monthly joint gas and electricity bill was £120. It was agreed with the interviewer that this was likely to be split at around £80 for gas and £40 for electricity. This reflected the split made in similar scenarios with other interviewees.

The home's emissions were second highest amongst the interviewed households, and the footprint from car use was the third highest. The overall footprint was second highest but it is likely that she would be left with the highest home footprint if Melanie and her family made the improvements that she seemed enthusiastic about. Ironically, Susan had asked for a carbon footprint from the interviewer because of high electricity and gas bills. Living in a home built less than a year earlier, there are not many carbon saving measures to be installed. The interviewer could not identify any issues which would explain what Susan thought were very high bills, except that the house was large.

This household would only just achieve a surplus if carbon allowances were given equally to all adults and children, and in the half-allowances-for-children scenario (shown in the table) it has a deficit of one and a half tonnes. Under a scenario of allowances only for adults, there would be nearly a five tonne deficit. Susan's greatest opportunity to reduce her household footprint was to reduce her own driving, which seemed to be very high for someone working part-time and living a few miles from her work. This is an occasion where children also have indirectly contributed to a high household footprint, due to trips to drop and pick-up at childcare providers and schools.

Household 15 - Dave and Carol

Dave and Carol live in a 1950s detached home (with cavity walls) in Newark, with their two children of secondary school age. Due to billing complications caused by monthly payments being set too low by the suppliers, there were complications in working out the gas and electricity consumption. Eventually, electricity use of £25 a month was

agreed, based on the recently received quarterly bill for the autumn quarter. For gas, because the old monthly payment was £30 and the new one was £94, a monthly figure of £60 was agreed on.

Emissions from the home were unremarkable, being middling, as was the footprint from car use. Emissions from flying were joint third highest amongst households, mainly because the whole family of four go away on a Mediterranean holiday once a year. The overall (household) footprint was again middling, being seventh of the fifteen interviewed households. A new boiler was included as a carbon saving measure but in reality this might not be justifiable for a few years. Replacement of the home's incandescent lightbulbs would bring bigger carbon and financial savings, however. Overall there were not many opportunities to reduce carbon. Interestingly, under any of the three systems of allowance allocation considered (adults only, half allowances for children, and equal allowances for all adults and children), this household avoids a deficit.

However there were unmeasured emissions from the business use of vehicles which would have affected businesses owned by Dave and Carol.

7.3 Quantitative results from interviewing

Table 7.1 gives, on each row, summary carbon footprint data for each interviewed household. The data has been extracted from the individual households' footprinting spreadsheets (one per row). It has groups of columns separated by solid lines. On the left, there is the number of the household (as used by the researcher, abbreviated to 'HH'), its location, names and ages of the occupants, and the duration of the interview (in minutes).

Reading rightwards, there are columns giving physical facts about the home, namely the number of bedrooms and the year the boiler was installed. Household occupancy details are then given, specifically the number of adults and the number of allowances allocated, this being one allowance for each adult and half for each child (the footprint 'allowance' used in these calculations is that for the scenario where there are half allowances for children, i.e. 5.056 tonnes per adult). The emissions from each main fuel used in the home are presented, with a total of these. Emissions from car use and

airline flights are given, and then a current total for the household (i.e. a total of the previous three columns).

The current emissions figure per person (that is, per adult allowance) is given in the next column, followed by the household's surplus. If this figure is negative, then it should be read as a deficit. The emissions that would be saved by implementation of the measures discussed with the occupants of the household (as detailed in Table 7.2) are shown in the second last column, with the last column showing the surplus (deficit, if negative) in the last column.

The bold lines across the middle of Table 7.1 give the separation between the different recruitment methods, namely one pilot interview, followed by interviewees recruited from previous surveys, followed by those recruited via the Newark and Sherwood District Council website. The last two rows give averages and standard deviations for all fifteen households.

Table 7.2 gives details of the carbon reduction measures each household could implement, and the total savings each measure could achieve per year. The first column describes the measure (in some cases these are behaviours), and the second gives the typical saving that one implementation of the measure can achieve per annum (p.a.). The next fifteen columns show how many of each measure the respective fifteen households could implement. This is followed by a column which summarises how many times each measure can be implemented, and the total carbon dioxide emission saving, across all the households, p.a. The average annual saving per measure is given in the final column (across all fifteen households). At the foot of these last two columns are the total emission saving for all measures across all households, and the average carbon emissions saving per household. Note that at the foot of each household column, the depth of loft insulation is shown, as explained by the notes underneath.

There were three properties not using gas, and as the proportion of properties in Newark and Sherwood without such a supply is 10% (EST 2004b), they appear to be over-represented. However, one property did have a gas supply available but had remained with oil heating, and that leaves only two properties without a gas supply. Although the sample size of just fifteen was selected to suit the qualitative emphasis of

this stage of the research, any lower level occurrence of non-gas properties might have been interpreted as under-representation.

Table 7.1 Households' carbon footprint sources and savings

HH no.	Pseudonyms (and ages)	Location	Dur (min)	Bed rms	Boiler year	No. adults	No. allowances	Gas	Elec	Oil	Coal	Overall home	Car use	Airline	Current total HH	Current per person	Current surplus	Saving from msrs	Emissions after msrs	Surplus after msrs
1	Pete (59) & Jacquie (21)	Greater Nottingham	125	3	2006	2	2.0	4,582	1,377	0	0	5,959	1,778	624	8,361	4,181	1,751	5,010	3,351	6,761
2	Helen (66)	Village near Mansfield	123	2	2005	1	1.0	2,397	1,103	0	0	3,500	1,778	2,985	8,263	8,263	-3,207	645	7,618	-2,562
3	Alf (64) & Ev (63)	Village near Mansfield	227	3	1974	2	2.0	0	2,199	7,236	0	9,435	1,186	624	11,245	5,623	-1,133	2,330	8,915	1,197
4	Philip (67)	Village near Mansfield	152	3	1987	1	1.0	5,152	1,377	0	0	6,529	2,724	134	9,387	9,387	-4,331	2,770	6,617	-1,561
5	Jim (70)	Newark	105	2	1985	1	1.0	2,777	1,103	0	0	3,880	0	0	3,880	3,880	1,176	810	3,070	1,986
6	Rosemary(56) &Tom (18)	Newark	127	3	1975	3	3.0	6,577	1,925	0	0	8,502	4,831	0	13,333	4,444	1,835	5,190	8,143	7,025
7	Cathy (42)	Newark	126	4	1994	1	1.5	6,577	1,925	0	0	8,502	2,864	0	11,366	7,577	-3,782	2,294	9,072	-1,488
8	Leonard (69)	Village near Nottingham	138	4	1996	1	1.0	7,147	1,761	0	0	8,908	2,797	624	12,329	12,329	-7,273	1,880	10,449	-5,393
9	Lynne (44)	Rural location	133	3	n/a	1	2.0	0	2,747	0	764	3,511	3,783	936	8,230	4,115	1,882	1,393	6,837	3,275
10	June (35)	Village near Newark	157	4	1997	2	3.0	0	1,720	6,700	510	8,930	4,817	0	13,747	4,582	1,421	2,275	11,472	3,696
11	Melanie (36)	Small town	101	4	1976	2	3.5	7,527	2,747	0	0	10,274	9,785	624	20,683	5,909	-2,987	3,274	17,409	287
12	Janet (37) &Nick (38)	Village near Newark	186	3	1999	2	3.0	6,363	1,935	0	0	8,298	6,158	0	14,456	4,819	712	645	13,811	1,357
13	Marion (37) & John (38)	Greater Nottingham	162	3	2006	2	2.0	4,677	1,377	0	0	6,054	1,398	1,829	9,281	4,641	831	3,061	6,220	3,892
14	Susan (38)	Village near Mansfield	141	4	2007	2	3.0	7,527	2,199	0	0	9,726	5,691	1,248	16,665	5,555	-1,497	236	16,429	-1,261
15	Dave (43) & Carol (44)	Newark	164	4	1997	2	3.0	5,627	1,377	0	0	7,004	2,795	1,248	11,047	3,682	4,121	1,831	9,216	5,952
		Average:	144	3.3	1993	1.67	2.13	4,462	1,791	929	85	7,267	3,492	725	11,485	5,932	-699	2,243	9,242	1,544
		Std deviation	32.2	0.7	11.9	0.6	0.9	2,768	525	2,454	229	2,282	2,463	842	4,032	2,447	3,081	1,478	4,177	3,620

Adult allowance: 5,056 kg carbon dioxide p.a. A child has half of this.

Figures in columns with grey headers are emissions in kg carbon dioxide.

Table 7.2 Potential carbon saving measures for households

Measure	Msr. saves (kg pa)	Interviewed household number															How many (all HH)	Total saving (kg)	Average saving (kg)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
Upgrades																			
Loft insulation (from 0 to 27 cm)	1,500						1										1	1500	100
Loft insulation (from 5 to 27 cm)	410	1	1					1	1	1	1	1	1				8	3280	219
Cavity wall insulation	1,000	n/a			1		1	1	1	n/a		1		n/a			5	5000	333
Double glazing	680																0	0	0
Floor insulation	340	1		1						1	1			1			5	1700	113
Internal wall insulation	2,250													1			1	2250	150
External wall insulation	2,400	1															1	2400	160
Draught-proof incl. skirting boards	265	1					1										2	530	35
Hot water tank jacket	150																0	0	0
Low energy lightbulbs	47	30	5	5	10	0	20	10	10	10	10	12	5	10	5	20	162	7614	508
																	Total:	*24274*	*1618*
Replacements																			
New boiler	810			1	1	1	1				1	1				1	7	5670	378
Heating controls	490			1	1		1				0.5	1					4.5	2205	147
Fridge (A+ or A++)	80			1												1	2	160	11
Fridge-freezer (A+ or A++)	185	1		2			1	1									5	925	62
																	Total:	*8960*	*597*
Behavioural																			
Turn off standby on multiple devices	173									1							1	173	12
Don't tumble dry in spring / summer	99																	0	0
Don't fill the kettle (4 times a day)	27																	0	0
Lower thermostat by 1 C	80																	0	0
																	Total:	*0*	*0*
Existing insulation depth		8NV	4BJ	8	8+	10?	4P	4B	4N	10P	4B	4	4V	8?	10V	8?	***Overall:***	***33,234***	***2,216***

Key to 'Existing insulation depth' row: [Numeric]= depth in inches; ?= value uncertain; P= patchy coverage, some areas have less; N= non standard material; B= partly boarded; J= junk in loft; V= vertical aspects un-insulated / dormer.
Columns with headings shaded in grey show how many of each measure could be implemented in each household.
A blank cell should be read as zero. 'n/a' means not applicable, i.e. cavity wall insulation cannot be applied to a solid-walled home.

The sample of fifteen household footprints is not sufficiently large to justify the search for any statistically meaningful patterns in the data. However some examination of the total (or average) data is worthwhile. This is confined to carbon emissions issues and to carbon reduction measures, as financial figures are more difficult to discuss, as explained below.

7.3.1 Households' carbon emissions

The 'Householder Global Warming Liabilities' work updated by Newark and Sherwood Energy Agency in 2004 (see Figure 2.3 on page 29) suggested emissions from a typical household in the district as being around 8.0 tonnes from the home, 4.5 tonnes from motoring and 3.0 tonnes from airline use - thus 15.5 tonnes overall. This compares with averages for the RedHENS research of approximately 7.25, 3.5 and 0.75 tonnes - about 11.5 tonnes overall. Therefore this work has found lower figures for all three main components, and differs most, proportionally speaking, on airline use. However given the extent of long commuting found by RedHENS (see section 8.5.1), it is surprising that the NSEA figure for car use exceeds it.

The average footprint 'allowance' used in these calculations is that for the scenario where there are half allowances for children, i.e. 5.056 tonnes (per adult). Thus the average personal emissions under 'current per person', at 5.932 tonnes, indicates that these interviewees and households may be higher emitters than the general population. However any difference might also be caused by a variety of assumptions such as input data errors (interviewee's monthly payments), conversion errors (supplier pricing) and so on. Regarding emissions from the home only, the average in RedHENS, 7.267 tonnes, is much higher than that calculated by British Gas and Best Foot Forward, at 5.779 tonnes for Newark and Sherwood District (NSD) and 5.743 tonnes for the East Midlands region (two of the households were in districts of the East Midlands other than NSD) (Best Foot Forward 2006). Emissions including transport are also higher, with RedHENS at 11,485 kg and statistics from the Office of National Statistics at around 10 tonnes for the East Midlands (ONS 2004). The average reduction in footprint achievable by the households was about two and a quarter tonnes, bringing the average footprint down to about 9.25 tonnes, a reduction of 19.5%. Section 7.3.2 explores these savings.

The use of a figure of 0.43 kg of carbon dioxide per kilowatt hour of electricity meant that emissions from the interviewees' electricity consumption figures may have been under-estimated. The calculation methodology for the Act On CO2 calculator, which became available around the time that the footprint calculator was being built, uses a figure of 0.527 kg CO_2/kWh (DEFRA 2008b). The NEF calculator, which was the source of the 0.43 kg figure, has since been revised to offer both figures, and to explain that the higher figure addresses average emissions, whereas the lower figure takes account of marginal savings (e.g. from energy efficiency measures) (NEF 2008). It is worth noting that the lower figure was being widely used in 2007. As a result, it was decided not to regenerate footprint and savings figures, especially as this would have involved changing the figures previously given to interviewees. This electricity calculation issue may go some way to explain why the savings from the suggested thirty compact fluorescent lightbulbs exceed the carbon footprint from electricity for household number one. It may also be explained by the interviewee giving incorrect billing data, or by the 47 kg of carbon dioxide saving per lightbulb being optimistic for large numbers of bulbs. Fortunately, the next highest number of bulbs suggested for a household was twenty, and after that twelve and ten, and no other measures involved electricity savings as extensive as those for lighting, so distortion of the overall carbon savings figures should be limited.

7.3.2 Potential carbon saving measures for households

Referring to Table 7.2, one can examine the various measures and how they could be used in each household (if at all). Because no-one showed potential for behavioural measures associated with transport, they have been missed off the table (they were based on those used in Act On CO2, and are eco driving, driving at 60 rather than 70 mph, and not using air-conditioning in a car). Note the total at the bottom right, 2.216 tonnes, is the average carbon dioxide saving per household (it differs only slightly from the 2.243 tonnes in Table 7.1 because of rounding errors).

Heating improvements, including boiler replacements and heating controls, at a total of 7,875 kg, provided the largest opportunity for carbon savings, although in some cases boiler replacements might not take place for a few years' hence. Compact fluorescent lightbulbs, at 7,614 kg, provide the second biggest opportunity for carbon savings, with all but one household (number 5, Jim's) capable of making carbon savings from them (it appears that the subject was overlooked when interviewing Jim, although he lived in

a very small home). However it should be noted, as discussed in the previous section, that the carbon emission savings from using CFLs are not likely to be proportional to the number of conventional lightbulbs being replaced as there will be a tendency towards diminishing returns if a large number of bulbs are replaced in one home. Thus it is reasonable to leave CFLs ranked after heating improvements. The next two biggest opportunities were cavity wall insulation at 5,000 kg and then loft insulation (combining the two figures for this to give 4,780 kg). Fifth would be solid wall insulation but this is not a low-cost measure.

The only behavioural saving that households showed an interest in ('turning off standby on multiple devices') registered a very low 12 kg average saving. It is clear that behavioural savings are of very low interest to interviewees - further compounded by the fact that, referring to the typical saving figure in the "measure saves" column, the behaviours save little compared to the investment measures.

7.3.3 Households' financial savings

Table 7.1 does not include financial savings, as these were not calculated for all households. In fact the concept of calculating financial savings was only incorporated into the carbon footprinting spreadsheet for the later interviews because of feedback from earlier interviewees about the importance to them of financial savings over carbon savings. Before that, only carbon savings, in kilograms or tonnes of carbon dioxide, were calculated. Savings involving non-electric heating, such as a new boiler or loft insulation, assume a financial saving of 13p per kg or £130 a tonne. Savings for electricity use, such as low energy lightbulbs, involve savings of 22 pence per kilogram or £220 per tonne of carbon dioxide (EST 2007c). Given that the footprinting spreadsheet see appendix 12.10) assumes a value of £40 per tonne for a surplus or deficit of carbon dioxide in a personal carbon trading system, the value of carbon savings, in terms of fuel bills, without any system of personal carbon allowances, appear to far exceed the value of carbon within a PCA system. The valuation of units at £40 a tonne is possibly an over-estimate. The government later put a value on the social cost of carbon at around £26 (DEFRA 2007e). Thus even more emphasis is put on the savings from fuel costs as opposed to carbon unit values.

Net financial savings from the measures and monetary gains from a system of PCAs cannot be included in the above tables, due to the difficulty of quantifying the cost of

measures. Although both the fuel bill savings and carbon allowance financial savings appeared on the individual footprint spreadsheets for the later interviews (for the first few interviews, only the gains from carbon allowances were featured), the cost of the measures were not featured at all, making any net or payback calculation impossible. Calculating payback needs to take into account that the cost of the measures fall into at least four categories. Some of the measures are free as they are behavioural. Some measures are very variable, such as heating upgrades, and compact fluorescent lightbulbs (some of these are free, whereas others can be specialist and therefore appear quite expensive). A third category of measures have subsidised prices for professional installation which are fairly predictable (e.g. cavity wall insulation), and a fourth group are available at subsidised professional prices but can also be DIY installations (e.g. loft insulation).

7.4 Results and Findings - qualitative themes

This section quantifies the occurrences of passages of conversation on identified themes in the interviews, and indicates whether they have been analysed. Some themes were identified before the interviews took place (template analysis), and some emerged during the interviews; the following tables mark each theme appropriately. The ‘No. of Interviews’ column gives the number of interviews in which the theme was discussed whereas the ‘No. of occurrences’ column gives the number of times a subject was discussed. The ‘Analysed in’ column gives the section number in the next chapter in which the results are presented. The main themes are alphabetically ordered within the first table, and then the subsequent tables, which document each main theme in turn, have the same ordering. Within the tables explaining each main theme, the sub-themes are alphabetically ordered, except that the main theme appears first. In some cases the main theme has no occurrences of passages associated with it, and acts merely as a grouping for the sub-themes.

During the coding process, passages where the interviewer was speaking were not coded except where it aids the understanding of responses from the interviewees. Long coded passages were split up into multiple codings if the aspect of the conversation changed (this sometimes necessitated the insertion of blank lines into the source transcripts as NVivo would join codings on adjacent lines into one large coding).

There were 83 themes, of which fifteen were main themes. It was not possible to present results for all themes. The main method of selecting themes for the presentation of results was to default to presenting ‘a priori’ themes and to not presenting ‘emergent’ themes (and main themes without any occurrences of passages). However, if it was possible to identify that more than one household gave a view on an aspect of an emergent theme, results were presented for that theme. In several cases this was achieved by combining coverage with a related ‘a priori’ theme. Within a selected theme (for presentation of results), only those aspects mentioned by more than one household were covered, unless an aspect was strongly made. For instance, under the theme of ‘Cycling’, the fact that several interviewees mentioned they could not cycle for health reasons meant that this aspect was discussed in the presentation of results, but Melanie’s views about cycling in a small town and rural area were also given.

It should be noted that occurrences for themes that were not explored still constitute results, in that the number of occurrences count towards overall totals for a main theme, and therefore indirectly influenced the results, as discussed in the section, 7.4.1 Review of the extent to which issues were discussed. Further, many sections of interviews were, in NVivo terminology, ‘multiply coded’, i.e. were marked as occurrences for more than one issue. Thus if a passage of conversation was not explored qualitatively under one heading, it may have been explored under another.

The following commentary on themes begins with Table 7.3 which lists for each the main theme the number of occurrences passages of conversation associated with itself and its sub-themes.

Table 7.3 Occurrences of main themes and their sub-themes

Main theme	No. of occurrences	Emergent or a priori?	No. of themes
Attitudes	40	A priori	5
Behaviours	61	A priori	4
Carbon and Energy Knowledge	127	A priori	4
Climate Change	40	A priori	3
Energy Services	131	A priori	8
Energy Sources	33	Emergent	3
Financial Issues	75	A priori	4
Footprinting	91	A priori	8
Heating	74	A priori	6
Insulation	91	A priori	8
Organisations' Responsibilities	102	A priori	4
PCAs System	102	A priori	7
Related Environmental Issues	48	Emergent	5
Social Issues	140	Emergent	8
Transport	198	A priori	6
Total	1353		83

The main theme of 'attitudes' (Table 7.4) was identified as a likely subject grouping well before interviewing commenced, as can be seen at section 2.5 Linking attitudes and behaviours. However it was not until the interviews took place that the sub-themes emerged.

Table 7.4 Sub-themes under the main theme 'Attitudes'

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Attitudes *(main theme)*	A priori	0		---
Attitude to warmth	Emergent	9	5	Not analysed
Attitude to waste	Emergent	10	7	Not analysed
Self-perception	Emergent	10	7	Not analysed
Thrift	Emergent	11	4	Not analysed
Total		40		---

The main theme of ‘behaviours’ (Table 7.5), and all but one of its sub-themes, were identified before the interviews. Section 2.5 Linking attitudes and behaviours again identifies the main theme, with two of the sub-themes explained by reference to the ‘measures’ worksheet of the footprint spreadsheet (see appendix 12.10): “Turn off standby” relates to the ‘standby’ theme, and “Lower thermostat by 1C” is an example of ‘Reducing consumption’. This leaves only ‘Switching off’ as an emergent theme, although had the commonly cited behaviour of ‘switching off lights when leaving a room for more than five minutes’ been included on the list of behavioural measures, ‘the ‘switching off’ theme would have been ‘a priori’.

Table 7.5 Sub-themes under the main theme ‘Behaviours’

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Behaviours *(main theme)*	A priori	0		---
Reducing consumption	A priori	33	12	8.4.9
Standby	A priori	18	13	8.4.8
Switching off	Emergent	10	6	See ‘Reducing Consumption’
Total		61		---

The ‘Carbon and energy knowledge’ main theme (Table 7.6) was ‘a priori’ because of the contents of the postal surveys, which featured a question about sources of information (the use of the term ‘knowledge’ in the theme’s title was meant in a broad sense and therefore included ‘information’), which also explains the sub-theme ‘Sources of information’ being ‘a priori’. The ‘Metering and measurement’ sub-theme clearly is ‘a priori’ as measurement is a key aspect of the carbon footprinting process, which was designed prior to the interviews. Under this main theme, only the ‘Professional and tradesperson view’ was emergent, mainly because more than one of the households featured an interviewee who was working in some aspect of construction.

Table 7.6 Sub-themes under the main theme ‘Carbon and Energy Knowledge’

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Carbon and Energy Knowledge *(main theme)*	A priori	38	14	8.6.1
Information sources	A priori	40	14	8.6.2
Metering and measurement	A priori	38	14	8.6.3
Professional and tradesperson view	Emergent	11	5	Not analysed
Total		127		---

The ‘Climate Change’ main theme (Table 7.7) was clearly ‘a priori’, as it drives the research at the highest level, and is featured in the first ‘open’ style question of the interview questionnaire. The two sub-themes, ‘Confusing climate and weather’ and ‘Natural climate change’ were emergent, mainly because it was not an original intention of the research to pursue issues to do with climate change.

Table 7.7 Sub-themes under the main theme ‘Climate Change’

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Climate Change *(main theme)*	A priori	29	13	8.1
Confusing climate and weather	Emergent	4	3	Not analysed
Natural climate change	Emergent	7	7	See ‘Climate Change’
Total		40		---

The ‘Energy services’ theme (Table 7.8) was bound to be ‘a priori’, even if it was just a convenient way of grouping together themes which related to the devices that use energy in homes. Those themes that were ‘a priori’ were those that are most relevant to people’s daily lives and which provide the biggest opportunities for reduced emissions, ‘Lighting’ and ‘Cold devices’.

Table 7.8 Sub-themes under the main theme ‘Energy Services’

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Energy Services *(main theme)*	A priori	0		---
Clothes washing	Emergent	22	12	Not analysed
Cold devices	A priori	24	11	8.4.2
Computers	Emergent	15	8	Not analysed
Cooking	Emergent	8	6	Not analysed
Integral appliances	Emergent	3	3	Not analysed
Lighting	A priori	50	13	8.4.1
Tumble dryers	Emergent	9	8	Not analysed
Total		131		---

The main theme ‘Energy sources’ (Table 7.9) was one of only three main themes to be emergent. It was mainly created to act as an umbrella for sub-themes ‘Coal’ (which was emergent) and ‘Renewable Energy’. Although ‘Renewable energy’ was ‘a priori’ because the question asked in the postal survey which asked about renewable energy on homes, many of the ‘codings’ to this theme were about large-scale renewable energy. This was not something intended for discussion in the interviews, so in effect this sub-theme is partly emergent.

Table 7.9 Sub-themes under the main theme ‘Energy Sources’

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Energy Sources *(main theme)*	Emergent	0		---
Coal	Emergent	3	3	Not analysed
Renewable energy	A priori	30	10	8.7.2
Total		33		---

‘Financial issues’ main theme (Table 7.10) was ‘a priori’ as is evidenced by the valuation put on a tonne of carbon dioxide, and the general principles of personal carbon allowances. The sub-theme of ‘Grants and subsidies’ had been an important topic of the postal survey, so naturally was ‘a priori’. ‘Money versus carbon’ was an emergent theme that came up very strongly in the interviews, in fact more than any other emergent theme, with ‘Willingness to invest’, also under this main theme, very close behind it.

Table 7.10 Sub-themes under the main theme ‘Financial Issues’

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Financial Issues *(main theme)*	A priori	0		---
Grants and subsidies	A priori	12	7	8.9.2
Money vs carbon	Emergent	32	12	8.9.1
Willingness to invest	A priori	31	10	See ‘Heating’
Total		75		---

‘Footprinting’ (Table 7.11) was obviously going to be a main theme, and one that was ‘a priori’. The footprinting process which took place during the interviews would ensure that the sub-themes ‘Actions to reduce footprint’, ‘Calculating footprints’, ‘Components of footprint’, and ‘Overall figure’ would naturally be discussed (and are therefore ‘a priori’ too). Other sub-themes were emergent - ‘Carbon calculators’ because interviewees became interested in what they could do for themselves in addition to receiving the results from the footprinting spreadsheet, ‘Not in footprint’ because

interviewees wanted to know why 'waste' or other factors were excluded, and 'Picturing CO2' because interviewees struggled to put meaning on tonnes of carbon dioxide.

Table 7.11 Sub-themes under the main theme 'Footprinting'

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Footprinting *(main theme)*	A priori	0		---
Actions to reduce footprint	A priori	17	8	8.2.3
Calculating footprints	A priori	19	8	8.2.4
Carbon calculators	Emergent	8	8	Not analysed
Components of footprint	A priori	16	8	8.2.2
Not in footprint	Emergent	7	5	See previous
Overall figure	A priori	20	10	8.2.1
Picturing CO_2	Emergent	4	4	See previous
Total		91		---

'Heating' (Table 7.12) was designated a main theme as it was highly likely to be analysed extensively, and is featured in measures on the footprinting spreadsheet. Most of the sub-themes are also 'a priori' as they were explicitly or implicitly used in the spreadsheet. 'Oil heating' was 'a priori' because the rural nature of the area in which the interviews took place meant that the theme was identified before the interviews. 'Dysfunctional heating' was a theme that emerged during the interviews, with interviewees revealing that heating systems that were not working properly leading to energy wastage. In the end, all these subjects were analysed together (excluding 'dysfunctional heating' which was not analysed).

Table 7.12 Sub-themes under the main theme 'Heating'

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Heating *(main theme)*	A priori	7	7	8.4.5
Boiler efficiencies	A priori	21	9	See 'Heating'
Dysfunctional heating	Emergent	17	11	Not analysed
Hot water	A priori	7	6	See 'Heating'
Oil heating	A priori	10	3	See 'Heating'
TRVs and other heating controls	A priori	12	8	See 'Heating'
Total		74		---

A main theme of 'Insulation' (Table 7.13) was unavoidable. The two main insulation 'low cost' measures, that give the biggest reduction in carbon emissions, were identified as 'a priori' sub-themes (although solid wall insulation would naturally be included with the low cost cavity wall insulation under the general heading of 'wall insulation'). The other insulation measures emerged during interviews.

Table 7.13 Sub-themes under the main theme 'Insulation'

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Insulation *(main theme)*	A priori	1	1	---
Double glazing	Emergent	6	4	Not analysed
Draught-proofing and curtains	Emergent	11	6	Not analysed
Floor insulation	Emergent	9	5	Not analysed
Loft and roof insulation	A priori	32	15	8.4.6
Multi-foil insulation	Emergent	5	4	See previous
Non standard home designs	Emergent	7	3	See previous
Wall insulation	A priori	20	15	8.4.7
Total		91		---

"Organisations' responsibilities" (Table 7.14) was created as an 'a priori' main theme to group together two key sub-themes about local authorities and gas and electricity suppliers, which were pre-identified due to their key roles in this area of research (including the postal survey questions). One theme emerged for which this main theme was an appropriate home, that being "Business responsibility". It was one of the most prevalent of the emergent themes across all the interviews.

Table 7.14 Sub-themes under the main theme 'Organisations' Responsibilities'

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Organisations' Responsibilities *(main theme)*	A priori	0		---
Business responsibility	Emergent	30	7	8.8.2
Local government responsibility	A priori	24	9	8.2.6
View of gas and electricity utilities	A priori	48	14	8.2.5
Total		102		---

A main theme of 'PCAs System' (Table 7.15) was inevitable, as were 'a priori' sub-themes for support, opposition, trading and understanding personal carbon allowances. 'Allowance allocation' was also pre-determined due to the choice of different allowances for children on the footprinting spreadsheet. The one emergent theme was 'Distrust'.

Table 7.15 Sub-themes under the main theme 'PCAs System'

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
PCAs System *(main theme)*	A priori	0		---
Allowance Allocation	A priori	4	4	8.3.6
Distrust	Emergent	8	5	8.3.4
Opposition to PCAs	A priori	28	9	8.3.2
Support for PCAs	A priori	25	11	8.3.3
Trading and Transferring	A priori	7	3	8.3.5
Understanding PCAs	A priori	30	13	8.3.1
Total		102		---

'Related environmental issues' (Table 7.16) was the second of three main themes that were emergent. On reflection it was likely that sub-themes fitting under this heading would emerge, even if those sub-themes could not be identified beforehand. This is because interviewees are likely to stray onto other environmental issues when discussing carbon issues. All the sub themes were emergent, with 'Recycling waste and composting' being most popular. Although 'water use' featured in the survey, it was not expected to arise in the interviews.

Table 7.16 Sub-themes under the main theme 'Related Environmental Issues'

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Related Environmental Issues *(main theme)*	Emergent	0		---
Economic growth	Emergent	9	6	See Business responsibility
Land use	Emergent	9	4	8.5.6
Recycling waste and composting	Emergent	24	13	8.7.1
Water use	Emergent	6	6	Not analysed
Total		48		---

'Social issues' (Table 7.17) was the third of the emergent main themes, and it serves as a grouping for a set of emergent sub-themes. There was one 'a priori' theme, 'Family and generational issues', stemming from the question about how PCAs would affect members of the household and family. Ironically, despite quite a high number of

occurrences to the theme, no results or patterns worth reporting could be identified, a situation which is unique amongst the 'a priori' themes in this research.

Table 7.17 Sub-themes under the main theme 'Social Issues'

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Social Issues *(main theme)*	Emergent	0		---
Effect of social and income class	Emergent	16	9	8.3.7
Family and generational issues	A priori	36	12	Not analysed
Food and local purchasing	Emergent	8	5	Not analysed
International issues	Emergent	17	9	8.8.1
Living solo	Emergent	16	6	8.3.8
Media	Emergent	30	11	8.8.3
Vulnerable	Emergent	17	10	Not analysed
Total		140		---

Transport (Table 7.18) was another inevitable main theme. All the sub-themes were also 'a priori', not particularly because they appeared in any of the interview 'tools' (questionnaire etc.) but because they are unavoidable issues which were obviously identifiable before the interviews took place.

Table 7.18 Sub-themes under the main theme 'Transport'

Theme	Emergent or a priori?	No. of occurrences	No. of interviews	Analysed in
Transport *(main theme)*	A priori	0		---
Cycling and walking	A priori	15	10	8.5.5
Flying	A priori	39	15	8.5.3
Local public transport	A priori	44	13	8.5.2
Motor vehicle use	A priori	65	13	8.5.1
Rail and coach	A priori	35	9	8.5.4
Total		198		---

7.4.1 Review of the extent to which issues were discussed

There were noticeable patterns in the number of occurrences of dialogue (passages) for each of the themes. For example, the sheer number of passages under the main themes "Energy Services", "Heating" and "Insulation" is notable. They constitute almost three hundred passages. Transport achieved approximately two hundred passages. All these main themes, featuring around five hundred passages in total, relate to means of reducing a home's or a household's carbon footprint. These themes were not featured in the main text of questions on the interview plan and only appeared as prompts for situations where interviewees struggled to give an answer, although many did appear

on the list of measures on the footprinting spreadsheet. The number of passages is significant.

Furthermore, there are further themes which fit with interviewee concerns regarding reducing their footprints, these achieving 28 occurrences under Behaviours (“Standby” and “Switching off”), 30 in “Renewable Energy”, and 89 under “Carbon and Energy Knowledge” (which encompasses “Information sources”, “Metering and measurement” and “Professional and tradesperson view”). By comparison, the themes under “Footprinting” and “Personal Carbon Allowances System” constitute around only two hundred passages in total. This shows that interviewees were prepared to talk at length - over 630 occurrences of dialogue - about the issues involved in reducing their footprints, and allowed the interviewer to examine the barriers, opportunities, behaviours and perceptions about those issues.

Of the remaining main themes, “Social issues” has 140 occurrences but the significance of this is low, as the main theme is a convenient grouping of issues not particularly associated with reducing carbon emissions. “Attitudes”, which only has 40 occurrences, suffered from a similar diversity of sub-themes. Although main theme “Climate Change” also only had forty codings, qualitatively the significance was high, due to the findings being unexpected, as explored in section 8.1. Another main theme with similar qualitative significance is “Financial Issues”, with 75 occurrences, more than was anticipated. “Organisations’ Responsibilities” had over a hundred occurrences, with nearly half of these to the sub-theme “View of gas and electricity utilities”. Some of the above patterns are discussed further in Chapter 9 ‘Discussion’ (see section 9.1 “Interviewees’ interest in carbon reducing measures”).

8 Interviews - qualitative results in detail

Whereas the previous chapter looked at quantitative results from footprinting, as well as providing a quantitative summary of the qualitative interviewing results, this chapter looks at qualitative results in detail. Rather than using the alphabetic ordering (of the main themes) as used in the previous chapter (see Table 7.3), it explores the themes in a content-oriented manner. Generally, main themes are explored in sections below. The ordering begins with 'Climate change', and progresses through 'Carbon footprinting' and then to 'Personal carbon allowances'. After this there are major sections on 'Home energy services and savings' and 'Transport'. The final main themes are 'Knowledge and information', 'Related environmental issues', 'Social issues', and 'Financial issues'.

Sub-themes are explored within sub-sections of the appropriate main theme's section. For example, "Overall footprint" is a sub-theme of "Carbon Footprinting". In some cases, themes are explored "out of place". For example, "Effect of social and income class" is explored under "Personal Carbon Allowances System", "Land Use" is looked at under "Transport", and "Willingness to Invest" (which in the last chapter comes under the main theme "Financial Issues") is explored along with the sub-theme "Boiler efficiencies" (under the main theme "Heating") to give a section heading "Heating Efficiencies and Willingness to Invest". Note that the other sub-themes under "Heating" are not explored, as is the case with certain other themes.

8.1 Climate Change

All interviewees were asked the question 'Can you briefly tell me what you think about climate change?'. The question was designed to ascertain general environmental awareness and attitudes before launching into the later, more specific, questions. Unexpectedly, some interesting findings were made. Six households spoke about 'natural' climate change in giving their answers.

Helen said "I'm not very sure about it. Erm, climates have changed over the millennia, haven't they? And I think man has had a lot to do with it. And before they didn't know what they were doing." She does not mention natural climate change specifically, but the historical angle and the identification of an effect other than mankind imply it.

Philip also takes an historical standpoint: "I think there's no doubt that there appears to be climate change, perhaps as a result of the contamination by England … but also by the United States, and China, India and Russia, really, the large countries. Having said that, I believe from my reading, since records have been kept, there have been changes in climate without there being industry. … it's difficult to come to an absolute conclusion."

Even Jim, with his low footprint and pro-environmental views responded thus:

Interviewer:	So you accept it's happening and it's caused by mankind?
Jim:	Some of it. I'm aware that we've got a climatic circle [sic] but it's been accelerated by mankind.

There was a similar theme from June: "I don't know what to think really. I know that there are things changing in the climate, but whether it is attributable to what man does, I don't know. I believe a lot of it is, but I also think some of it is cyclical. I know we've had an ice age and that sort of thing. Perhaps it's coming back or we're at the end of it, I don't know."

Dave and Carol appear to be looking for an excuse for inaction:

Dave:	There's no doubt something's happening. Whether it's climate change - whether it's caused by us, or natural, I don't really know. I don't think there's anything we can do about it.
Interviewer:	OK. Are you of the same opinion?
Carol:	Yeah.

Rosemary implies that there may be a natural source of emissions:

Interviewer:	Do you believe it's caused by mankind?
Rosemary:	It's that plus emissions from somewhere, I don't know.

This means that interviewees in six households talked about natural climate change, or at least acknowledged that climate change is happening while also expressing the concept that the cause is not just anthropogenic.

There were a smaller number of perhaps more predictable responses on various topics. There was disbelief from Alfred: "I'm not really convinced about climate change" and this attitude was confirmed by Helen: "I do think a lot of older people are in complete denial about global warming." There was outright scepticism from Melanie: "If it turned out to be a scam I wouldn't be surprised".

Two interviewed households indicated confusion between climate change and the weather, these being Helen (talking about others), and Alfred with Evelyn. However this almost masked or downplayed an issue which was touched upon by a total of six households, that being a tendency to talk about climate effects that have already happened, or are happening now, with little recognition of what might happen in the future. This exchange with Alfred and Evelyn neatly demonstrates the issue:

Evelyn:	Is there an impact now?
Interviewer:	Some I think.
Evelyn:	The floods that are here now.
Alfred:	We've always had floods.

Shortly afterwards Evelyn returned to how things were different in the past: "Of course we used to have a lot worse winters. We had snow in this lane this high," to which Alfred responded "1976". Helen pointed out that older people say that "the weather has always been unpredictable." Leonard gave a fascinating account: "I don't think it's as man made as we think it is… I was brought up in a colliery village, where the soot was being blasted up into the sky, about twenty chimneys. The whole of the UK was that way. Alright the climate has changed since I was a boy. Those chimneys have gone and have been replaced by other things." Leonard seems to be saying that emissions have been around a long time and the climate has changed only more recently. There's no consideration of accumulative effects and future climate change effects, nor does he reveal how he perceives the climate is different from when he was a boy. Susan talks about how "But when they look back on records, you realise that that particular flood hit us in the 1940s and it has a re-occurring cycle anyway. So I just don't think it's all

down to climate change." In this context, she appears to be using the term climate change to mean man-made emissions. What is not in doubt is the emphasis on the past.

Dave almost makes the same confusion about the term climate change in the comments quoted above. Again, there is the downplaying of future effects of climate change, although he does balance it with his comments about not being able to anything about it - which may almost be a nod to the future. Perhaps the comment which most acknowledged the future was made by June: "I know that there are things changing in the climate". At no time did any interviewee talk about future carbon dioxide concentrations, future average world temperatures, climate projections and modelling, rising sea levels or any other future impacts.

Amongst some other comments made about climate change, Leonard offered the sun as an explanation: "Just off the top of my head it's activity in the sun." Philip talked about peak oil "I shan't be here but oil is a finite thing. We'll have used it all up perhaps within about 50 years… it may be self solving, may it not?" Lynne commented on the world-wide situation: "You can do your own bit but there's the rest of the planet, China, America and these other potentially big polluting countries, a bigger issue I think."

Janet seemed almost like a lone voice, and seemed to express the feeling that she and her husband Nick felt alone: "There's a lot in the papers, and we've watched lots of programmes. Some say yes it's happening, others say no it's not. We believe it is, you can see the ice caps melting, we're bound to have an effect... Using all the oil, using up the rainforest… I think it's definitely happening… I think there was [a programme] on Channel 4 because we were both very sceptical... I think there was a David Attenborough one that was on the BBC two years ago, and how he feels we're contributing to it, and it all made sense. And we watched another programme which said we're not contributing to it, but it was a case of 'Well of course we are!' Logic tells you. I said to Nick 'Am I thick?' Surely common sense tells you we are contributing to it?". Nick joined that interview later and asked, to the interviewer's surprise, "Do you believe in [climate change] then?"

In summary, nearly half of the interviewees attributed climate change to natural causes, at least in part. No interviewees referred to future projections or impacts of climate change, with some prevailing upon past cycles, changes and unpredictability.

8.2 Carbon footprinting

This section looks at the interview data in connection with the carbon footprinting exercise which was conducted for each interviewee household. It begins by looking at how interviewees responded to their overall household footprint, measured in tonnes of carbon dioxide emitted per annum. Discussions about the components of the footprint are examined, including a brief look at sources of carbon dioxide (components) not included in the footprinting exercise. There is then a discussion about the measures that interviewees suggested they might implement to reduce their footprint (as opposed to measures that the interviewer took the interviewees through at a later stage). The interviewees' responses, to the idea of producing carbon footprints for the general population, are examined, followed by a look at views about gas and electricity suppliers, covered here because such suppliers are well placed to calculate households' footprints. Finally, continuing on the organisational theme, interviewees' views of local authorities (and their involvement in carbon footprinting) are examined.

None of the interviewees had used a carbon footprint calculator nor were they aware of any.

8.2.1 Overall footprint

Interviewees made a number of comments about their overall carbon footprints, sometimes in comparison with the average footprint, which the concept of a personal carbon allowance encouraged. Helen, who had enjoyed a number of flights over the previous few years, observed "Right, so I am using twice as much as I am entitled to, then?".

Two recent retirees, both occupying sizeable bungalows, were taken aback by the size of their footprints. Philip: "I really was feeling that, I don't like the word smug or halo, that not much could be done, that I was so minimal on everything. You've shown to me that that isn't the case.". Meanwhile, another single occupier of a bungalow,

Leonard said "It's opened my eyes to the fact that I ought to be doing more than I am doing. I thought I was an honest citizen. I do try.".

Altogether, interviewees in five different households, not just those with single occupants, indicated that they thought their footprints would be lower. Evelyn thought "we would be under" and Cathy stated "I would have thought I was not too bad". Finally, prior discussion with June meant that the interviewer could easily pre-empt June's viewpoint:

June: It makes me a bit more worried because I thought we were quite -

Interviewer: Average?

Before her household's footprint had been calculated, June, had a question: "Perhaps you could explain what proportion of carbon output is from various industries? And what comes from domestic and how does it all balance? Who are the worst culprits? People say it's the airlines or is it all us in our homes?". The interviewer responded "About 45% of use is attributable to homes, personal transport car use and flights. Actual use within the home about 27%". June then observed: "So [personal carbon allowances] could have quite an impact targeting home owners".

However when presented with the footprint of a shade over 15 tonnes, which worked out at about the UK average per person, June was quick to apportion blame within the household to the children: "They probably account for half the tonnage" and then the calculation method "That doesn't take into account …".

The most unperturbed response to an overall footprint came from Susan, whose household was well above average, due to the whole family of four flying away twice a year, high mileage in cars which are not very fuel efficient, and a very large four bedroom home: "I'm not surprised at mine to be honest". However she was later to voice the strongest opinions of all interviewees against personal carbon allowances.

Actually being able to picture a carbon dioxide footprint, or even part of it, provides for some interesting observations, with the general idea that it is not at all meaningful. The interviewer explains to Janet what the footprint is from the gas used by her family:

"Comes out at just over six tonnes." Janet's response was "A lot isn't it!", as if struggling to attach meaning to a large figure. Tonnes are likely to sound large, but even when other units are used a similar response can occur: To the interviewer's "Your likely emissions for your gas usage are about 2.4 tonnes a year or 2,400 kg , electricity 1.1 tonnes or 1100 kg and car use just under 1.8 tonnes or 1800 kg", Helen's response is "It's an awful lot isn't it, when you start to talk about tonnes. I've only just become aware of that in the last couple of months, really. The actual tonnage of carbon, you can't imagine that many tonnes of carbon floating around in the atmosphere, can you?". Those with a scientific background can distinguish between weight and mass, but to everyone else the concept of a tonne of a gas may seem alien.

Pete, when told of the emissions from his gas and electricity, asked whether the figure of just under 6 tonnes a year was "on the high side". Dave thought about it in a different way: "Well eleven tonnes of carbon dioxide doesn't mean anything. You would have to put in the context of something else. Like how much an American uses, how much a Briton uses, how much a Chinese uses. But there are a lot more Chinese than British. Get it in to some kind of context. And what it would actually mean."

In summary, where interviewees have any expectation or perception about the size of their footprint, it was higher than expected. Three people living alone were interviewed, and while one was a council tenant, the other two were taken aback by the size of the household footprints which they had to carry as their personal footprints. Picturing an amount of carbon dioxide is difficult for most people, although comparison with an average, of whatever source, was more useful than trying to visualise an actual amount.

8.2.2 Components of a footprint

Once some interviewees had been presented with their overall footprints, conversations took place about the component parts of the footprint. Lynne probably made an accurate observation in this exchange:

Lynne:	It's my travel.
Interviewer:	Is some of it business travel?
Lynne:	All personal, I work [on the other side of Nottingham], 25 miles.

The following exchange shows the difficulty in looking at the electricity component of a footprint, because no-one can be quite sure, without the assistance of facilities like plug-in meters, just where all the electricity is being used. Rosemary jumped to a probable wrong conclusion about the computer used by her son Tom and then provided evidence for an alternative and more likely explanation:

Rosemary: What about his computer?
Interviewer: That's all covered by the electricity figure.
Rosemary: That's probably why the electricity bill is high.
Interviewer: In my judgement it's probably because of your old freezer.
Rosemary: I also wondered that, because it's icing up a lot.

Rosemary's son enters, and the conversation continues:

Interviewer: …your electricity is very high… I can explain some of it. What other electrical equipment have you got? Your light bulbs will be part.
Rosemary: My son's got his computer on all the time, well nearly all day.
Tom: It's not on now!
Rosemary: Hairdryer every day?
Interviewer: Unlikely to affect it.
Tom: You've got the telly on all day.
Rosemary: Only in the evenings. I go to bed early. Your dad has probably got the telly on till 2 or 2.30 - asleep - which is wasting electric.
Interviewer: You've got nothing on charge - not that it makes much of a difference…
Tom: Three freezers, one which is off the scale of energy relations by far.
Interviewer: - and light bulbs -
Rosemary: We never leave lights on if we're not in the room.

Whereas the lack of compact fluorescent lightbulbs is likely to be a partial explanation, here we have knowledge within the family as to what a probable major source of the

problem is. Thus the old freezer gets the blame again, along with the sheer profusion of cold devices.

Instead of blaming sub-components of the footprint, a rather more thoughtful approach is to make a comparison. "So your emissions from car use are about 3.5 tonnes." Philip responded to the interviewer's statement with: "I would have thought it would have been more than from the gas." The gas figure was over five tonnes, probably due to a twenty year old boiler and the lack of cavity wall insulation. In the following exchange, involving Marion and John, a potential reduction in one part of the carbon footprint is compared to two other components:

Marion:	My bedside light probably hasn't got an energy saving.
John:	No.
Interviewer:	You've probably got about ten [more lightbulbs that you can replace], that would cut out another half tonne.
Marion:	Half a tonne!?
John:	It's quite significant.
Marion:	Really? More than a third of our car miles.
John:	It's a lot, it's very important. You can quarter your energy consumption.

Marion has made one comparison and goes on to make another:

Interviewer:	That's probably worked out assuming you've got ten -
John:	Hundred watt bulbs.
Interviewer:	Well, 60 watt bulbs.
Marion:	It's still more than I expected, it's still the equivalent of a return flight to Ireland for the pair of us.

That observation only takes account of the aviation fuel burnt, creating carbon dioxide, and does not cover the multiplier effect of taking into account emissions (including water vapour) higher in the atmosphere.

Some interviewees queried as to whether some other aspects of life might be included in the carbon footprint. In the footprint calculated in these interviews, the components

included reflected the likely carbon sources which would be included under a system of personal carbon allowances, i.e. home energy, car use and airline flights. Prompted by the shift of conversation from car use to her forthcoming plans to live and work in London, Jacqui took the calculation of carbon to its extreme: "So every time I get on the tube. 'Excuse me, Mr Driver, how many are there of us on?'." Jim also latched onto public transport:

Interviewer:	So you'd have a 2 tonne surplus.
Jim:	But I go out on coach trips. They're sponsored through the patients' club or different organisations - bums on seats.
Interviewer:	They would be excluded.

A couple of interviewees asked about food miles. Alfred "Does this take account of food miles as well?" and Lynne "So that doesn't cover things like food". She also made a somewhat less viable suggestion: "How much do people get that have concreted over their gardens?"

June did come out with the rather more topical "That doesn't take into account anything you put into landfill?"

In summary, some animated conversation took place about the component parts of the household footprint: Identifying one particular component could either involve correctly identifying the culprit or searching around in order to cast blame. There is an irony to this - breaking down the component parts of the footprint from electricity is difficult to do, and may be a distraction, seemingly caused by the sheer variety of devices driven by electricity. Furthermore, emissions from electricity were, in most of the interviewed households, lower than gas (or oil) and motor vehicle emissions. Unfortunately there was insufficient attention paid by interviewees to emissions caused by heating and by car and even airline use. Public transport was raised more than other carbon generating activities that were excluded from the footprinting exercise.

8.2.3 Considering measures to reduce a footprint

Perhaps more productive than looking at the components of a footprint, is the idea of looking at ways of reducing it. This was a key intention of the interviewing process, but some interviewees made independent observations on the matter. One interviewee's

comments were particularly revealing. Having earlier said "I think a boiler and individual TRVs would be a good idea," he developed his thoughts further:

Philip:	I'm aware, but I think what your visit did - and it doesn't have to be a visit ... You've highlighted things. Standby - I knew that. Boiler - I knew that, Light bulbs - I knew that. TRVs - I knew that. Cavity wall insulation - I knew that and explained my reservations. You've made me aware of things this morning.
Interviewer:	What particularly made you aware?
Philip:	Just talking, I don't particularly think about carbon footprints.
Interviewer:	Is it the size of the footprint that made you aware?
Philip:	To be provocative… if you can save people money, they're more interested in that ... As time goes on [English people] might see that they've got to think more about their carbon footprint.

Philip seems to be saying that calculation of the footprint is just a hook or prompt to get people to take action in order to reduce it but the benefit has to be expressed financially. This was not initially done using the footprinting spreadsheet. Only the potential gains or losses through selling or buying carbon allowances were quantified. It was because of this type of feedback that the financial values for savings from measures were calculated in the later interviews.

Leonard repeats a theme of earlier, that the occupant in the household knows what the problem might be. Calculating the footprint just highlights it. "For my own satisfaction, I should look at the loft." Living alone like Philip, he had to carry a considerable household footprint as his own personal one.

Lynne, having identified her commuting as contributing in large part to her ands her household's footprint, asked "If I went to totally wood this year, would that bring it down?". She was referring to her open fire and back-boiler. The interviewer's response was "Well, you're producing 0.75 tonnes from your coal". Lynne then prematurely concluded that "There's not much more I can do." On the face of it, that seemed true - Lynne lived in a remote home, off the gas network, and had a very long commute. But the home was in a process of improvement, and the heating and insulation were far from complete.

Lynne's best option, given her awareness of spatial planning issues such as the need for living and working to take place in the same districts, was to move home. This was another example of the interviewee already knowing the answer. Moving for another reason came up with another interviewee, as the next but one discourse shows. Firstly, June makes an observation about flying:

June: So we're bang on average.
Interviewer: Assuming you don't do anything to reduce it.
June: We can't go on holiday.

If the household had been way below average in terms of emissions, would so much consideration be given towards avoiding flying? The interview was dominated by the theme of comparison of the footprint with other households. There was a sense that once a reasonably below average footprint had been achieved, the pressure to reduce further would be off.

Interviewer: Looking at the total -
June: So we need a newer smaller house [both laugh].

Despite the amusement generated, this was a very interesting point. Although Lynne could have moved to reduce her commuting, June and her family could move to have a smaller house which would have meant lower heating bills (but she wanted to remain in the village, so being on the gas network would likely not be achievable).

This wasn't the only amusing sequence, even in this subject area. Dave had not long acquired his sports car, which was a second vehicle for him, his van being used for work.

Interviewer: There's measures you can do, get that down even more.
Dave: I'm not selling the car, not selling it! [Laughter].

Dave and Carol however did appear to have the luxury of a fairly sizeable 'surplus' regarding their emissions.

In summary, the financial savings from measures were of interest to interviewees. In some cases the interviewees already knew what actions they needed to take, and the footprinting exercise reminded them of those measures.

8.2.4 Calculating other people's footprints

Once interviewees had been told about their own carbon footprints, they were asked, where possible, to comment on the prospect of other people's (or households') footprints being calculated, and who could be relied upon to produce such footprints. The positive response, during the early interviews, to the footprint calculation process, meant that the interviewer deliberately guided the conversation to this subject. Of further interest was whether electricity and gas suppliers, who already have much of the appropriate data, could be trusted to do it. Note the 'Interview Questions' document was not altered to include these questions - the whole issue was so prominent following the negative light in which suppliers were cast by the survey, that it was near impossible to overlook. The final question 'What do you think the government and local councils could do to help?' was a sufficient prompt, if no other route to making the enquiry was found.

Philip made his support for mass footprinting clear:

Interviewer:	You were touching on how to get people to be more aware and talking about forcing them to have their carbon footprint calculated?
Philip:	I think we ought to know. There are people such as yourself working on this problem, it's real and people should be made aware of it.
Interviewer:	Who would you imagine would be involved in coercing people into doing their footprints?
Philip:	Would it be the universities, would it be the suppliers of gas and electricity, would it be one's local authority, the council? The council send a fair amount of stuff about rubbish and recycling.

Not long afterwards he is given another chance to comment, with deliberate emphasis on the gas and electricity suppliers:

Interviewer: So you're not in favour of mandatory carbon footprinting by the utilities which we discussed earlier on?

Philip: Yes, that's another, because they send a bill. I think when it comes in the form of a bill, you are a bit more likely to read it.

Interviewer: The electricity and gas suppliers can probably co-operate on producing footprints.

Philip: In my case it's the same, Powergen.

Interviewer: What about the electricity company ringing up and saying, tell us how much you use your car or fly?

Philip: Well there are lots of studies that are done with tick box systems with a response rate of 40%, relatively low. But even that would be quite useful information.

Interviewer: It's the idea of how many would respond, only they would get to know their footprints. I suppose out would come the info on the bill, this is your footprint from electricity and gas use, please fill in the form, we'll produce your whole footprint including car use and flying.

Philip: And "It may be possible to use the following measures, insulation etc. This could reduce your bill". That's a carrot ands stick system. I said earlier, human beings respect their pocket more than anything, not their consciences.

Philip doesn't discount the idea of utilities producing people's footprints. Although he seems to lose track part way through this exchange, apparently thinking that the whole exercise is just about data collection, but then clarifies his understanding by making the point that measures to reduce the footprint should be specified. Furthermore he mentions how money would be saved by implementing the measures (insulation, etc.). This is rather similar to the way that the Energy Saving Trust's 'Home Energy Check' (HEC) works, except that collects household form data, rather than carbon footprint data. In contrast, Act On CO2, the government's carbon calculator, does not give financial savings, nor do any other carbon footprint websites known to the author.

Leonard was asked what he thought the government and local councils could do to help with footprints and the like. "What they're doing now, filling a simple form in, it's produced this interview with you, I think that's great. A very good connection." The

interviewer explained that he was going to interview just a few people and that the council send out thousands of the HECAmon questionnaires each year, so only a low proportion got the visit. Thus the interviewer asked what else could the council could do. "Some sort of information they could interpret themselves and find out for themselves. What emissions they are producing. If it's possible to, simplify it. It would certainly appeal to a great deal of middle England. It would save a lot of time and expense. You've done it from that and a few questions." Asked if he thought basing it on the monthly amounts (for gas and electricity) was right, Leonard responded: "Well prices do vary but it at least tells you that there is a problem - 'You are producing this'."

June was less enthusiastic, but she had just found out that she was about an average emitter rather than below average:

Interviewer:	You contacted me about getting your footprint done. Is that something that you feel should be done for people?
June:	Well it's quite an involved lengthy discussion. It would cost quite a lot of money which could be diverted into something positive to cut carbon dioxide emissions rather than to tell people how bad they are.
Interviewer:	But then they might not take action to reduce it if they don't know what their footprint is.
June:	Yeah!
Interviewer:	Have you heard of Act On CO2?
June:	No.

June seemed to make the understandable assumption that the interviewer had meant that footprints would be produced as part of an interview like the one she was currently participating in.

Nick was succinctly supportive: "It really is about encouraging folks by letting them know how much they are using."

Husband and wife Dave and Carol managed to cover a variety of issues, and disagree slightly:

Interviewer: Should all houses have their footprint calculated?
Dave: Yeah.
Carol: I don't think that everybody would take any notice of it.
Dave: No. I think if you're going to do something like that, you've got to get everybody included in it. Everybody's got a part to play in it. But whether you could actually get that done in practice.

Regarding Dave's point about 'getting it done', Susan, a former call centre worker in the energy industry, didn't see any barriers and even cited an obligation for suppliers to provide emissions data: "... I know it's easily accessible, like everything else, data protection, you can have access to every detail of your account".

In summary, where it was discussed, there was support for the idea that all households should have a carbon footprint produced for them.

8.2.5 Gas and electricity suppliers

Interviewees' opinions about gas and electricity suppliers emerged as a strong theme in the interviews.

All six households, with whom the subject was discussed, lacked awareness of the gas and electricity suppliers subsidising energy efficiency (note that the Energy Efficiency Commitment (EEC) came to an end shortly after the interviews took place, and was replaced by the Carbon Emission Reduction Target (CERT) in April 2008). Pete suggested "Make the suppliers more responsible to make the individuals more responsible". When asked if he was aware of anything they do currently, he said "with the bills you get little booklets but I think they're there to sell you things. Whereas maybe they could be offering more services to help you be more efficient." Philip suggested "a subsidy on high efficiency light-bulbs" and was surprised to learn that such subsidies already exist. Here is a not untypical exchange with Rosemary and Tom:

Rosemary: They should promote it.
Interviewer: Who should be advertising it?
Tom: I don't think the utilities would do it. It would affect their profits.

Interviewer: They do.
Tom: Do they?
Interviewer: Most schemes are paid for by them.
Tom: Are they?

Nick even managed to misunderstand the concept, confusing it with generation rather than demand management:

Interviewer: … utilities provide most of the energy efficiency grants.
Janet: I didn't know that, did you?
Nick: They boast about it in their adverts, building wind turbines, Powergen, Eon.

Even those who were aware of supplier subsidy of energy efficiency measures sounded cautionary:

Interviewer: The electricity and gas suppliers… subsidise energy efficiency. Did you know that?
June: I know that last time they did. But then you've got to look for the information.
Interviewer: Do you not get anything in with your bill?
June: I'm on direct debit.

Here scepticism set in once Andy and Marion knew it was an obligation on all suppliers.

Andy: I knew British Gas was doing things and I thought it was out of the goodness of their heart, not because they were told to do them.
Interviewer: Yes the government tells them.
Andy: Huh!
Interviewer: At least you were aware that utility was advertising it.
Marion: Hmm.
Andy: Mm.

These last two conversations indicated partial awareness of the EEC schemes. In total, six interviewees expressed a lack of awareness, with two expressing fuller awareness (although one of these worked in the industry).

Another area in which suppliers came up was on billing, with four of the interviewed households having problems. In Rosemary's case, the problem seemed self-inflicted, or at least caused by her husband's chaotic switching and paperwork. Two households - June's, and Dave and Carol's, had recently experienced sudden large increases in monthly payments, making the footprint calculation more challenging. Janet and Nick's problems were long running, leading to a large debit that had to be cleared. Regarding switching, June had switched reasonably successfully about a year earlier (although eventually experiencing the sudden increase) using an on-line referral service to move to a best value supplier. Meanwhile Rosemary's husband switched when a canvasser came to the door.

Two interviewed households gave tentative support to the idea that gas and electricity suppliers might produce carbon footprints for the public. Dave said: "Probably your utilities, they've got that data there." Philip also gave cautious support.

In summary, the gas and electricity suppliers have a seemingly poor image, if certain proxies - knowledge of their energy saving schemes, and billing problems - can be used to measure it.

8.2.6 Local government

It was difficult to get interviewees to respond about how local government can help people reduce their carbon footprints. In all, four expressed support for local councils getting involved in footprinting, advice provision and the running of systems handling personal carbon allowances, while two were against. Meanwhile another two, when asked if they were aware of Newark and Sherwood District Council's activities in the area of home energy, they said they were not.

Philip offered the following idea regarding energy efficiency grants and so on: "written publicity… should come with one's demand for council tax... You may as well publicise what you can have!... And perhaps another sheet… which perhaps gives some ball

park figures of what your car does, what your flying does, what your house heating does."

8.3 Personal carbon allowances system

Subsections of this section look at issues to do with personal carbon allowances including understanding of PCAs, opposition, support, distrust, transfer and trading, allowance allocation, the effect of social and income class, and living alone.

8.3.1 Understanding personal carbon allowances

This sub-section looks at how interviewees understood or failed to understand aspects of a system of personal carbon allowances. In some cases the lack of understanding manifests itself as opposition, and even if the issue is clarified, the interviewee may continue to be opposed. Note that, somewhat surprisingly, the level of understanding about a system of PCAs was good. This was the case even before the footprinting exercise, which may have aided understanding. Even the points below, showing interviewees' confusion, showed mostly that interviewees had already understood much of the concept.

It is not just the aspects of a system of personal carbon allowances that people may struggle to understand. The background issues are likely to cause confusion. Alfred declared "To be honest it's the first time I've ever heard them explained. I don't have a lot of time to read things. Every time you switch on the TV, they're on about carbon neutral, carbon footprint. I think 'What are you talking about?'." Additionally there is scepticism about climate change which may be caused by a lack of understanding of the science etc. (see section 8.1). Thus a lack of understanding in one area may cause a lack of understanding in another.

One interviewee declared that she didn't understand PCAs but the claim was hard to believe. Rosemary, who was recovering from illness, demonstrated understanding before denying it:

Interviewer:	Given what I've described to you, would you support this system?
Rosemary:	Would this carbon contaminate the atmosphere?

Interviewer: Yes...

Rosemary: OK then I would. Say for instance my mother who lives on her own, wouldn't use as much as a family, wouldn't she?

Interviewer: She would probably use less but I have met single people in deficit because there's only them in the household... Would you say you support them moderately or strongly?

Rosemary: Moderately. But I'm just guessing at answers because I don't understand it.

Rosemary was saying in a roundabout way that she needed more information. Alfred was more explicit, despite his wife Evelyn's enthusiasm for PCAs, he wanted more information:

Interviewer: Having shown you your footprint... given your moderate support before … are you more or less supportive?

Evelyn: More supportive!

Alfred: I'm not convinced either way, at the moment, but I might find out something.

Alfred, more than any other interviewee, exercised the invitation to ask the interviewer questions:

Alfred: Would it be related to what you pay?

Interviewer: No it would be related to the carbon content...

Alfred: How would you arrive at the number of carbon units you would be allowed to have?

Interviewer: You'd start with the average figure that people use at the moment…

Evelyn: Some old granny who uses hardly anything, people are going to say, come on granny, give us your allowance.

Alfred: It sounds ever so strange, how's it going to work?... I thought it would be if there was an average carbon footprint for a place like this, and there's a tax if you went above it. And if you didn't you get a refund. And I thought it would be on the actual price you paid for the energy.

There were more questions from Alfred: "How current would the footprint be?" and "Who will make up your footprint?". By this he appeared to mean the carbon account balance. The interviewer explains that a carbon account will be retrospective, rather like a bank account. This prompts Evelyn to assert that "Youngsters don't care do they? … Nowadays they have it whether they can afford it or not." The interviewer was forced to point out "There wouldn't be a lending or credit system for your carbon account."

The most significant misunderstandings about PCAs revolved around the overall aims and purposes of such a system. Helen said "don't you think quite a lot of people would use up their units and then buy more and just think, 'well those people in Africa aren't using them'?". Helen's failure to understand that the system would be a UK or European based one prevented the interviewer from explaining again that trading was fundamental to the system, so she returned shortly afterwards with this: "There are people who just don't care about anyone else than themselves, aren't there? And after making a big fuss and asking what this government is doing taking all the stuff from us, they'll find ways around, as you say, buying them from other people." The interviewer's response was "Well that's the general idea." There is presumably some confusion caused by substituting the concept of rationing for that of tradable allowances.

Another interviewee, Jim also looked upon the idea of buying an allowance as somehow cheating the system:

Interviewer:	You're willing to let someone else have your allowance, they'd have to pay you for it of course.
Jim:	There'll always be people who try to take advantage, won't they? There'll always be wasters.
Interviewer:	They'd have to pay!

Although not airing disapproval, Leonard also showed some confusion about the potential to buy units. "The way of life, people's habits would be affected somewhat, until they got used to the idea." The interviewer's response was "They can continue to

do what they do, it's just that if they are a high emitter, they may have to pay a little more."

Melanie misunderstood in almost the opposite way, not realising there's a limit to the number of units available for purchase. "There is a potential for inequalities in wealth, those that have money there's not the incentive, you would just buy some poor person's share … The affluent would buy more. It doesn't tackle the nub of the problem … decreasing what you use." The reality is that if lots of people behaved this way, they would pay increasingly higher prices for carbon units, because of the cap on the number of units available (which would be decreasing each year).

Four interviewees mistakenly believed that the part of the PCA system for vehicle fuel would be based on recording mileages when in fact it is based on fuel purchased. Two of these were people who joined an interview part way through, and another was the main interviewee of the first interview, who did not benefit from the slideshow (which was developed immediately after that first interview). Jim benefited from the slide show but to be fair he suffered from deafness and may have missed the point, so there was the following exchange:

Interviewer:	I'd be interested in knowing what you feel about PCAs from what I've told you there?
Jim:	I think it would be hard to control because not everyone would tell the truth. You see if I got a car, how many miles do I do a year? If I want to impress you, I say 8,000 - when I've probably done 12,000…
Interviewer:	In terms of the way the system works, you wouldn't being able to buy petrol without your carbon card. If you don't have a carbon card you'd have to pay a higher price.

Two interviewees had objections because they tended to think about the current situation, rather than one which might exist in several years' time, when a system of personal carbon allowances might be introduced:

Interviewer:	Understanding a bill -
Janet:	I've just had the bills out! I couldn't understand -

Nick: I'm not stupid, and I find the calculations hard. And when we were charged extra. They ran my bill on estimates rather than on the readings I provided them with, over a two year period when there were four price changes. We had to go back, and work out the cost of gas and electricity over two years. Doing the calorific conversion into kWh - too complex! I think you'd forgive for saying, the average person, looking at the people you want to help, the ones that aren't particularly well off, I don't know how well they'll cope.

Interviewer: Two things have been suggested in relation to this. One that metering would have to be accurate. The end of estimated metering. In any case it's likely that we'd go to smart metering with a display in your kitchen or what have you.

Nick: I like that.

Dave's thinking also appeared to be selective when looking into the future. He generally questioned the point of environmental protection, and provocatively suggested, if action to protect the environment was being taken, it ought to be drastic:

Dave: They keep making environmentally friendly washing machines which are using electricity but why make them at all, why not stop making them?

Interviewer: Ah people want a certain quality -

Dave: But somewhere along the line you've got to make that sacrifice whether it's in 50 years time -

In fifty years' time, it is highly likely that much electricity will be 'carbon free', so Dave's concerns may be excessive - or perhaps an excuse for inaction on his part.

Confusion with taxation might have been expected to come up, but with the exception of outright opposition to PCAs, only this exchange demonstrated it:

Interviewer: Do you think a system of PCAs will change the way people behave?

Philip: To a degree. Except, look at alcohol. It's reasonably taxed but really rather cheap by comparison with what people earn. And there's a sort of reluctance in England to tax anything out of existence. We're so liberal really.

Misunderstanding of PCAs was sometimes difficult to distinguish from opposition to them. In the following conversation, Nick expresses a preference for taxation, despite the fact that he appears to be someone that might support a system which was more equitable. However, here, he also manages to confuse renewable energy and energy efficiency, bring in an unconnected concept (balanced scorecards), assume that what's good for Britain might be bad for individuals, and to assume that the system won't be designed for those who are easily confused.

Interviewer: I was explaining that the utilities provide most of the energy efficiency grants.

Janet: I didn't know that, did you?

Nick: They boast about it in their adverts, building wind turbines, Eon. In terms of a balanced scorecard for carbon emissions, I don't like the idea, you have to look at the lowest common denominator. People have trouble managing their bank account… To introduce that to everyday people, is that a bit too much? I think the system we have, indirect taxation of fuel, is probably the best way. Fuel is very costly but it's probably the best way of getting people to conserve it.

Janet: I don't agree, I agree with it.

Nick: I'm looking at the bigger picture, what's good for Britain.

Interviewer: … You could push up the prices more but the idea of an allowance is for the less well off in society, they're going to get their needs satisfied without having to pay this tax, percentage, on electricity … It's not really a tax, but a tax on people with large footprints, the money goes to people with smaller footprints.

Nick: I'd prefer to pay a tax. I know how much there is in my bank account. But to worry about how much there is in my carbon account and trading it, there it becomes complicated. Who's going to swap it, is it going to be the power companies or not?

This is probably the longest passage demonstrating misunderstanding - and this was one of the most intelligent and informed interviewees, demonstrating that a little knowledge can cause a completely different stance than having no knowledge at all. However Nick was the only interviewee to directly talk about an alternative to personal carbon allowances, in the form of taxation of fuel. He points out that this already exists but implies that this should be increased - he did not appear to be making an objection to personal carbon allowances by making an insincere suggestion of an alternative. There was no discussion about the EU ETS or the supplier obligation raised by interviewees, although Susan did appear to misconstrue one comment by the interviewer and referred to the Supplier Obligation (but not by that name).

In summary, most of the misunderstandings of the proposed system of PCAs involved failure to grasp certain specific concepts, which is not surprising given that the interviewees had not come across the concept before the interview took place. In particular, the idea of being able to buy units was one that interviewees tended to struggle with, perhaps because of a history of straightforward (not-tradable) rationing in the UK. There was also a tendency for some interviewees to jump to conclusions about how vehicle fuel would be covered by the system.

8.3.2 Opposition to PCAs

Of the twenty interviewees whose views were gathered, six demonstrated opposition to PCAs with a further three not being clearly supportive. The six that were clearly against were Pete, Melanie, Nick, Susan, Dave and Carol. It was not recorded whether they were strongly or moderately against. The three that gave less certain answers were Philip, Leonard and Alfred. Note that the section on ‘Understanding personal carbon allowances’ is of great relevance in this context, as misunderstanding is likely to lead to opposition, and many of the issues therein should be treated as arguments against PCAs.

There was little in the way of incredularity. Leonard was the most surprised by the proposals:

> Leonard: You are saying that there would be a control put on this?
> Interviewer: It would be an annual ration.

Leonard: How on earth would you do this?

After some explanations, he was still perturbed: "It's very radical this approach". He also drew parallels with the ill-fated poll tax (community charge) of the early 1990s, although it appeared that he may have been a supporter of the poll tax.

Sometimes indirect indicators of opinion needed to be sought. Here there is a hint of Philip projecting the opposition onto some other party: "Well as an English person you're meant to say that's an infringement of your rights, because we don't like to be controlled too much, and we can talk about identity cards and so on. But on the other hand if it's being shown we mustn't contaminate things too much and therefore we've got to stop and to reign in, and therefore I can't see anything wrong with it really. But there will be some people who will say that it will be an infringement of their rights, and that we've always wanted to be profligate, and pay for it, and that's the English attitude, by many."

Philip appears to be supportive but then give indications that he is not. Whereas Susan's projection may have been an attempt to strengthen her anti PCA argument, which she was not hesitant in expressing: "What infuriates a lot of people, is that they're being dictated to, by people who are probably worse than I am. I find it very frustrating."

Fundamental attitudes are likely to influence attitudes to a system of personal carbon allowances. Pete put it thus: "At the end of the day most people will ask what's in it for me? I think less about making money, selling your allowance. For me personally I don't like that because it smacks of capitalism. Saving money by saving my consumption … whether it's saving money on my bills directly or saving money indirectly in the form of a local tax, that's more stimulating to me". He doesn't like the idea of receiving money but is comfortable with parting with less money. Interestingly, Pete lives in a large home in a relatively affluent area.

Pete made the more obvious point about the systems for PCAs: "I don't think that this country, or very few countries, have got the infrastructure, to be able to be seen to administer that openly and fairly". Dave also makes the point "it's just a load more

bureaucracy". This sort of point may have arisen more often, had it not been for the fact that the interviewees were asked, early on during each interview, to assume the systems would work.

Only one, in this largely rural set of interviewees, made any point about rural living. Melanie, who was against PCAs and thought they would be generally unfair said: "People who live rurally need their cars, there's no decent shop around, the local Coop is so expensive, so you have to drive everywhere for everything. There's a mismatch in that way. There are so many ways in which it is difficult to even out those things so that it's fair." Melanie and her family had recently moved from an affluent city suburb to a small and attractive town in Nottinghamshire, mainly for the children's education.

Melanie later picked up on a theme which is likely to be more pronounced for village and small town dwellers, having room for manoeuvre: "I think there are other ways for it to be done … A lot of people are not going to be able to reduce things. It's no good limiting people if they've got nowhere to go... You have to be able to catch the train, to catch the bus, and if that isn't there as an alternative, what do you do? If the alternatives are very expensive, then people get in a pickle."

Within that broad theme of 'having somewhere to go' in terms of reducing a footprint in order to cope with a potential deficit on a personal carbon allowance, Melanie has introduced a new concept, of investing in infrastructure, both household and public. In the home: "With a few little measures and not doing anything so drastic we're below anyway. My perception is that people need to do things". Earlier she had complained about the state of the transport system: "With transport, I think they should put some money into having better trains. Why do we have the most rubbish train system in Europe? Why don't we have decent cycle routes? If you live rurally, your children can't cycle."

Melanie was promoting the concept of 'other ways' rather than having a system of PCAs. Dave, who disliked the idea of a PCA bureaucracy, gave a strong hint in favour of intervention: "But they'll still make a great big motor like that which is going to use three times the petrol of a smaller car. That's my arguments of the whole

environmental thing." He was throwing in the idea that large four-wheel drive vehicles, like the one he had seen earlier in the day, should no longer be made.

Finally there was the outright opposition of Susan, who offered no constructive arguments, as these quotes show: "You just feel your being restricted in everything. You watch the prime minister turning up at parliament in a Jaguar that does about 12 to the gallon, and he wants me to change my way of life." Interestingly, Susan was upgrading her nearly new sporty super-mini for a four wheel drive the next day, so any restrictions were not apparent to the interviewer. Nor can any record of the prime minister exhorting the public, in the way that Susan describes, be found. She continues: "I don't like being told what to do, and I don't see why I should be charged any more for what I do. But I do agree we need to do something, and there are some people who are worse than others." Susan was asked to propose an alternative but avoided the issue.

Susan:	Where is that money going to go, and what is it going to do?
Interviewer:	Well, it would go to other people who are emitting less, basically.
Susan:	I don't see why I should have to pay for other people, that's what I find more frustrating.
Interviewer:	Would you rather that money go to taxation then, or not charged at all?
Susan:	I don't think I should be charged at all. My fuel, in particular, is extortionate.

Susan was referring to her gas and electricity, not the fuel for the family's cars. The wealth one would expect of someone living in such a large new home, and the purchase of a new vehicle costing upwards of £20,000, did not fit with the unexpected concern about gas and electricity bills. It may have been that the family was living beyond its financial means, thus leading to hostility about a new expense.

In summary, there was a variety of interviewees opposed to PCAs. The reasons for opposition included systems and bureaucracy, the vulnerable, dislike of capitalism, having easily achievable means of reducing footprints, and there being better ways of achieving emissions cuts (investments and interventions). Only one 'anti' interviewee linked opposition to PCAs with rural living.

8.3.3 Support for PCAs

Ten people were supportive of personal carbon allowances, these being Helen, Evelyn, Jim, Rosemary, Cathy, Lynne, June, Janet, Marion, and John. Only Marion was recorded as a strong supporter. Rosemary , Helen, Lynne and June were examples of moderate support:

Interviewer: Would you support this system?
Rosemary: Would this carbon contaminate the atmosphere?
Interviewer: Yes, it would, it's a ration ...
Rosemary: OK then I would.

Interviewer: Any reservations other than black market issues?
Helen: I think it's just going to be a huge, huge thing to work out, and hugely expensive thing to do, providing the computers don't crash. But I think that given that everything comes together and works, the good.
Interviewer: Would you say you're strongly supportive, or moderately supportive of them?
Helen: Yeah I would support it, I wouldn't go over the top.

Interviewer: Do you support the ideas of personal carbon allowances?
Lynne: I think it sounds a good idea, from what I've understood, I've never heard of this before.

Interviewer: Do you support the idea of PCAs, anything from strongly against to strongly for, or no idea?
June: I think it would be a really good idea, but it will disadvantage the disadvantaged.

One late joiner to an interview declared support before hearing the proposed details of the PCA scheme. John said "I think it's definitely a good idea, I don't know how you'd police it. I suppose they could look at your mileage each year."

While Philip was eventually designated as opposing PCAs (see previous section), the opposite was the case with Cathy:

Interviewer: On your initial view, what do you think of a system like that?

Cathy: My honest answer is it's a very good idea but it would take a heck of a lot to get it working.

Interviewer: Would you say you moderately support it or strongly support it?

Cathy: I don't think people would agree on their allowances.

Interviewer: OK your initial allowance would be the amount of energy used in the domestic sector the previous year, divided equally amongst the population, with a slight reduction to force people's consumption down. Because the whole idea is to reduce it year by year.

Cathy: I think the other thing is that you'd have to make it quite easy to use, for people who are not up on it. I'm thinking an 80 year old pensioner.

Cathy makes a valuable point about the vulnerable, which was a theme that came up several times. She was eventually 'classified' as supporting PCAs because she showed other signs of support:

Interviewer: Do you think the system would be a fair one? Why did you think it would be?

Cathy: I think it makes you aware of what you are doing and tries to make you reduce it. Until you start adding it up and writing it down, I don't think people are aware of what they do. It's a bit like when you are dieting, there's some little things you forget to write down. You forget about that little thing.

Interviewer: So it will make you aware?

Cathy: Yes.

Some households were divided:

Interviewer: Ok, do you support the idea of PCAs?

Evelyn: Yeah.

Alfred: Yeah, I should have thought so. I'm not really convinced about [climate change], but.

Evelyn: You've got to do your bit, haven't you.
Interviewer: Strongly or moderately?
Evelyn: Moderately.

Alfred indicated he wanted more information. Another divided household was Janet and Nick's:

Interviewer: OK, do you still support the idea of PCAs?
Janet: Oh yes!
Interviewer: Strongly, moderately?
Janet: Moderately, I'd need more information before strongly supporting them.
Interviewer: And what makes you support them?
Janet: This sounds awful, class-ist, but you see all these four wheel drives around, jetting off all the time … Is it a status thing, you're just contributing to the greenhouse effect.

When Nick came home, they disagreed:

Nick: Fuel is very costly but [tax is] probably the best way of getting people to conserve it.
Janet: I don't agree, I agree with [personal carbon allowances].

At least one interviewee was strongly supportive:

Interviewer: Do you support the idea of PCAs?
Marion: Yes I think I do. Yes.
Interviewer: Would you say moderately support or strongly support?
Marion: Er - strongly. I think it's a good idea.

There were few examples of someone changing their mind, after their footprints had been calculated. Most explicitly stuck to their original opinion:

Interviewer: You wouldn't make any money out of this. Does it alter your opinion?

Rosemary: No…

Interviewer: So your view of PCAs still moderately supportive?

Rosemary: Yes.

Back to Janet:

Interviewer: After the first year, if you didn't take any measures, you'd be in shortfall... Does that alter your view of PCAS?

Janet: No not really. We would hope not to buy and it's a way of making people sit up and take notice.

But despite her husband sitting on the fence, Evelyn's support grew:

Interviewer: Having shown you your footprint… Given your moderate support before… are you more or less supportive?

Evelyn: More supportive!

Furthermore, there was eventually an implicit kind of support from Leonard, who started out seemingly thinking the idea was incredulous, but was soon thinking about how he'd cope:

Interviewer: I wonder what you think of PCAs now that we've looked at your footprint … The cost to you £315 a year. Does that in any way affect your view? You talked about them being radical and mind blowing and concentrating the mind. You mentioned uproar, do you think you'll be part of that uproar?

Leonard: I'd be sorely tempted to alter my way of life.

In summary, support took many forms, with moderate support (often citing concerns such as about vulnerable people) predominating over strong support. Households were in some cases divided, and although most stuck to their opinions, it was not unknown for people to change their minds after some discussion.

8.3.4 Distrust and PCAs

The interviewees did not say much regarding potential fraud and distrust in organisations that might administer the system. Pete was particularly critical, though, and after criticising the current council tax system, he reviewed other potential candidates:

> Pete: I wouldn't trust the banks to do it.
>
> Interviewer: Who would you trust to do it?
>
> Pete: At the moment I've got difficulty in trusting any one organisation to do it. I wouldn't trust [a credit reference agency] to do it!... I think it would scare me to death, you know, big brother-ish… Central government have got an appalling record with computer systems. Local government don't have much of a record at all. Somehow a mechanism which was local so you could vote people in and vote people out is probably the best of a bad lot.

So after initially aiming his criticism at an aspect of local government, he eventually concluded that something akin to local government was the least worst option.

Nick condemned all public sector bodies: "I think you leave it to business, a run-for-profit organisation. Any public organisation is over managed … I work in the [public sector], I see this every day, and local councils - there's too much money on management and not enough on solving, on doing the actual job."

Helen was more considered:

> Helen: I'm very much in favour of the people who know what they're talking about running systems. So I was very much in favour of the Bank of England working out interest rates and how they should change even though it made a difference to my mortgage. I'm very much in favour of educationalists running the education system, and doctors knowing what's best in the health service. Rather than it being done by somebody who was running Northern Ireland last week and running the health service this week.

Interviewer: So it sounds like your saying that the utilities would be quite well qualified to run these systems.

Helen: But with obviously [someone] above them to set the amounts and the size of the footprints.

Individuals also came in for some suspicion. Jim said "But this is sure to - a new professional - a carbon exchanger / trader. This might defeat the object." Meanwhile Helen was concerned about fraud:

Interviewer: But you feel there might be people who'll …

Helen: Find a crafty way around it, make up their cards or something. Perhaps I've just got a suspicious mind.

In summary, there was a variety of parties that might not be trusted to run or be associated with a system for personal carbon allowances, but distrust was on the whole not a major issue.

8.3.5 Transfer and trading

The mechanism of trading or transferring carbon units came up very little. Jim wanted to know: "If I go out with someone in their car, would I be able to give them some of my points?".

Pete liked the idea of retiring units:

Interviewer: What has been proposed is that people with … a strong environmental or social attitude, would be able to retire their units so that no-one could use them at all, thereby reducing overall personal energy use.

Pete: That sounds better to me.

Jim proposed a variation on retiring units:

Jim: My units could be sold to buy you some insulation.

Interviewer: So are you saying that the value of [your] unused units could be used to pay for energy efficiency measures?

Jim:	Yes.
Interviewer:	But your units paying for my energy efficiency measures, or would it have to be somebody whose not very well off before they're entitled?
Jim:	I don't think it matters whether you're on a big salary or a little salary, if the units can be used. Because if you had your home insulated and you moved, then the person you sell your home to would benefit and it would come down the scale, cascade down.
Interviewer:	So you wouldn't mind that you wouldn't get your £80 for your unused units, you would give away your units, and say "spend that £80 on energy efficiency somewhere in Britain".
Jim:	Yeah!

It is almost as if Jim has heard of the local council's philosophy of CODAE - ensuring that every home is capable of providing, now or in the future, affordable energy to the poorest occupant- ironically a single pensioner like himself, although not on minimum income (NEA 2003: p.41, NEA 2006b).

Jim was concerned that people would waste units: "You'll get a lot of people who'll say 'Oh I've got 24 units left, I'm going to blow it by going on an aeroplane'."

Helen posed a very interesting question: "So do you think everyone will be able to understand how much carbon they're using and they will know [to] put your extra units back into the system for somebody to buy?"

8.3.6 Allowance allocation

Helen mentioned different sectors in which PCA units might be used, and was asked whether they should be pre-allocated in some way. "I'm thinking that for everybody we need to keep some by for essentials… to keep warm, to run your home. I think maybe each home will have a carbon footprint to it… Maybe everybody allowances should be divided up so that you would be allowed to run your home to a reasonable level, but extra would come with the extras that you would do… So then you would not be needing to worry too much about people with dementia, learning disabilities and so on."

Lynne verified what the interviewer had already realised from calculating previous household footprints where there were children in the home:

Interviewer: I presume you support the idea of half allowances for children?

Lynne: Yes I do.

8.3.7 Effect of social and income class

Nine interviewees commented upon class issues, with most comments being directed at the rich (five comments) or the poor (six comments). The poor were treated in a rather more derogatory fashion, with three references to people taking from the system (to the extent that people might resent those on certain welfare benefits receiving a carbon allowance) and one to them allegedly producing more waste. Even the least unkind comment was an incorrect assumption by June that the poor would be worse off under a system of personal carbon allowances with Pete stating: "I suppose with detached houses there's more of an individual responsibility. Whereas with communal living, I would suggest that groups of people are less likely to feel a personal responsibility for the efficiency of their living accommodation. Certainly that tends to get reflected in the way they look after the local environment". One comment about the poor by Lynne was double-edged: "I could well say I'll just not go to work, I'll just go on the social security, what an awful lot of people do… I'd really object to having to pay another tax… that I wouldn't be able to afford because I'm a single parent."

8.3.8 Living Solo

Four interviewees (Helen, Philip, Jim and Leonard) lived alone and two (Cathy and Lynne) were single parents. Jim, in his small council bungalow, had a very low footprint. It is not just because they have to heat a home on their own but because they may fly more. Helen had a high footprint but the cause was her flying. Her 1980s' bungalow was modestly sized and had a modern boiler and reasonable level of insulation, and she had a small car. Philip and Leonard would lose out significantly under a system of personal carbon allowances. Philip's home was larger than Helen's and he was perturbed by his footprint, which was 4.3 tonnes over the allowance (assuming the system of half allowances for children, thus giving him a 5.1 tonne allowance):

Philip: I'm supposed to be a modest user.

Interviewer: But you live on your own.

Philip: Yes, so that creates a problem. This could be divided by four…. The way you've presented this, even if I took maximum effort, it wouldn't reduce it to an average footprint. But where is the waste? You've got to run a car in the country. You've got to warm a house, to a degree, even if you've got the most efficient system.

Interviewer: You can choose not to fly. But you're rather hemmed in.

If he was to install all suitable measures (notably a new boiler and cavity wall insulation), he would be left with a deficit of over 1.5 tonnes. However his problem was small compared to Leonard's, who had an even larger bungalow and a 'deficit' of almost 7.3 tonnes, which could only be reduced to just under 5.4 tonnes. The conversation was as follows:

Leonard: What I really ought to do is sell the place and move into an apartment…

Interviewer: … You're not the first person I've met who lives in a large home and is thinking of downsizing. Do you think if PCAs came in, it would induce people to move?

Leonard: It's strange isn't it, something does come in, and all sorts of activity stemming from it. Old people getting away from the problem by moving into an apartment.

Cathy had been the first person to mention moving. Her daughter would be going to university in the next few years and would presumably take her carbon allowance with her. Cathy bravely told her story: "There were three of us but my husband died. We're still in the same house. If there'd been me and [my daughter] for a long time, we perhaps might not been in such a big house… It's been something that I know I will do in the next ten years… It's not the sort of thing you change on a whim, your house."

Lynne had two children and a smaller household footprint so could look at the issue more generally.

Interviewer: In my situation I'm a lodger.

Lynne: Yes, it encourages people to… If you take in lodgers your community charge automatically goes up. But you could have it the other way around. A bonus.

When asked about moving, she sounded as though she might eventually do so: "I don't want to move yet because my children are at school and they're doing their exams. But eventually because this place is difficult to manage. Your circumstances dictate how you live and where you stay."

In summary, those living alone would be more likely to be at a disadvantage under a system of PCAs, not just because they need to heat a home on their own but also because of lifestyle issues. Lone parents would also be at a potential disadvantage unless they are given allowances for their children.

8.4 Home energy services and savings

This section has sub-sections covering interview results in a number of areas of home energy use, including lighting, cold devices (fridges and freezers), washing, computers, heating efficiencies, loft insulation, wall insulation and standby. Because willingness to invest is a subject that is most pronounced for heating systems (a heating upgrade generally being the most costly measure that achieves a major reduction in a home's carbon footprint), it is discussed with heating. There is also a sub-section which addresses two key related behaviours - reducing consumption and switching off.

8.4.1 Lighting

In this section, a number of themes are explored. These are awareness of the range of compact fluorescent lightbulbs, lighting in new homes, spot-lights (including halogens), opportunities to make savings from lighting, the process of replacement of conventional lightbulbs, and paybacks from installing compact fluorescent lightbulbs.

8.4.1.1 Awareness of the range of compact fluorescent lightbulbs

A key issues as regards the interviewees potential to save carbon by making changes to lighting, was the awareness, or lack of it, regarding the types of compact fluorescent lightbulb (CFL) available on the market. Evelyn, Rosemary and June were all unaware

of the available of candle CFLs, including those with the SES (small Edison screw) mount. June was unaware of (standard Edison screw-mount) spotlight CFLs and Janet was unaware of CFL replacements for the GU10 mount halogen spotlights. Melanie and Marion simply complained about not being able to locate CFLs 'to fit'. Marion was also unaware of dimmable CFLs, and of the very small CFLs such as the five watt example that the interviewer showed her. One householder's problem is an enthusiasm for antiques, as his wife Rosemary comments: "I always say we are using far too much electric. There are eight there ... There's only the bathroom with a low energy lightbulb. He replaced all the fittings with fancy ones, and they take candle bulbs and the shades won't fit anymore." There were also mentions of specific retailers and the non availability, from those retailers, of specific types or sizes of bulb.

Thus the interviewees lacked of awareness about the availability of compact fluorescent lightbulbs in a variety of shapes, sizes and mountings, as well as the availability of dimmable CFLs. Perhaps the biggest gap in knowledge is the lack of understanding about the variety of different powers of CFL:

Carol:	They're so dark, you can't see anything with them.
Interviewer:	Which ones have you bought?
Dave:	Don't think we bought any, they're free ones…
Interviewer:	They tend to give out the 11 watt ones. If you've got a 100 watt, incandescent, and replace it with a 11 watt CFL, it's going to seem dark. You need a 20 watter...
Carol:	And they're similar, are they, at output, then?
Interviewer:	You'd use a 20 to replace a 100.
Carol:	Right.
Interviewer:	And, I'd say, a 12 could replace a 60. They tried to say it's a ratio of six but it's not, it's a ratio of five.
Dave:	We've got some here from IKEA. They're 11 watt.

The interviewees had appeared to have adopted negative attitudes towards CFLs on the basis on a lack of understanding of selecting bulbs of the correct power. There was only one other brief mention which may have alluded to the alleged dimness of CFLs. This was unexpected, as the interviewer had expected to hear this more often, assuming it was 'received wisdom' amongst less aware consumers.

To complement the ‘dimness’ theme, one interviewee even complained about the alleged ‘brightness’ of a 2-pin CFL in her new home:

Susan: They’re really, really bright.
Interviewer: They’re like daylight.

The interviewer did not perceive any problem himself - in fact imagining the light cast by the bulb would be refreshing if it was dark outside - but it may have been because the colour of the bulb was different to the norm as perceived by Susan that she used the term ‘bright’. The bulb appeared to be of 13 watts power, equivalent to about 60 to 75 watts incandescent.

Five different households mentioned six different retailers with the implication that they did not stock a full range of compact fluorescent lightbulbs. The interviewees that were advised as to the outlets with the widest range of CFLs - B&Q, and on-line retailers like Bulbs Lamps and Tubes Direct - were unaware of them (although there is no branch of B&Q in Newark and Sherwood District).

In summary, interviewees lacked awareness of the range of compact florescent lightbulbs, and how to select the correct power bulb to replace an incandescent bulb (which in itself is a lack of awareness of the range).

8.4.1.2 Lighting in new homes

The above mentioned 2-pin bulb actually lead to a situation which was much more complex. Susan’s home was one of many on a new estate built within the last year. This was the dialogue as soon as the interviewer switched on the recorder before the interview had fully commenced:

Susan: [In response to a cracking sound] That’s how efficient these bulbs are, look, another one’s just gone!
Interviewer: Well if you go to B&Q this - hang on what are they?
Susan: They’re G9s, the most inefficient bulb you can find. They’re about £5.50 for two and once goes, umph, umph, umph, [indicating others blowing].

Interviewer: G9s, not GU10s?

Susan: I've got the box. I keep the box otherwise I never know what I'm buying.

Interviewer: Halogens, hmm.

Susan: Not the best!

Interviewer: My goodness, people said to me these things go the whole time, but -

Susan: Once one goes it's like a surge, and they all start to ping away.

Susan's home was one of many on a new estate built within the last year. The bulb that had blown in the kitchen was on a light fitting which might be described as a candelabra, or a 'designer' light fitting. It featured many of the small halogen bulbs that Susan had described. The bulbs were too small to be replaced by a compact fluorescent bulb (even the CFL replacements for the ubiquitous kitchen spotlights, known as GU10s, are somewhat larger than the halogens that they are replacing). The conversation continues:

Interviewer: What puzzles me is that they're building new houses and they're meant to be highly energy rated but they're putting in halogen lights.

Susan: … It's us that's put -

Interviewer: Ah!

Susan: Every room in the house had a … flex except for the hall stairs and landing, and they're energy efficient bulbs. We've left those in. A lot of people have changed them and put normal light fittings in… You cannot get lampshades to go round the width of those bulbs. They're continental size ...

Interviewer: Oh can I have a look ...?

Susan: Yeah ... Pull it, it'll come out.

Interviewer: Oh I see, it's like got … pins …

Susan: But they are so wide… that you can't get a standard lampshade. I've seen them in John Lewis and they're about £30, and I've got … five light fittings…I begrudge putting extra light fittings in for something I don't ever really have on... It's either change the

actual complete light fitting [she turns on light]… When they go I'll change them for something else.

Interviewer: I have seen them available, on specialist websites.

Susan: [Undecipherable] I've scoured the Internet and you just can't get them. That's why we went to IKEA. A shade. I'm not changing the lightbulbs. And it's an immense thing. An energy efficient house and I've gone against it in putting in -

Interviewer: Yeah.

Under the latest building regulations, all new homes are required to have 30% of the 2 or 4 pin lightbulb mountings which will only take compact fluorescent tubes. The starter electronics are built into the lamp holder and it is the size of this holder which restricts the choice of lampshades, as well as restricting the variety of lightbulbs, which are available in only a limited range of powers, and only in the 'stick' design. Susan had assumed that the fittings in question were 'continental' and the interviewer attempted a clarification, explaining the use of Edison screw mount bulbs on the continent of Europe but this did not sink in. He allowed Susan to continue because the findings from her observations were potentially valuable. She observed how other occupants of the new estate had responded to these issues:

Interviewer: So you're saying other people have taken the whole light fitting out?

Susan: Yeah, and they've put in that kind of thing [indicating the light fitting taking the G9 bulbs]…

Interviewer: So nobody's gone to Wilko's and got a standard £1.50 standard ceiling rose?

Susan: [Laughs] No, I don't think so.

Interviewer: Because then you've got with those, what I'm saying with those, with the wire piece and the cable, then you've got a choice.

Susan: Choose whatever you like at the end. No they don't.

Interviewer: So they actually go out and buy -

Susan: Full light fittings! [laughs].

Susan summarised it succinctly: "You don't realise until your electrician has fitted them how much they're going to cost you."

Susan also made reference to an issue which, although she was the only one to live in a new home and to raise it, could have serious implications for new homes:

Susan:	There's no window in that wall. Which is a massive complaint that everyone has made about this style of house. In the utility room there's no window and you have to have a light on.
Interviewer:	Have you thought about putting a window in?
Susan:	Yeah, yep, we're going to.
Interviewer:	Have they started doing it already?
Susan:	We're going to write to the builder and ask permission and then write to the council for planning permission. I don't think we need it but we need permission from the builder because there are covenants if you alter your house… It's little things like when you're washing your pots, you expect a window to be there.
Interviewer:	I know they're built to certain regulations.
Susan:	We asked. And he said that we have to supply a certain percentage of light into every room, and that's sufficient for this size room.
Interviewer:	But what they're not taking into account is that the light is coming in at the bottom of the T shape. And the bar of the T is -
Susan:	I know, but what they say is right, building regulations state - I can't remember what the percentage is, but he did tell me. He said, I know what you're saying, it is stupid, what we need is a little window there.

In summary, the forced installation of low energy light (two-pin) fittings in homes may be backfiring and having unintended consequences. Builders of new homes may also be cutting corners on new home designs in order to achieve SAP ratings, at the expense of common sense and daylight provision.

8.4.1.3 Halogens and spot-lights

As in new homes, in older homes there were further problems with the seemingly fashionable use of inefficient halogen, and to some extent incandescent, spot-lighting. This first came to light when discussing another energy efficiency measure:

Helen: I've got halogen lights in the bathroom and you have to leave a space round those because of the heat.

Interviewer: Really? I suppose you could replace it with low energy lighting!

Helen: I've just put it in. Well no I suppose they've been there about 7 years. Anything I've put in is "just" although I've been here 11 years.

Interviewer: … I haven't got halogen lighting… You can't have anything touching it because it gets very hot.

Helen: I assume there'll be something they can do, put a tube around it or something.

Helen mistakenly thinks that her whole lighting system would be replaced but all she needs to do is use CFLs rather than halogen or incandescent bulbs in her down-lighters.

Regarding the efficiency of halogens relative to incandescent bulbs, there were some varying views:

June: We've got those spot light halogens, they're quite low energy anyway, those down-lighters?

Interviewer: They're about half the incandescent ones. Where've you got those?

June: Both bathrooms, three in each bathroom.

Interviewer: If you still had florescent tubes…

June: We've got those as well, they're low energy aren't they?

Interviewer: Oh yes!

Janet: The thing we're concerned about is halogens. They're not very energy efficient, are they?

Interviewer: They're a bit more efficient than old fashioned incandescents. They have a tendency to get a bit hot still. Have you got them?

Janet: In the bathroom and both kitchens.

Interviewer: If they're GU10s you can get CFL replacements for them. But if they're low voltage ones, as mainly used in retail places, I've

been investigating and can't find replacements for them. But most domestic situations you can buy a CFL for.

Janet: I'll do that.

In yet another household kitchen spotlights were present - but there was another surprise in the front room:

Marion: Those are GU10s are they?

Interviewer: I'll have a look [walks from dining into kitchen area].

Marion: We've got different ones, we've got a strange type of pendulant lamp set in the front room.

Interviewer: … I think these are GU10s...

Marion: We've not had any of those go yet, those are just the ones that were here when we came. And the one in the front it's a modern style one with lots of lights coming off it. And one of those has gone, and we said well let's just wait until it's about three and change the whole thing.

Thus Marion intended to do the opposite of the occupants of Susan's neighbours new homes - removing fashionable but inefficient light fittings. Dave and Carol also had halogens and incandescent spotlights:

Dave: There's four there, halogens, across the front.

Interviewer: You can get replacements for the halogens now.

Dave: Yeah.

Interviewer: In fact B&Q this week, they're doing Megaman replacement for these halogens, they're GU10s aren't they, they've got two pins, I think. And these [down-lighters] are just the standard screw.

Dave: Edison yeah…got those [GU10s] upstairs in the bathroom…

Interviewer: … have a look in B&Q [snip]. They last for 15 years.

Dave: Is that just the bulb, or the whole light fitment?

Dave is surprised that bulbs can last so long. Unfortunately the conversation is distracted by a discussion about varying quality of halogen bulbs:

Carol: Those ones you bought for the bathroom, they're quite expensive aren't they?

Dave: I think in the past we used to put cheaper lightbulbs in. But now we go for a better type of bulb…

Carol: I think I bought a load of them from Homebase.

This being the last interview, the interviewer makes an observation:

Interviewer: I'm really surprised at the way halogens have taken over in kitchens because nothing can beat [fluorescent tubes] for energy efficiency and casting a safe light.

Carol: You mean one of those very long tubes?

Dave: …Or the round ones.

Carol: But they're ugly aren't they? That's the thing.

Comments about the alleged aesthetical qualities of CFLs had been expected by the interviewer but not offered by any interviewee, but Carol offered a variation of the theme.

In summary, there is widespread use of halogen and incandescent spotlights and this is a potential barrier to reducing carbon emissions caused by lighting.

8.4.1.4 Opportunities to make savings from lighting

Although halogen light fittings did seem to be quite widespread in kitchens and bathrooms of the interviewees, the overall opportunities to reduce their carbon footprint from all lighting were even more considerable. All but one of the interviewee households had at least a few CFLs but where any relevant figures were recorded at all on the footprint spreadsheet (which was the case in twelve of the fifteen interviews) the average number of bulbs which could be replaced by CFLs was 10.6, a net savings per annum, using the Energy Saving Trust's figures at that time, of £100 and half a tonne carbon dioxide (498 kg). There was little response from the interviewees when told of the savings. For the interviewer, there was a tendency to downplay the saving because the 47 kg per annum saving per lightbulb is difficult to believe for less well used light-fittings.

Interviewer: If you really could, how many could you replace? Some people have said 20 or 25…

Carol: More than that.

Dave: There's four in that room, and that's the smallest room in the house…

Carol: I'd say 40-odd, if you count all the bedrooms.

Interviewer: 40, wow!

Dave and Carol's figure was eventually recorded as 20 lightbulbs. Their electricity billing arrangements were chaotic but it is feasible that saving the associated monetary figure of £100 a year could have been achieved.

In summary, there are huge opportunities for carbon and financial savings by installing compact fluorescent lightbulbs, but the benefits may be hard to quantify when the number of lightbulbs is taken into account.

8.4.1.5 The process of replacement

Two interviewees talked about the gradual process of replacing conventional bulbs with CFLs, when the former expire:

Alfred: We try to put them in as they go.

Interviewer: Do you have any energy saving lightbulbs?

Leonard: Yes. Not throughout, but as I am using them I am tending to replace them with low energy bulbs.

No-one else spoke of the way they had replaced bulbs, so whether anyone replaced less efficient bulbs with CFLs before the former had expired was not clear.

8.4.1.6 Payback from CFLs - Savings, claims, prices and longevity

One area where a minority of the interviewees struggled to understand the issues was the financial savings from investing in compact fluorescent lightbulbs. Cathy summed it up when she talked about her wavering enthusiasm to invest in CFLs. "I started but I got a bit incensed about it. I'm changing these and everybody is still driving everywhere and flying around the world, so what difference is that going to make? And

then I heard the other day that you can't get rid of them, the same as fluorescent tubes and batteries, you have to find a special place. They do cost more, how much actually do they save? So I got so far and thought, sod it." So a feature on the Jeremy Vine Show on BBC Radio 2 brought to light the effect of WEEE regulations on expired CFLs, and lacking in knowledge about the savings, Cathy stopped buying them. She continues:

Cathy:	That's the trouble you see, you hear one thing, you hear something else and in the end your so bamboozled you don't know what to do, do you? And then you think, the people who sell the lower energy light bulbs, they're only out to sell them anyway. [snip] The likes of Philips or whatever.
Interviewer:	But what else do they make - the old fashioned lightbulbs!
Cathy:	Yes, yes. But in the end you're so - That is part of the reason why people don't do these things.

The price of CFLs attracted contradictory opinions.

Interviewer:	Have you noticed the price of any other energy efficiency stuff. Lightbulbs?
Lynne:	They're very reasonable.
Interviewer:	What was the cheapest price?
Lynne:	I can't remember. I've got quite a few.

Melanie felt CFL prices were falling "They've become much cheaper". Dave and Carol didn't see it like that: "It's just the thought of going out and spending that much on money on a lightbulb." Dave was referring to a CFL replacement costing £6 for a halogen GU10 but as an original GU10 halogen is likely to be expensive compared to an ordinary incandescent GLS bulb, the comparison is valid.

Dave:	We would look at that and say we 're not paying six quid for a lightbulb. Even if it is going to last 15 years.
Interviewer:	What about the full life cost?

Dave: You don't tend to look at that do you? I'll look at that and think … it's going to cost me £24 to replace those. It's going to [need] another six bulbs to do the rest of the kitchen.

Dave had only just learnt, from the interviewer, of the 15 year life of some Megaman branded CFLs. His wife Carol, when presented with another manufacturer's five watt CFL, shaped like a small incandescent bulb, read from the packaging:

Carol: 8,000 hours?

Interviewer: Yes the assumption is that people will use a lightbulb for a 1,000 hours a year.

Dave was sceptical about information sources including the packaging of CFLs:

Dave: You see figures and I get very sceptical about statistics. And they're going to tell you the statistics in their favour because they're trying to sell you a lightbulb. And I haven't got time to sit down and actually work it out myself - how many pennies it might save over the course of a year.

Interviewer: … basically there's not much out there which you can trust which is saying to you -

Dave: We do go through the motions sometimes, of buying energy saving lightbulbs. But we do get put off by the fact that they're expensive, and the benefits, even when you read it on the packet, don't seem to be worth it.

Interviewer: How? In what way do they seem not to be worth it?

Carol: Monetary benefit, do you mean?

Dave: I know you're going to save money on it, but are you going to save enough money to (a) pay for the lightbulb and (b) make significant savings down the line. Which you've already said we are. But I've never actually sat down and proved it. And I've never taken what's on the packet to be true. But I might look at it now.

Interviewer: That's interesting.

Here is a phenomenon which appeared in at least one other interview - the presence of an ‘expert’ has shifted the viewpoint of the interviewee. Dave has however expressed a concern which other interviewees may have had but not expressed because they felt they were doing the right thing environmentally. Could the purchase of CFLs, although reducing running costs (and carbon emissions), increase the overall cost of lighting, i.e. when including the cost of the bulbs?

In summary, there is ignorance about the savings that compact fluorescent lightbulbs can bring, even when taking into account the cost of the lightbulbs.

8.4.2 Cold devices

There was a surprising number of interviewee households with more than one fridge, more than one freezer, or with a very old ‘cold’ device:

Evelyn:	I’ve actually got two freezers. That in there is not really kosher. It’s supposed to be frost free but it freezes up a bit. And I’ve got a little chest freezer because we used to grow our own stuff you see. And I like to save it. And we’ve got an ordinary larder fridge in here.
Interviewer:	How old are these?
Evelyn:	This one must be 20 or more.

Interviewer:	Fridges?
Rosemary:	That one is switched off, it’s just got tins in it. This one -
Interviewer:	It looks fairly recent.
Rosemary:	Yes, I think it was a saver one… We got it [from my son], he’d never used it. And I’ve got another deep freeze in the conservatory and it’s fairly recent. And I’ve got a real old chest freezer in the garage. I’m trying to empty it.

Interviewer:	That electricity figure is rather high. Have you got an old freezer somewhere?
Cathy:	Got one in the garage.
Interviewer:	How old is it?
Cathy:	Don’t know, got it second hand.

June: I think my fridge-freezer's probably quite low because it's quite old... The freezer is newer. A rating.

Interviewer: Do you know what brand the fridge freezer is?

June: Hotpoint. Around 1998… I do have another fridge and freezer in the garage but they are used at Christmas and perhaps for a while in the summer.

Interviewer: You haven't got any old fridges and freezers lurking anywhere?

Janet: A fridge in the garage, came from a friend who was emigrating, from new six or seven years. We use it as a beer and wine fridge.

Interviewer: Fridge - I think we ascertained that your fridge and fridge-freezer are relatively up to date.

Carol: Hmmm [sounding doubtful].

Dave: No, the fridge is but the freezer is about 12 years old. In fact it's 17 years old, that.

Susan's situation with extra 'cold' devices was in part due to moving into a new home:

Susan: Every appliance is A rated. It has to be now, to pass all the rules and regs, of building the new house.

Interviewer: So have you got built in appliances?

Susan: Built in fridge, freezer, dishwasher, washing machine. [I also have] an extra fridge, freezer and tumble dryer in the garage.

Interviewer: Did you bring those with you?

Susan: Yes.

Interviewer: Do you know how old they are?

Susan: They are less than five years old.

Interviewer: Oh right, OK.

Susan: Because the freezer in this house is ridiculous. Stupid size. The bottom cupboard there… It's got about two shelves in it, which is probably alright if you've got the one person but - Really silly design, it's like a 60:40 split.

Interviewer:	So you would have preferred - ?
Susan:	Fifty-fifty… That's just the builder, what they put in, isn't it?
Interviewer:	…What would have happened if the one they'd supplied had been sized more towards your requirements?
Susan:	We'd have kept the tumble dryer, and kept the fridge.
Interviewer:	But the freezer?
Susan:	Probably not if [the integral one] was 50-50.

The only other interviewee to speak about cold devices was Jim, who was also the only interviewee to state he had just a simple fridge without an ice box.

In summary, seven of the fifteen households revealed that they had extra cold devices.

8.4.3 Washing

Twelve interviewees discussed clothes washing. There was some awareness of a recent wash at 30C campaign, which appeared to be driven by the manufacturers of washing powders and liquids, etc. Five households indicated their awareness of the campaign and a sixth may also have been as the interviewee mentioned modern washers having 30 C washes. The two households which declared that they did washing very frequently also appeared to have old washing machines not capable of washing at 30C. One if these was Evelyn, who had only just switched from washing at 60 to washing at 40C, and was doing three or four washes on the day of the interview. The other was Rosemary, who did washes daily. Cathy was still washing at 60, using an E setting on her machine, rather than using an 'ordinary' 60 C wash but she did not know what the E meant. June was mainly using a quick wash on 40: "I do wash some things on 30 but having two boys, it's better to wash on 40 once than 30 twice". Carol said that "I just feel that if I turn the temperature down it won't wash the clothes." Four interviewees knew the ratings of their washing machines, and these were all at least 'A' rated.

8.4.4 Computers

Seven interviewed households talked about their computers. Five of these indicated a lack of awareness of the footprint resulting from their use, and in four of those cases a tendency to blame the computer (or their users) for using a lot of electricity. "I'm not

very good - I've heard it said they're very thirsty" said Melanie, while Cathy asserted "Teenagers haven't got a clue, they … turn the computer on and leave it on all day."

Dave and Carol's computer had the right settings: "The computer always powers down fairly quickly." But Tom misunderstood computers power saving settings: "The computer is off. It's not like in the school office when they leave them hibernating." Unless he has switched his computer off at the wall socket, it is likely to be using as much power as a hibernating one.

8.4.5 Heating efficiencies and willingness to invest

In this section, two themes are explored. The first is heating system efficiencies, which are not confined to just boiler efficiencies. The second is willingness to invest. As they are the largest of the measures considered during the interviews, and grants are generally not provided for them (unless there is no working system and an occupant of the home is on certain benefits), willingness to invest in energy efficiency in exercised most of all by investments in heating systems. Thus they are explored together here.

Five of the fifteen interviewees had boilers more than fifteen years old (note that one interviewee had electric heating and, of the other fourteen, three had oil boilers). Jim's tiny council bungalow was one of those with an old boiler, but his household footprint was still the lowest of the fifteen interviewees because of the size of the home and because Newark and Sherwood Council had installed cavity wall insulation, loft insulation and double glazing. Jim was also against waste and demonstrated good understanding of how to use his heating system.

Melanie and her family had recently moved into their 1970's home and were intending to replace the boiler, which dated from the construction of the home, as soon as funds allowed. Interestingly, an intermediate investment had been made, mainly for reasons of comfort (this interview took place in late summer):

Interviewer:	Have you got TRVs?
Melanie:	We had them all put in about a month ago.
Interviewer:	… they won't be reflected in your bill yet...
Melanie:	There were none at all, and because it's a gravity fed system the three radiators near the boiler would be boiling hot in mid

summer. Also my [children] are hot-blooded things and typically it was their bedrooms...

Interviewer: When you get your new boiler it will be a pumped system.

Melanie: Yes there's no pump at all, everything just back fed.

Ordinarily, when a new boiler is put in, thermostatic radiator valves (TRVs), a modern timer-programmer and a pump with full diverter capability (so that the hot water and space heating can be separately controlled) are installed. Radiators are often also replaced, because of failure to install ones with large enough heat-delivery capacity in the past, or because of corrosion. Sometimes the hot water tank is replaced, especially if it is the type that is not encased with the hard green polystyrene insulation. In many such cases, plumbers will recommend abandoning a stored hot water system, and installing an instant hot water system, i.e. a combi boiler.

Melanie had dealt with the TRVs. It is not uncommon for old systems to have a gravity feed to the bathroom radiator and the hot water cistern, with pumped feed (controlled by a room thermostat) to all other radiators, to allow the bathroom radiator to be a heat overflow (and also provide a means of drying towels in summer). In effect, installing a new boiler, which in itself will usually be considerably more efficient, tends also to mean other aspects of the system are made more efficient too.

Philip had not been enthusiastic earlier in the interview about thermostatic radiator valves and showed initial reluctance to change the boiler which dates from the mid-1980s:

Interviewer: And you have thermostatic radiator valves?

Philip: No, but there is a thermostat in the hall, I think that's satisfactory.

Interviewer: How old is the boiler?

Philip: As old as the house... And my central heating man says it's still going strong.

The theme of boiler servicing personnel praising old boilers was to come up in another interview. Philip kept his home rather cool "I think if I'd been more generous with central heating I might still have a wife, you never know! I'm inclined to enjoy getting

up into a cold house, which makes you smile." When he found out the considerable size of his footprint from gas, at about 5.1 tonnes, he reconsidered:

Philip:	I consider myself a small user… You don't know do you, the boiler comes on.
Interviewer:	It could be because it's an old boiler, 20 years old. If you replace it you might find your gas use would drop by a third.
Philip:	That's interesting because I could afford a fancy new -
Interviewer:	Condensing boiler?
Philip:	Yes. That would be £1500 and might be money well spent.

Philip had not been prompted with any costings, and revealed he had been tentatively investigating the issue. The investment would inevitably come with the other improvements (although perhaps with extra cost), including the TRVs which he had felt unnecessary. However, within minutes he's also warmed to the idea of TRVs, perhaps because the savings for a new boiler and heating control upgrades are quoted separately on the footprinting spreadsheet's list of measures, at 810 kg and 490 kg p.a. respectively. "I think a boiler and individual TRVs would be a good idea."

Two of the five households with boilers represented much greater challenges. In Alfred and Evelyn's case, they presented a constant stream of reasons for not improving on the oil boiler which was 34 years old.

Evelyn:	Never had anything done [to the original oil boiler] except one new pump.
Alfred:	And that was about 5 year ago. It's been very economical - in maintenance.
Evelyn:	We've had no trouble at all…
Alfred:	... The same bloke who came when we moved in services our boiler.
Evelyn:	He says there's still nothing wrong with that boiler. They don't make them like that nowadays…
Interviewer:	I wonder how if it was replaced with a modern boiler, how much your oil consumption would go down?
Evelyn:	More efficient.

Alfred: Yeah, possibly, but -

Evelyn: We are thinking about having gas, because they put it up the [street], a few years ago.

Alfred: About ten years.

So the story is even worse than it first seems, as gas (which has a lower carbon content) is available outside their gate but not being exploited. But Alfred seemed unaware that gas was also cheaper than oil: "Horrendous prices, gas, people [are] telling me." Even after the price difference had been explained he was adamant:

Alfred: We know people who are paying for gas more than us on heating, a lot more per year.

Interviewer: They might have no insulation.

Alfred: Not just that, they have it on more.

Unsurprisingly, Evelyn revealed, by quoting their two grown-up offspring, that their system did not deliver adequate heat despite all that oil use:

Evelyn: They think we're terrible 'This water is not hot enough', 'This bathroom is not warm enough in the winter for a shower'. I say 'Just get a bit of steam up, that will warm you'.

The influence of family had no effect, it seems. "Our [grown-up children] are always trying to convert us, especially the younger one," was Evelyn's observation (yet when it came to confirming their attitudes about waste, the experiences of [one of them, who worked] in the waste industry, were readily taken on board). The problems regarding the heating seem even worse when taking into account that they look after a disabled child on a daily basis, and that Alfred and Evelyn were just short of retirement age and could soon be in fuel poverty.

Some of the arguments were bizarre. Regarding the overall oil usage, Alfred stated "We use a lot less than other people because they say to us 'We've had 5 loads of 900 litres.' We're frugal." The interviewees talked extensively of their dislike of waste and more than once claimed not to be extravagant, but they have three or four of such oil deliveries per year.

Evelyn: Perhaps it's like you say that our boiler is getting to the situation when it's not -

Alfred: - as efficient as a new one. But it costs a lot less… Would we drop our oil usage or would we get warmer?

Interviewer: It's up to you really.

Alfred: That's what I mean, it'd be alright having an efficient boiler, but no, it isn't.

Despite having a maintenance contract on the old oil boiler, Alfred referred at length to a feature on the BBC TV's consumer programme 'Watchdog', about a control circuit board, for a particular boiler model, that had gone wrong for a large number of owners. "It worries me, because that thing's simple, compared."

Even a small investment was resisted. Given that Alfred was a tradesman and probably could do the job himself, he resisted thermostatic radiator valves, and looked for a completely cost free alternative which simply would not do the same job: "You can balance them, can't you?". He also relayed a story of a friend who had problems with TRVs in the early days of their availability.

When Evelyn pointed out that at some point a new system would eventually have to be put in (implying it is worth doing it sooner rather than later), Alfred responded "But I might be dead by then". One of his last remarks was "There's only one thing about this energy saving, it strikes me, and that's how much it all costs."

Another household where there was reluctance to replace the boiler was Rosemary's, and again a man in his mid sixties was the barrier. Two of her statements summarised the heating situation: "That boiler is totally shot" and "This house is a cold house in winter." The boiler did appear to be very old and dilapidated. There was a perception, even from the teenage son, that boilers have long lives:

Tom: What is the life expectancy, 15 to 20 years, I read somewhere?

Interviewer: I think ten to 15.

Another barrier to replacement was perceived cost. Coincidentally, the interviewer had lived until very recently in an identical house and had also replaced the original boiler.

Tom:	It's having the money there to do it. A new boiler, £5,000.
Interviewer:	No!
Tom:	What was yours just out of interest?
Interviewer:	I had a new boiler, TRVs and two new radiators … I think you can get the whole lot done for about £2,000, may be a little less, if you shop around…
Rosemary:	Trouble is that once you have a new boiler you've got to start decorating.

The financial decisions appeared to be strongly controlled by the husband, who was not present.

Rosemary:	Try telling that to [him] - because he won't listen to anyone's opinion. "I'm not paying out money".
Interviewer:	So he doesn't mind paying out money on the bill?
Rosemary:	Well obviously not. But he won't pay to change it. Very set in his ways.
Interviewer:	When I had a house similar to this, I mean very, very similar, I was paying less than half in gas.
Rosemary:	He's always moaning about the cost of the gas bill. And I say it's the old boiler.

Asked whether Rosemary's husband would be influenced by financial incentives or disincentives, it appears that he would suffer quite heavy penalties before investing or acting:

Interviewer:	People have talked about having higher council tax if you don't have energy efficiency measures.
Tom:	Depends how much. If it was £50 to 100, people would pay it rather than go for the savings. If it's going to be thousands difference, people would go for it. Probably £400, people would do something.

Even when discussing awareness, the reluctance to invest came up again:

Rosemary: How could we make Dad more aware of this? We were saying about a documentary.

Tom: But he'll say "No, no, I'm alright". You'll need to say you can save 'this' amount of money. But he'll say, "That's 15 years of using this one..".

Rosemary: He doesn't move with the times, he's set in his ways.

There were three households where a new boiler had recently replaced an old boiler. Pete's had been a replacement for a boiler under ten years of age, and Marion and John had moved into the house shortly after the new boiler was installed, so could not comment on any change in gas consumption. Helen could comment on the cost reduction, however:

Helen: I noticed a big change in my energy bills when I had my new boiler fitted . A big change. I had a back boiler before. It was quite old, put in when the house was built.

Interviewer: So a 1986 model.

Helen: I was always having to put the fire on because the room wasn't warm enough but with the new boiler I've put it on twice in two years.

In fact, Melanie could also comment, due to moving twice in the last year "Certainly I'm aware that a condensing boiler would pay its way because we had one in our old house and the bills were much more favourable... We had about five extra radiators put in, and I'd just had a baby and I was at home the whole time, the bills went down fractionally... It clearly saved us loads." There was more, however: "After moving out of our [old] house … we moved into some rented accommodation. It was … not at all insulated and the boiler was very old. For the five months over the winter the gas bill was nearly £1000. It was extremely expensive".

Cathy asked about checking boiler efficiencies:

Cathy : What about the efficiency of the boiler, can you get that checked?

Interviewer: … online, at SEDBUK.

When SEDBUK was mentioned to June, she revealed that when her household's oil boiler is serviced, they are given an efficiency figure: "I think it's not too inefficient. We get a reading, every time we have it serviced, of its efficiency rate and how much of whatever emissions it's emitting… I don't think I've still got it. But it didn't strike as horrific when I read it, had it been [as low as] 60% or something." SEDBUK was also mentioned to one other interviewed household, Alfred and Evelyn.

Leonard gave indications that, in his mind at least, investment in energy efficiency is not seen as exciting. "You see there's only a certain amount of money you are prepared to spend on a property. I've just spent a great deal of money on the kitchen - several thousand pounds. I've had the external guttering and fascias plasticized. I'm thinking of when I sell it, I'd better get it right…I'm not quite sure about this new document that we're supposed to produce when we sell the property… So you've got to state what you've got, which is fair enough in a way. But there are cost implications to it."

In summary, some interviewees had very considerable reluctance to invest in heating improvements, despite high bills and low comfort. Meanwhile those who had installed a new boiler recognised that they were rewarded with lower bills.

8.4.6 Loft and roof insulation

In this section, loft and roof insulation is examined, along with some issues relating to non standard house designs (such as multi-foil insulations).

There was no household that had no loft insulation. Seven households had 100 mm of mineral wool although one, Leonard's, used a non standard material, polystyrene slabs, for which the insulatory properties were unknown but assumed to be at least the equivalent. Another had patchy coverage and three had partial boarding. Helen described her experiences with trying to get a grant to increase the insulation from 100 mm, as she had quite a lot of possessions in her loft:

Helen: The prices they quote are all to do with coming in, rolling the stuff out and going away again.

Interviewer: And they said they weren't willing to roll it over the top of the boarding you've got?

Helen: They just said that everything that's in there would have to be removed.

Helen considered raised boarding in her loft. "In order to put the flooring back over ten inches of loft insulation... I'd have to have extra beams so I could put the flooring back. So it would all be an awful lot of work".

Five households had 200 mm of insulation, although one of them also used non standard materials, in the form of insulatory granules. The depth was uncertain in a couple of these cases. 100 mm is easy to recognise because it will fill the gaps above ceilings and between joists, as the joists are approximately 100 mm deep. 200 mm is far less recognisable as rolls which are either 100 mm or 170 mm (or possibly 150 mm) deep could have been rolled out over the joists, obscuring them (it is usually done at right angles to the joists).

The remaining three households had 250 mm or 270 mm of insulation, and one of those was in a newly built home. Only one interviewee, Melanie, expressed awareness of this being the recommended depth of insulation, and this was because she had just moved home:

Melanie: We've got some loft insulation but not the full 27 cm.

Interviewer: Where did you here about the 27 cm?

Melanie: In the surveyor's report.

Interviewer: So this wasn't the Energy Performance Certificate?

Melanie: No it was the bog standard survey. What he didn't mention was whether we had cavity walls and CWI.

Two interviewees (both with professional interest in building matters but not specifically in energy or insulation) brought up the subject of multi-foil insulations without being prompted. Alfred was the first: "on a roll, you staple it to the underside of the rafters

and it does the same job as 90 mm of Celotex… there were 26 different surfaces for [the heat] to go through... with Celotex, he'd have had to cut it down with a saw because you can't buy it to fit, it would have taken him three or four days but it took him two hours. And that met the new regulations for having a room in a roof."

Meanwhile Leonard had kept a sample for the interviewer to look at. "If you put your hand on that. The heat from your hand isn't going through the material… for under-floor insulation".

Three interviewees lived in homes which were of a non standard roof design, where it would be necessary to install insulation against a dwarf wall or immediately under the roof in order to insulate the home's envelope. Two of these were dormer bungalows (or chalet bungalows), where the upper storey is in the roof-space, and a third interviewee lived in a new three-storey property where the top storey was 'in the roof'. Pete's home was built in the 1920s and the roof space overhangs the ground floor floor-plan. He had concerns about insulation. "Because of the deep roof and the drop is going down the sides of the bedrooms, there it's not insulated. I've been reticent to stuff anything down because that would affect the airflow. Rather than me trying to invent something, sooner or later I'd like to get some expert advice on the best way to insulate this house because it's an unusual style."

Janet too:

Janet:	If you go into the … the loft space above the kitchen… The floor's definitely done, but … there's just this black, like canvas. Is that where the tiles are?
Interviewer:	… So you've got nothing insulating the bedroom wall from that triangular space?
Janet:	No. That would be something, wouldn't it?
Interviewer:	You mentioned the temperature upstairs in summer. That's usually a sign that it could be better insulated... You could use [mineral wool], hang it on something so it insulates the walls into the bedroom.
Janet:	We could do that all along the landing...
Interviewer:	There's also these foil insulation products.

Janet: I've seen them, they look like silver-foil, don't they?

In summary, there are plenty of opportunities to increase loft insulation levels in homes. However some homes are of non-standard roof design, and owners are unsure how to insulate them.

8.4.7 Wall insulation

Of the thirteen interviewed households with cavity walls, eight knew they had cavity wall insulation (CWI), three knew they did not have cavity wall insulation, and two were unsure (of which one home was judged by the interviewer to have CWI, and one was not). Two households could give feedback on the effect of CWI being installed, and in both cases this was positive - reduced bills and greater warmth. Ironically, one of these was the partner of Leonard, who was one of two householders (the other being Philip) who referred to damp allegedly caused by CWI. Both these interviewees backtracked somewhat from this claim.

8.4.8 Standby

Thirteen interviewees discussed standby issues. Four households did not leave electronic equipment on standby. Another three switched most things off, with a few exceptions, these being satellite and cable TV systems. Three more households had started or were trying to not leave equipment on standby. Three households did not concern themselves with standby, with Carol even thinking that standby was energy saving. Two households selected washing machines for purchase on the basis that they did not have permanent clock displays.

8.4.9 Reducing consumption and switching off

Nine of the fifteen interviewed households discussed reducing consumption, such as turning down heating, to save energy, while six discussed switching off. There were three households in the overlap between these, giving a total of twelve commenting on these issues. Four households mentioned behavioural measures when asked which household energy saving measures are the most effective (in other cases interviewees answered this question by mentioning investment measures such as installing insulation or an efficient boiler). Three of the four were reduction behaviours - turning

down the heating thermostat - and one response concerned itself with switching off (although not specifically heating).

During other stages of the interview, four more interviewees talked about turning down their heating, including two where the heating was regularly turned down and then back up again because the home became too cool, suggesting that the limit of lowering the temperature was being reached. Leonard talked about turning the heating off rather than turning it down but stated he was aware that he needed to be careful at his age. There was no assurance that those who answered the 'most effective measure' question were actually carrying out the action, whereas those who spoke of turning down their heating at other stages of the interview appeared to be doing it.

Four households talked about switching lights off. Only one interviewee talked about blatant wastage. This was Rosemary complaining that her husband would not stop over-filling the kettle. Alfred and Evelyn mentioned how they had 'tutored' their son's student housemates to switching electronic equipment off to save money.

8.5 Transport

This section covers transport. It has sub-sections which address the results for car use (including motorbikes and vans), local public transport (mainly buses), flying, rail (and coach) and cycling. There is also a sub-section on land use (spatial planning), as this is strongly influential on commuting behaviour.

8.5.1 Cars, motorbikes and vans

Interviewees showed little interest in, or had little opportunity to exploit, the suggested measures to reduce carbon emissions from car use, such as eco-driving and avoiding the use of air conditioning in their cars. However they commented on a wide range of issues within the subject of private road transport, although one issue came up more than others, these being long commutes. There was also a couple of interesting comments about caravans and four-wheel drive vehicles.

Interviewees in eight households spoke of current or recent long commutes by car. Cathy said "I'm only ten minutes from work. When I think of other people, who say work in Nottingham from here, they must use far more energy." However she revealed

that she leaves the office at lunchtimes, and often comes home. There was more: "My husband … worked in Nottingham so it could have been more...". Lynne revealed that she drove "50 miles a day, a tank of diesel a week" - emissions from car use of over 6.5 tonnes p.a. Asked if some of it was business travel: "All personal, … 25 miles… A lot of people travel a lot further than me, from Leicester." June's husband often worked for long periods abroad. "He probably drives less now than he did when he was in Lincolnshire, every day, 16 miles [each way]." Melanie revealed that her husband commuted 350 miles a week and stated, "Lots of people can't actually work locally to where they live... One of the reasons we moved… despite the fact it was nearer to my husband's work, the schools were appalling, so it was going either the private school route or moving to an area where we were happy to send the kids to school." Janet revealed that both her and her husband separately commuted to Nottingham, a distance of 15 miles. Philip had driven 20,000 miles a year before he recently retired, and Rosemary's husband drove to Lincoln every day to work.

Marion talked about a friend's journey to work.

Marion:	I've a friend who commutes to Leicester every day…
Interviewer:	About 300 miles a week [snip] for ease 15,000 miles a year, assuming a medium sized car, that would be 5.2 tonnes.
Marion:	Blimey.

Marion then wondered if it could happen to herself or her partner John:

Marion:	It assumes we both maintain our jobs within cycling distance. As soon as one of does what [my friend] does and all of a sudden it's blown.
Interviewer:	So that's a transport change.
Marion:	You could take the train, I guess.
Interviewer:	You might move.
Marion:	But if one person is in one place and one in another.
Interviewer:	Yes this is the -
Marion:	We bought here because we both work [here].

Susan spoke about her neighbours: "There is hardly anybody who works in Mansfield. You might find the odd one… people on this estate, have to drive to work. They either work in Nottingham, Northamptonshire, working down south." She herself did around fifty miles a day to drop off or pick up her children and to get to and from work. Susan's husband, also Dave and Carol (both from the same household), were all effectively self-employed and did high business mileage compared to their personal mileage. The business mileage was excluded from the household carbon footprint calculations even though it might be argued that some of this mileage was commuting.

Two people commented upon the linking between caravanning and four wheel drive vehicles. Helen commented in passing: "My son in law for instance, he'll fly where he want to go, he'll drive his four wheel drive where he wants to go. OK it costs more in tax and fuel. 'It's convenient for me, for pulling my caravan, for taking the kids places'." Melanie, however, made some very detailed comments.

Melanie:	The last few years we've flown. However we've bought a caravan. But of the course the trade off is that you drive. But of course amongst caravanners, the four by four [is popular but] they're really slammed. You'll holiday at home … but you're slammed by the [four by four] taxes.
Interviewer:	I'd not thought of a choice between flying and a four by four.
Melanie:	On the caravan forums, they're saying the government says don't fly. Holiday at home, it's good for our economy, industry. And so there is a big resurgence in caravanning, lots more caravans being sold. But it's really helpful to have a four by four … It's to do with torque. With our estate car, we got our caravan stuck... It's only because we've got a little motor-mover within the caravan that we could get off the campsite... A slight incline and a bit of mud, you know, you need a four by four. On the caravan forums, there's a lot of irritation... But actually, caravanning, increasingly… you need the weight, the torque… It's all to do with the weight of your car compared to the caravan, the long caravans with all mod cons are actually significantly heavier than older caravans, so you've got to have a heavier car... Also you've

> got to think there's five of us, so five bikes, and stuff for a fortnight.

In summary, long commutes were common in the interviewed households. There are hints that the popularity of caravanning may be encouraging the purchase of large cars, especially four wheel drives.

8.5.2 Local public transport

Although not explicitly part of the footprinting process, and having only a brief mention in the interview tool (list of questions), public transport was raised extensively, presumably because reducing car use inevitably leads to the subject of buses and other local transport solutions.

Several interviewees talked about the cost of local public transport, and those who benefit from free passes. Jacquie had lived in a city in France and offered this, amongst many other observations of public transport : "Improve it, and in particular… the expense of getting on a bus… because it costs £1.40… into the city centre. If there's two of us it's cheaper to drive and pay for a car park." Evelyn complained that "it's very expensive. But we have got our passes now." Jim had also retired: "I use a bus pass which is free… I notice that since [pensioners] had a free bus pass, there's more people using the public transport. If they could get to the working population and encourage them to use the buses more." Tom had attended college in Lincoln and had spotted what he thought was a bargain: "I think these passes they have in Lincoln, City Rider, £7 for a week, are a good idea." Even Leonard, owner of a prestigious car, when asked about public transport, said "I do use it. I've got a bus pass."

Some interviewees talked about having better public transport. The following quotes show that they want greater bus frequencies, better quality bus vehicles or simply a better form of transport altogether.

Jim said of making buses "a little more comfortable… Get people onto the buses." Philip commented on his attempted trip to work by bus "I thought the [time might] be an opportunity to sit and read. Well, my goodness, the noise, the bus was clapped out." Tom complained: "Look at the diesel fumes they give out. If they looked a bit

better. The Pathfinder ones from Nottingham, they look good. But some of the double-deckers… are not attractive."

On the subject of frequencies, Tom mentioned that "buses in Lincoln are every fifteen minutes. If you have to wait a long time it puts you off." Lynne, who disliked buses, used to live in Toton in Nottingham, very near to where the interviewer had more recently lived:

Interviewer:	The corridor out to Long Eaton was completely altered... It's a turn up and go service where you don't need to look at a timetable… now you can go to the bus stop and see one bus just left and another one coming. Would that sort of service be good?
Lynne:	Yes… similar to what you'd get with a tram service, you just get on.

John and Marion, living in Greater Nottingham, had the benefit of services that others lacked:

Interviewer:	How do you find using public transport? I know you cycle because you work close by.
John:	I find the public transport fine, got no problems with that.
Marion:	We've moved... Any bus from the south of the county went past the end of our road, almost. Fine, great. Here it's fewer but we can walk [to catch more].

Unprompted, some interviewees mentioned the Nottingham tram. Jim said "The trams in Nottingham are a brilliant success. 3 pm and they're full." Lynne spoke of the park and ride for "the tram, to take you into [Nottingham] and back, I thought that was very good." Susan commented on the experiences of her former colleagues: "Yeah, used to work there. They've got the tram... transport was never a problem there."

There was a perceived urban versus rural split on public transport. Rosemary seemed to have fond memories: "Different when I lived in Nottingham." Susan was direct: "The further you get away from a city, the worse it becomes." Dave cited a couple of examples of how much better city transport was: "My mother lives... just outside

Derby… it has a good service, every 20 minutes… straight in, doesn't go round all the villages." And then: "We went to Manchester… a concert, stayed up there. We got the bus from Gorton into the Apollo Theatre. There must have been one at least, I'd say, every five minutes… fantastic service. Same coming back." But of home: "It's fine in the cities isn't it, but when you come out to the sticks, places like Newark… I hardly ever use them."

The urban versus rural split is difficult to distinguish from the issue of radial routes (those going to the city centre) versus orbital routes (those not going into a major centre). Jacqui gave the view from within Greater Nottingham: "The transport systems all link into the centre of Nottingham, so if you are travelling from one suburb to another suburb, it's very difficult… Obviously that's where the majority are going but I still think it was a bit daft that I had to go into the centre to get out again." Philip gave the view from a village, and told this story: "One day I thought I'd see what it was like getting public transport to work in Newark, well what a disaster! …To do a twenty minute journey it took about an hour and a half. I think the driver was fairly impolite - she couldn't understand why anybody like me was on the bus when I should be using my car… In Newark, [my work was] about half a mile from the bus. You can walk for your health but it's not so good for time and convenience... But you walk down to the village and you can get a very good service into Nottingham."

Jacquie had a potential solution, as she was able to compare transport in a city in France, where she had lived for a while, with the situation in Nottinghamshire.

Jacquie:	When I was in France last year they … had trams there and buses as well. They had ticket machines for whilst you were waiting.
Interviewer:	Did those tickets take you on one journey or were you able to transfer?
Jacquie:	You could get different ones. They would last an hour or one and a half hours. You could get on as many trams as you could in that time and after that it refused you at the machine.

In summary, free public transport is used more, with the hint that cheaper public transport might be more attractive. Interviewees wanted better buses, and liked trams. There is a split between those making radial journeys in cities, and those making orbital journeys or rural trips, with the former having more positive experiences of public transport use than the latter.

8.5.3 Flying

Six interviewees said that they and their households did not fly, these being Jim, Rosemary (and Tom), Cathy, Lynne, June, Janet (and Nick). In all cases it appeared no-one in the household flew, although June's husband flew on business.

Amongst those that did fly, three - Helen, Leonard and Philip - were recent retirees, living alone, who had done a lot of flying, presumably because they had the time while also having sufficient health. One household, Janet and Nick's, had stopped flying because they had started a family, whereas another, Alfred and Evelyn's, had started flying only after their children had grown up. Two households, Susan's, and Dave and Carol's, took annual package holidays, with their children included. Pete's household were reluctant flyers, taking occasional short flights to the near continent, but preferring to go by car. Melanie's household had bought a caravan and planned to go on fewer holidays as a family although the adults were planning a plane trip to Germany to visit a relation.

One household, Marion and John's, flew extensively and being strongly environmentally minded, had tried to find alternative ways of reaching their destinations, or to select alternative destinations altogether. The account here does not take account of the fact that Andy also flew on business. Some of their personal flying was to go skiing in Alpine resorts, presenting an opportunity to go by surface transport with its lower carbon footprint. Said Marion: "With France, skiing, we looked into driving and looked at the trains, and it just couldn't be justified, we felt, in terms of time and money. The French - Italian border... a group of ten of us drew up the options… it was going to take us an extra half day and… cost us twice as much to not fly. As a group we have to be motivated enough." On a more positive note: "We went to Dublin and although we could have flown from East Midlands for about £30 each. We drove to the ferry, which cost us three or four times that price. We have made some changes…" Unfortunately, an other skiing opportunity was perhaps just a bit too far: "[We] flew to

Turin to go skiing." They persevered, though: "We looked at cycling in Brittany, and … looked at driving and taking a ferry and it worked at about £400. When the flight was £50 or £60 each. And we looked at the train and it again was a fortune."

The government was implicitly and explicitly criticised for policies on flying. Marion summarised the general situation thus: "The economics would force you to change the way you behave. As it is, it's very hard to resist, £30 flights". Cathy put it this way: "You know they talk about putting tax on plane fuel, which I think they should do. It's ridiculous that you can fly to another country for £30. People say it's stopping the poor from doing what the rich do. It's ridiculous, the rich are always going to do more than the poor can. It just doesn't make any sense… There should definitely be a tax on that fuel". Philip complained about "You see the government is strange, look at the tremendous expansion of flying. New runways… encouraging people to fly more and more, cheap flights, and it goes on and on and on. We presume it's a big source of use of fuel and carbon contamination".

Marion and John, like all the other interviewees questioned, had not heard of the climate change multiplier effect of aircraft. The exception was Helen, who had just learnt about it. Philip had a friend who thought flying had a lesser effect than other emissions, due to them being high in the atmosphere.

In summary, a main finding here was the implication by some interviewees that the government is giving mixed messages about discouraging flying.

8.5.4 Use of rail and coach

In the context that the previous section covered flying, and touched on finding alternatives to it, this section is dominated by examining issues around international rail travel to near continental destinations. No other issues came up so strongly regarding rail and coach travel (only Helen commented upon coach services, and her observations related to one journey made some years previously). Note the interviews took place immediately before the passenger rail operating franchises serving Nottinghamshire were re-structured and re-awarded, and before London Saint Pancras International was opened as the terminus for Eurostar trains, and not long before National Rail's efforts to simplifying ticketing across all rail companies.

Helen had travelled to southern France by train, and revealed, that being restricted by health issues, carrying luggage is very challenging:

Helen:	Well if I wasn't flying to France I might drive there.
Interviewer:	Have you thought about going on a train?
Helen:	I have done. The older I get the less I want to do it. Flying you get rid of your suitcases as soon as you get to the airport and you don't have to worry about it again. I've been to my friends' by train … in the southwest. North of Bordeaux … I had a lift from here to Newark. Had to carry my suitcase over the bridge onto the train… Had to carry my suitcase from Kings Cross to the taxi. Out of the taxi into Waterloo. Hump it into the train, find somewhere to put it ... Eurostar to Lille then Charles de Gaul, hump the case off, hump it back on again... Since the Madrid bombing the French railways have removed their luggage compartments... So the luggage is everywhere in the aisles, under seats, under people's feet. I find it very difficult to put luggage overhead. And the French aren't good at disabled access, so [there are] very few lifts. If you are disabled you have to let them know in advance, to get you up and down the steps and things... I will never do that again. I was bruised and battered... If you fly you don't have to think about it.
Interviewer:	If you get more than one flight it gets transferred through?
Helen:	Yes, all you have to do is lift it onto the thing and take it from the carousel at the end... I've used Eurostar a few times to go to Bruges and Brussels and that was absolutely fine because you get off the train into your taxi or whatever and you just do it once at each end. But just heaving it on or off trains - I don't like it.
Interviewer:	Will it make any difference when the Eurostar terminal is at Saint Pancras from November?
Helen:	Yes…
Interviewer:	It sounds like [the railways] could do with a luggage check-in facility…
Helen:	That would also make a difference to security, wouldn't it?

Interviewer: Yes, because it would be like an aircraft then.

Helen: If luggage was scanned on its way to train but they would need space and people and hours of check in and the costs for that would go up so it's not easy.

Interviewer: Couldn't you send luggage in advance in the old days?

Helen: Yes you could, you could send it off a week in advance and it would be there.

Interviewer: So may be if people are to travel by train rather than aircraft, these things need to be taken into account…

There was also the issue that the French railway network does not go close to her final destination, with the journey also being longer and more expensive:

Interviewer: How do you get the airport when you fly, do you have to travel a long way to get to the airport?

Helen: I tend to fly from East Midlands or Birmingham if I can. I have a taxi or my daughter takes me... Going from Gatwick… [a relation] lives in Sussex so I drive down there, leave the car at her house.

Interviewer: So quite a lot of the journey … is actually car…

Helen: In France the train doesn't go anywhere near where I want to... Either way my friends drive for about an hour to pick me up. The TGV isn't too bad speed wise and that gets you to Poitier, but there aren't any local trains in the area where they live, so I'm afraid I'm going to fly. … I left here at 5 am and was in their house by 10.30 [am].

Interviewer: How long did it take by train.

Helen: All day.

Interviewer: And how did the ticket price compare?

Helen: It was more expensive on the train.

Although the RedHENS research involved calculating the interviewees carbon footprints, and draws attention to measures which should all reduce carbon emissions to a lesser or greater extent, it is not always obvious to them which method of transport has the least carbon footprint. The exclusion of rail travel from the footprint calculation

should have given Philip a clue, but nevertheless he was momentarily confused about an international journey:

> Interviewer: Is there any way you would change the way you travel, say to France?
>
> Philip: … I've done it by TGV, I've flown and I've driven. Which is the least contaminating? Flying, no the train probably.

Helen and Philip, both of whom were competent speakers of French, did not reveal how they had booked their journeys, and nor did June, whose young son had recently made a Eurostar journey. However the conversation with John and Marion revealed some problems, potentially explaining why they had apparently never succeeded in making an international rail journey from the UK. Neither of them had heard of the award-winning informational website 'The Man at Seat Sixty One' (The Man at Seat Sixty-One 2008b). Marion complained about the ski train "Where's it going to go, is it near where I want to be? I can't figure that out on a map, it's not clear where it'll end up". She revealed that they had used the French railways' (SNCF's) website when investigating a potential rail journey to the Alps but had not considered using German Railways' (Die Bahn's) website for travel enquiring on or booking between destinations in the UK and France. It covers most of Europe and shows detailed maps of individual journeys. Nor had they used the services of a specialist travel agent, such as Ffestiniog Travel. Furthermore, some of the issues raised would have been covered by a good quality guidebook. It may have been that ultimately John and Marion were not particularly committed to cutting down their flying, as they had made a total of fourteen flights in the last year, however they made an interesting point about information services allowing for overnight breaks in journeys.

> Marion: You want something that will tell you what the options are, the cheapest options... For the whole journey, you don't want to be faffing around to find the cheapest one for … Nottingham [to London]... Then how much it costs to get to Paris. Then what time are we getting in, will we have to pay for a hotel overnight in Paris? And then going onwards from Paris... You need something that will do your whole package for you… It could ask you 'Are you prepared to stay overnight?' And if you say 'Yes', it

could say 'Well you can get this [train], then this [train] the following day.' … You might decide it would be cost effective … to stay overnight somewhere. So you don't want to rule out all journeys that [don't] go on the same day ... For a £35 hotel … you [might] knock £80 off your train ticket, and have a night in Paris.

Interviewer: Right so that kind of thing might help to encourage you not to go by air?

Marion: I think it would make it a lot easier.

Interestingly, Marion and John had related views on the domestic rail ticketing system, complaining that websites like TheTrainline.com do not explore the cheaper options by splitting longer distance journeys into components, the total cost of which can be cheaper than a ticket for the complete journey.

In summary, there is a variety of barriers to use of rail to travel to the near continent.

8.5.5 Cycling

Of four recent retirees, two, Helen and Leonard, could not cycle for health reasons (hip problems affected both). Philip was a cycling enthusiast, while Evelyn said that she and Alfred were 'too old for bikes'.

Melanie described the situation in her small town and beyond "If you live rurally, you're children can't cycle. They can within [this town]. But [outside the town] you can't let them cycle because the roads are all 60 [mph] and even if they were 50 or 40, the roads are too dangerous. There's not the width, they're too winding, the are no safe places for overtaking." However Janet said that even on the very straight A46, the former Roman road known as the Fosse Way, adults fear to cycle, as it is a single carriageway trunk road. In Greater Nottingham, Marion and John both cycled to work.

8.5.6 Land use

Two interviewees spoke about land use issues - spatial planning, etc. Lynne had recently been in Germany and remarked on how businesses and residences there were mixed together. Regarding the UK, she talked about her own employer's new

green-field site, and generally about companies opening premises in edge of town locations: "They're using up green land, why not use brown field sites in the city centre? … It's not accessible for commuting. They get permission for businesses where people can't get to. The logic in that!"

Susan's mentioned that her workplace was "literally on the motorway junction". It prompted this exchange:

Interviewer:	Is there any housing near that place?
Susan:	No, apart from Annesley Woodhouse, the village.
Interviewer:	So they've built a place -
Susan:	Massive, massive.
Interviewer:	There's not enough housing around even if people wanted to live within walking distance.
Susan:	Yeah, yeah.

Lynne made further comments when given the opportunity:

Interviewer:	Any further comments about development, the German model?
Lynne:	I think things should be kept close together. I think it would take quite a lot for us to turn things round, the way things have developed. I don't like the way all these green fields site have been developed. We're totally disorganised, we've used green field sites for businesses, then there's green field sites popped up that are used for houses, a long distance away. It's all disjointed, isn't it?
Interviewer:	So you think that's something that needs to change?
Lynne:	Yes.
Interviewer:	I suppose that might mean where they've put some industrial stuff that they put in some houses and vice versa.
Lynne:	I don't know how you would change it back. All the villages round here were pit villages, all the houses built up around the mines. Instead of replacing the jobs in the villages, such as Bilsthorpe, replacing the infrastructure there, everybody's got jobs elsewhere, they all commute.

Interviewer: I've often thought that once you change jobs, you've got a challenge. When you change to a better job, it always seems to be further away, and if you don't want to move…

Lynne: Yes, you've got to move around. The types of jobs. The previous company went through a series of takeovers. The one I work for now, it's the eighth one, every couple of years it changes over. We're probably lucky because it's a nice site. Another company, the people from there have to be moved to our site. It's the way of life, private industry, causing people to move around the whole time.

Interviewer: Do you think companies should penalised for it, or dis-incentivised?

Lynne: Yeah, but I don't know how it would work.

Interviewer: I suppose you could add up all the distances that people travel to work and tax the company.

Lynne: A commuting tax not shoved back on the employees, it's on the company.

The above exchange fits with the long commutes by car discussed by Lynne and others in section 8.5.1 'Cars, motorbikes and vans'.

8.6 Knowledge and information

8.6.1 Knowledge of carbon savings

The most consistent subject to come up under the heading of Carbon and Energy Knowledge was about the most effective energy efficiency measures for homes, which was prompted by the specific question on the subject (and further prompting to ascertain interviewees' second and third answers, etc.). Thirteen households answered the question, giving between one and three measures. Answers considered correct were a heating improvements, loft insulation, cavity wall insulation or compact fluorescent lightbulbs, using the quantitative results from this stage of the research (see section 7.3.2). Seven managed to get the answer wrong in one of a variety of ways. Double glazing was mentioned by three households as being among the top two ways of saving energy, and another put it third. Another household said that both loft and wall insulation would not be amongst the top measures for energy savings.

Two households, both headed by tradesmen working in the construction industry, suggested that behaviours (turning down the boiler stat and switching equipment off) would save them more than any installed measure. When one of these, was prompted for physical measures, he got the answer partly 'wrong', specifying floor insulation as one of his responses. Only two mentioned compact fluorescent lightbulbs, only four households mentioned heating improvements, and only four mentioned cavity wall insulation (although one other did mention 'insulation' in general). Seven mentioned loft insulation.

On a related matter, two households (Alfred and Evelyn's, and Philip's) talked about how their servicing engineers (one for oil, one for gas) praised their old boilers but did not mention how inefficient they were. These were the households with the oldest boilers with a couple of exceptions - Melanie's, which she intended to replace as soon as possible, and Jim's, which was the responsibility of the council. This suggests that these engineers may lack knowledge about energy savings, or are fearful of new technology (Alfred and Evelyn have used the same engineer for three decades).

8.6.2 Information sources

Despite extensive discussion about information sources which might help the public reduce their carbon footprints, few usable results emerged, in contrast to the survey. There were discussions of channels for advice and information, including face-to-face, television, the internet, and leaflets accompanying bills from suppliers. Helen summarises it well: "I think we generalise too much ... it's the individual's way of learning things that matters", implying that a range of information channels is appropriate.

8.6.3 Metering and measurement

The use of plug-in electricity meters was discussed with nine people, and many of those were shown the model available from Maplin. One did not give a view, while eight were receptive to the idea of using them, and two of these already owned them (although one of these had been an employee of a gas and electricity supplier). The responses varied from Carol's "Ooh, right!", through Janet's "Wow! That would be

good wouldn't it?", to Pete's "The electricity suppliers should be forced to give away little meters".

8.7 Related environmental issues

Some off-topic discussions came up in the interviews, and recycling dominated this.

8.7.1 Recycling

Thirteen of the fifteen interviewee households mentioned recycling. Twelve of these spoke of the subject in a positive manner, generally explicitly or implicitly communicating that they were active recyclers. The thirteenth, Philip, was very likely also to be a recycler, but his only pronouncement on the subject was a minor criticism of the council putting recycling and other information leaflets on emptied wheelie-bins (tempting residents to throw them in that bin), a sentiment echoed by Susan.

Two of the twelve were more critical. Cathy felt that a lot of recycling efforts ended in materials being shipped abroad, and much of the effort was to make politicians look positive: "I think they are asking you to do something just to make them look good". Dave's general environmental scepticism stemmed from problems he perceived in the recycling of building materials, and from alleged plans to charge for domestic waste disposal.

8.7.2 Renewable energy

Ten of the fifteen interviewed households discussed renewable energy, seven of these mentioning generation on the macro scale and eight mentioning micro-generation. Of the seven discussing macro generation issues (i.e. energy generation outside the home), four mentioned local plans for wind turbines (including one who did not want to have that part of the conversation recorded). Amongst the eight mentioning micro-generation (i.e. generation within the home), two burned wood in their own home (both had no gas supply), one had done it in the past and would like to do so again, another aspired to have a log burner possibly for aesthetic reasons, and one had friends in a household in rural France which burned wood.

8.7.3 Food and local purchasing

Despite the popularity of the term ‘food miles’, the only common theme raised under this heading was that two interviewees preferred not to use supermarket delivery services, which might reduce their car trips, because they preferred to choose fruit and vegetables themselves.

8.8 Social issues

This section is effectively a ‘catch-all’ for subjects, which although related to carbon emissions by households, are not classifiable as environmental subjects.

8.8.1 International issues

There were limited discussion of international issues. Emissions from China were mentioned five times (although in one case it was about other countries effectively exporting their emissions to China by buying Chinese made goods), and from the USA three times.

8.8.2 Business and economic growth

The subject of business received a fair amount of attention but few themes emerged. Four interviewees felt that pressure should be brought to bear on business to reduce its emissions rather than on individuals, while only one, June, argued for personal responsibility instead. Interviewees from three households (June, John and Susan) talked of their employers exercising some kind of policy to protect the environment, whereas Janet complained that the NHS wastes by over-heating hospitals. Only two interviewees referred to the embodied energy in products. Five referred to consumerism but only two of these said that they believed the economy was dependent upon such consumerism. Jacquie was the only interviewee in a private rented situation and she highlighted the responsibilities of the occupant and landlord.

8.8.3 Media

Eleven interviewed households mentioned media outlets in connection with climate change, energy efficiency or related environmental issues. Television was mentioned by nine interviewees, often more than once by each interviewee. Newspapers were mentioned three times and radio twice (both times it was BBC Radio 2). Radio was the

only medium to prompt an action, which was to start recording daily meter reading (although this did not last for long).

8.9 Financial issues

8.9.1 Money versus carbon savings

Twelve of the fifteen interviewees made reference to monetary savings when carbon savings were being discussed. Comments included Pete "At the end of the day most people will ask 'What's in it for me?'" and Helen: "There is a hope is you are using less you won't pay so much." Philip made the very explicit point "The average citizen - and I'm one - doesn't think in terms of carbon, they think in terms of expenditure." June's was not dissimilar: "I think financial incentives are the best way to reduce people's carbon footprints. If they'll save they're more likely to do it." Rosemary's son Tom even gave a specific example of information provision: "When they sell these things [they should say] 'If you've got a boiler which was made between these years, then this could save you on average say £200 a year'."

Melanie, when told of a way of removing half a tonne from the household footprint asked "How does that relate to money?". Janet talked of the problems with the available information: "Even things like light-bulbs, people are not always aware, that they're going to save money." Meanwhile, Marion, when the subject of climate change sceptics doing things that protect the environment, offered this explanation: "I suppose it saves them cash."

The other three interviewed households did not make comments which suggested that they did not understand that saving carbon (from the home at least) also saved money. They seemed to accept it as fact, and it is simply the case that the point wasn't explicitly made.

8.9.2 Grants

Seven interviewees commented upon energy efficiency grants and subsidies. Five of them felt that grants were not flexible enough. Helen had been prevented from having extra loft insulation, as she would have had to clear her loft first while Melanie had been turned down because she already had some poor quality insulation. Lynne was

interested in a ground source heat pump and any possible subsidies for that, and complained that subsidies for self install of loft insulation were not available. Melanie felt that the whole process of finding grants was ‘faffy’ including a lack of helpful links from the council’s website list to the organisations giving the grants. Nick and Janet were disappointed that thin film insulation, potentially useful in their dormer bungalow, could not be supplied under a grant system. June had found it difficult to find for solar grants but had not picked up on the fact that she might better spend her money on better heating controls, or even a new boiler.

8.10 Summary of interview results

Interviewees in two fifths of households referred to natural causes of climate change. No interviewees talked about future climate projections, although some prevailed upon past weather events.

Regarding footprinting, where interviewees have any expectation or perception about the size of their footprint, it was higher than expected. Comparison with an average footprint was more useful than trying to visualise an actual amount of carbon dioxide. Identifying the component parts of the household footprint promoted conversation but insufficient attention was paid by interviewees to major parts, namely emissions caused by heating, car use and airline use. The financial savings from measures to reduce a footprint were of interest to interviewees. Where it was discussed, there was support for the idea that all households should have a carbon footprint produced for them. Gas and electricity suppliers seemingly had poor reputations amongst the interviewees, perhaps presenting a barrier to the concept that suppliers could generate household footprints.

On personal carbon allowances, the idea of being able to buy units under the proposed system of PCAs was one that interviewees tended to struggle with. There was a variety of interviewees opposed to PCAs, citing concerns including bureaucracy and the vulnerable. Moderate support for PCAs (often combined with expressions of specific concerns) predominated over strong support. Distrust was on the whole not a major issue. There were a number of comments about class issues, with the rich and the poor being commented upon. According to the footprint calculations, those living alone, and lone parents (if only adults received allowances) were more likely to be at a disadvantage under a system of PCAs.

Regarding lighting, there was a lack of awareness of the range of compact flourescent lightbulbs, about how to select the correct power CFL and about the savings that they can bring. There was widespread use of halogen and incandescent spotlights amongst the interviewees. There are huge opportunities for carbon and financial savings by installing CFLs, but the benefits may be hard to quantify when the number of lightbulbs (per household) is taken into account.

On electricity use, nearly half of the interviewed households had extra ‘cold’ devices (beyond one fridge-freezer or one fridge and one freezer). The majority of those discussing home computers lacked awareness of how much they contribute to the household’s carbon footprint, often appearing to over-estimate their impact. There was strong awareness of standby issues.

Some interviewees were very reluctant to invest in heating improvements, despite high bills and low comfort, whereas those who had installed a new boiler recognised that they were rewarded with lower bills.

Regarding insulation, there were plenty of opportunities to increase loft insulation levels in homes. However some homes are of non-standard roof design, and owners are unsure how to insulate them. If the findings from the interviewing were reflected across the country, between 20 and 40% of homes that have cavity walls need their cavities insulating. The barriers were lack of awareness as to whether insulation is already installed, and misinformation about alleged problems with cavity wall insulation.

On behaviours, most of the interviewees discussed reducing consumption and switching off, and a third of them cited a behavioural measure (usually ones within the home) as one of the major ways to reduce carbon emissions.

On transport, long commutes were common in the interviewed households. The cost of public transport was an important issue. Some interviewees felt that the government is giving mixed messages about flying.

On knowledge, the level of awareness about the top carbon reducing measures for homes could be better. No single information source or channel for home energy

efficiency information proved significantly more popular than any other, although as regards awareness, television was mentioned by more than half of the interviewed households. The concept of a plug-in meter was received well.

Regarding issues not featuring in the questions, these were generally related environmental subjects. Recycling was an unprompted issue which was raised by most of the interviewees. Two thirds of interviewed households mentioned renewable energy, predominantly wind for macro level generation and wood fuel at the household level.

The majority of interviewed households commented on the importance of emphasising financial savings made when saving carbon. There was low awareness about grants and those who were aware tended to be critical about limitations of the system.

The next chapter discusses many of the above results, along with results from previous chapters.

9 Discussion

This chapter reviews the results from the interviews and, as appropriate, the surveys. Where possible, related research is compared. Due to the predominantly qualitative nature of interviewing, some findings need verifying with quantitative research using a larger sample, so such recommendations, along with other research recommendations, also appear here. In this context, it is impossible to discuss research findings without also giving some coverage to potential policy solutions, so some of these will also be found below.

9.1 Interviewees' interest in carbon reducing measures

In the interviews there was a great deal of discussion of (i.e. there was a large number of passages about) themes which could be described as specific carbon reduction measures (e.g. "Loft and roof insulation" and "Boiler Efficiencies"), and services which could benefit from carbon reduction measures (e.g. "Lighting"). Some of this is due to the questions asked by the interviewer but there was willingness on the part of the interviewees to discuss these matters. This enthusiasm provides further insight into the findings of the survey which showed a very high level of interest for home energy efficiency measures in response to a system of personal carbon allowances (see section 5.2.10.1). Including the 28 passages about "Standby" and "Switching off", there are approximately 330 relevant passages discussing issues around specific carbon reducing measures for the home. The number of occurrences of interview passages under "Transport" was also high, approximately two hundred, despite the low emphasis given to transport measures in the footprint calculator. This gives a total of around 530 occurrences of discussion about carbon reduction measures from a total of approximately 1400. These figures suggest that the public are interested in or concerned about individual measures that can reduce their carbon emissions.

The government's work on personal carbon trading (DEFRA 2008a p(v)) indicated low interest amongst the public in behaviour change to reduce carbon footprints. However the way the carbon-reducing measures (such as insulation) are presented to the participants (ibid, Appendix 12) is less interactive, compared to the RedHENS research. This may partially explain why the government's research found a higher level of opposition to personal carbon trading, as participants saw fewer opportunities

to adapt to a system of personal carbon allowances. There is also a lack of clarity in the government's research between continuous behaviours (e.g. switching off lights when leaving a room) and one-off behaviours (e.g. installing insulation). Carbon Neutral Newcastle (2005) found significant numbers of people are already performing actions which involve an upfront financial investment or contribution (installing insulation, buying energy efficient white goods, installing energy efficiency light bulbs) and that the overwhelming majority of North East residents supported such actions as a means of tackling climate change.

It follows that there are many opportunities which should be exploited by government and society to reduce carbon emissions by households whether or not a system of personal carbon allowances is implemented. If a system of PCAs is planned, these carbon-reducing opportunities should be exploited in the run-up to the system's commencement. A planned approach of the run-up would be desirable, and this should help to positively influence acceptance of personal carbon allowances.

The run-up to a system of personal carbon allowances could include an appropriate supplier obligation from 2011 onwards, when the current obligation, CERT, will need replacement. The most appropriate scheme from the options considered would be the 'household sector cap and trade system', which applies a declining cap on total emissions from all homes (Climate Change Capital Ltd 2007: p.29). Gas and electricity (and possibly oil, coal, etc.) suppliers would trade with each other on the basis of whether or not they exceed allocations based upon equal allowances per occupant of customer households (children, as with personal carbon allowances, may have a partial allowance associated with them). Such a system would do much to encourage suppliers to bring about a variety of carbon reduction measures in homes, although it would not address transport emissions.

The RedHENS interviews found that one-off investments (heating, lighting, cavity wall insulation and loft insulation) provided much greater opportunities for carbon savings than the continuous behaviours (e.g. turning off standby). Interviewees showed a patchy level of knowledge of measures which were most effective in reducing carbon emissions from the home. Many of the more informal advice sources, such as those in the media, fail to give adequate attention to the behaviours and measures that will result in the greatest emission savings. Even those in the official sources, as used in

the footprinting spreadsheet (see appendix 12.10) may be diluting the important messages by giving coverage to behaviour change. It follows therefore that advice should concentrate on getting people to do the one-off measures in preference to attempting to influence continuous behaviours (these can be given greater emphasis in later campaigns).

9.2 Financial issues

The RedHENS research found that financial savings matter more to people than carbon savings. There is considerable further evidence that, in addressing their carbon emissions, people are motivated by money (DEFRA 2008a: pp. 14-16, Carbon Neutral Newcastle 2005: pp. 11, 50, 52-56, SDC 2008: p.34, RSA 208: p.7). As long ago as the beginning of the last decade, Hedges (1991: p.81) found that cost was more important to householders than environmental implications.

9.2.1 Grants by suppliers

Respondents were not always aware of grants being given by electricity and gas suppliers, this being confirmed in work by RSA (2008: p.6). It is possible that the giving of grants by suppliers is not fully understood or recognised by the interviewees involved in the RedHENS research for reasons of trust, an issue that has also been identified by the Sustainable Development Commission (SDC 2008: p.37). It may be that potential recipients are suspicious of bill inserts and other marketing approaches by gas and electricity suppliers and that such methods are seen as just an attempt to sell something people do not need, or at a profit. Historically, suppliers were viewed with suspicion on the issue of energy efficiency (Hedges 1991: p.120).

It may alleviate cynicism if suppliers explain why they want their customers to use less gas and electricity, as it seems counter-intuitive (Cragg Ross Dawson 2004: p.10). If it was widely advertised that the suppliers are forced to give grants then people might be more willing to take them up. Further research, preferably quantitative, is required in this area to verify public attitudes. Part of the research might involve the generation of a standardised text which could be quoted in marketing literature, explaining the situation to potential recipients of grants.

9.2.2 Council tax surcharges

Given the lack of willingness to invest, shown by some of the RedHENS interviewees, in expensive measures like new heating systems, and less expensive measures like cavity wall insulation (and even very low cost measures like compact fluorescent lightbulbs), there appears to be justification for a system of council tax penalties and grant incentives regarding the energy efficiency measures that give the biggest carbon emission savings. The measures might be the presence of cavity wall insulation (where appropriate), loft insulation topped up to the recommended level, the presence of CFLs in a proportion of light fittings, and installation of an efficient boiler (if using gas or oil as a fuel) of an age range which would be gradually narrowed (appropriate modern controls would also be required). The funds raised from those who are not willing to make their homes more efficient could be used to subsidise those who are more willing to invest. Only the owners of a property should have to pay a penalty supplement (or surcharge) to council tax, not those renting a property.

Consideration has already been given to the development of schemes like this. Dresner and Ekins (2006) looked at using economic instruments to reduce carbon emissions from households, without penalising the poor. They concluded that the best way was through energy audits and surcharges to council tax and stamp duty for those who do not install cost-effective energy efficiency measures (with grants and loans to help low income households). The Green Alliance (2005) has called for new fiscal incentives to encourage householders to install energy efficiency measures and called upon the Treasury to undertake specific work to look at stamp duty, council tax rebates or other incentives. The Sustainable Development Commission stated that one-off council tax rebates have been effective as a means of encouraging consumers to install cavity wall and loft insulation. They called for all councils to be able to deliver this, and that it should be centrally funded. They also suggested the re-banding of properties in according to their efficiency, so that less efficient homes pay more council tax (SDC 2006).

Of the three measures suggested here for inclusion in a council tax penalty scheme, efficient heating is the most expensive to install, whereas insulation measures can be procured relatively cheaply, even in the ‘able to pay’ sector. Therefore any funds raised would be best directed at subsidising improvements to heating systems.

9.3 Beliefs about climate change

The RedHENS project did not intend to set out to explore understandings of climate change or beliefs about man causing climate change, although there was interest in how these might affect attitudes to footprinting, personal carbon allowances and behaviour change etc. Nevertheless some findings about understanding of climate change did emerge.

The beliefs expressed by some of the interviewees about 'natural' causes of climate change is worth comparing with recent work in the area. Quantitative research showed that 41% of people think climate change is a mixture of both human and natural processes, compared to 46% who think climate change is mainly caused by humans; 9% think it is mainly caused by natural processes (Ipsos MORI 2007: p.7). Yet Poortinga et al (2006: p.13) make no mention of natural causes of climate change, even when interviewees are questioned and offered an open response option. However Poortinga et al's lack of coverage public perception of 'natural' causes of climate change is brought further into question when one considers the work by DEFRA (2008: p.11) which finds that cynical research participants still think of climate change as a natural phenomenon.

Amongst the interviewees, the lack of comment about future projections in relation to climate change, and their prevarication upon the past and present (including confusing the weather and climate), suggests that the public may lack basic knowledge of the issues. Further research is required to establish whether this is the case, and particularly whether the public has a blind spot in its thinking about the future because it is trying too hard to look for evidence of climate change. If the assertion is confirmed by the research, then the government may need to alter its education campaigns about climate change, perhaps to emphasise the basic science.

There was a high level of interest in recycling from the interviewees. It was almost a distraction but could be turned into an opportunity. The recent and rapid success in recycling, brought about by the expansion of doorstep recycling services, could be cited (to the public, and to government and others) as a precedent for achieving similar success regarding household carbon emissions. The challenge will be to identify the initiatives which parallel the establishment of doorstep recycling schemes and bring about major reductions in carbon emissions by households.

Climate change has been widely described as a bigger threat to society than terrorism, including by the Oxford Research Group (2006). In 2004, the United Kingdom government distributed a leaflet to all households about preparation for emergencies such as those posed by terrorism (HM Government 2004). Therefore the government might also consider distributing a booklet to all households about climate change. Rather than merely being motivational, it should also explain the science, including natural climate change issues, past climate patterns, and future climate projections. Taking the lead from the successes of recycling, it would set out how people can contribute to reducing carbon emissions, not least by finding out about their own household's footprint.

9.4 Carbon footprinting

In the RedHENS research, comparison of the interviewees' footprints with an average was inherent in the research design. Other research in the area has found that comparison with a target allowance or to other groups of people, locally, nationally or globally, is a concept that occurs independently to research participants (DfT 2007: pp. 12-13).

Amongst the interviewees, there was enthusiastic conversation about the component parts of the household footprints. The greatest enthusiasm was regarding electricity consumption even though on average this constituted the smallest component, compared to heating (gas, oil or coal), car use and airline use. One response to this bias in interest is to counter it by emphasising, in carbon calculators and other information sources, the relative importance of different footprint components, and how measures would reduce those components. The other might be to exploit the public's enthusiasm by making available easy-to-use plug-in meters (although they do not measure consumption by direct wired equipment like showers, alarms, water heaters and lamps on lighting circuits, which often have higher consumptions than devices that have plugs). The confusion that participants have about different components of a footprint is also reflected in other research (DEFRA 2008a: p. iii).

When specifically discussed, there was explicit support for the idea that all households should have a carbon footprint produced for them. There was also a great deal of indirect evidence that this would be a worthwhile proposal, particularly the extent of

conversations about carbon reducing measures prompted by the footprinting exercise. A larger scale experiment is required to test this hypothesis, perhaps measuring enthusiasm for a set of carbon reducing measures before and after the use of a carbon footprint tool.

The surprise amongst some interviewees about the size of their footprint suggests that there are potential reductions amongst those who feel that they may have nothing to offer (because they feel they are doing the right things already). The extent of such potential might be measured by altering on-line calculators to ask the user to give their perception of their (or their household's) footprint before going on to use the calculation process. New users might be asked whether they think their carbon footprint is higher than or lower than average. These responses can then be compared with the calculated figure.

Financial savings from the measures featured on the carbon footprinting calculation spreadsheet were of great interest to interviewees, to the extent that these were added into the spreadsheet part way through the series of interviews, allowing interviewees to learn the total financial gains they would make if implementing the measures, i.e. the value of saved carbon units plus the savings on their fuel spend. Facilities such as the Energy Saving Trust 'Home Energy Check' or HEC (EST 2008b) and its Energy Saving Checklist (EST 2008c) do show financial savings as well as carbon savings. In fact people are pessimistic about the public engaging with carbon calculators for purely environmental reasons, citing the need for incentives (DfT 2007: p.32). Therefore it is recommended that the Act On CO2 calculator (EST 2008a) be updated to include financial savings.

The findings of the RedHENS project, as regards interviewees' energy knowledge and their awareness of the top three measures to reduce carbon emissions from the home, also highlight a difference between Act On CO2 and the other two information sources. Act On CO2 does not, no matter what sort of home data are entered, recommend the user to install an updated boiler or improved heating system. This omission, which may be a design or software error, needs rectifying.

9.4.1 Gas and electricity suppliers

Electricity suppliers are well placed to facilitate the production of household carbon footprints for everyone in the country, as they already hold electricity consumption data. In many cases, one company supplies both electricity and gas, making the process easier. In performing this task, the supplier would collect information from its customers about their car use and flying (average data for typical scenarios might be used for those situations where households are unwilling to supply the data). Lack of awareness amongst the interviewees of the energy efficiency grants from gas and electricity suppliers, combined with billing and pricing problems, means that these organisations are potentially not currently being viewed as positively as they might wish. DEFRA's research (2008: p.13) found that participants wanted the government to put pressure on businesses regarding tackling climate change. However, in the RedHENS research, there was insufficient negative sentiment towards the suppliers to suggest that the public would resist them being involved in a mass footprinting exercise for households. Both the public's view of the gas and electricity suppliers and in particular their potential to become involved in mass carbon footprinting should be investigated further. The generation of footprints for households would also present opportunities for the companies to collect physical details about homes and thus achieve their targets in locating beneficiaries for their CERT grants.

9.5 Personal carbon allowances

There were more interviewees in favour of personal carbon allowances than against, although support tended to be moderate as opposed to strong. This was despite some specific misunderstandings about personal carbon allowances, and some expressions of distrust, both of which could lead to opposition. The RedHENS interview findings on support for PCAs were not incompatible with the findings from the RedHENS survey, in which support also tended towards the moderate. However the overall balance between support and opposition was more balanced in the survey.

Low (2005), as cited in UKERC (2007b), confirms the RedHENS finding, that when people are presented with the concept of PCAs, they quickly show a good level of understanding. As regards the level of support for PCAs, Siveter (2006) showed no clear preferred instrument option in interviews with stakeholders, where other options such as a carbon tax were discussed. As regards members of the pubic comparing such options, IPPR (2008) found that a carbon tax received 15% support, limits on fuel

and energy suppliers received 15% support , and personal carbon trading was ahead with 27% support. Harwatt (2008) found, in her work, which had a strong emphasis on transport, that 78% found a system of PCAs personally and socially acceptable, whereas only 50% felt the same way about increasing carbon taxes. Howell (2007) found that a large majority of the participants liked PCAs and preferred them to carbon taxes, mainly because PCAs were perceived as fairer and more effective.

There were a number of similar findings in the RedHENS research and that conducted by DEFRA in 2008. These include that support for personal carbon allowances tends to be moderate while opposition is strong (DEFRA 2008a: p. (iv) and p.21, and Appendix 17), that participants did not change their views greatly with the passage of time or stage of interview (ibid: pp. (iv), (v), 48, 49), that single people are viewed as being adversely affected (ibid: p.28 paragraph 4.28), that there is a need for allowances for children (ibid: pp. 27-28 paragraphs 4.25-4.27), and that there is concern for the vulnerable (ibid: p.27 paragraphs 4.23-4.24), a point confirmed by RSA (2008: p.9). This is echoed by Howell's (2007) research participants. There were also misunderstandings that were identified by both projects, such as the idea that PCAs would affect the poor most (ibid: p.23 paragraph 4.13 and p.26 paragraph 4.20), that the system would be similar to the now defunct community charge otherwise known as the poll tax, and that well-off people would somehow be defeating the system by buying more units (ibid: p.23 paragraph 4.12). However this last point contradicts the finding that the same DEFRA research made, that some of their participants disliked any perceived government controlled limits of personal emissions (ibid: p.50 paragraph 9.1), a sentiment that did not arise in the RedHENS research findings. One specific similarity in the two research projects was participants suggesting the idea of buying and selling privately (ibid: p.35 para 4.48).

The most important difference in the DEFRA research was the greater opposition to PCAs, compared both to the RedHENS survey and interviews (ibid: Appendix 17). The DEFRA research also highlighted concerns about government intervention and 'big brother' (ibid: pp. 21-22) which barely came up in RedHENS. A possible explanation is that participants knew that DEFRA's research was being conducted for the government (ibid: Appendix 1 page 1). Ironically, DEFRA's work found more concern for the rural population (ibid: pp. 28-29 paragraphs 4.29 - 4.32) despite the RedHENS project's data collection being performed in a rural area. The DEFRA research triggered criticism of

how PCAs would work (ibid: p.24 paragraph 4.15) although the system was probably more defined in RedHENS. There was also a focus on buying units rather than selling them (ibid: p. 26 paragraph 4.21) - many participants thought that they would have to buy units whereas the RedHENS interviewees, if they had any view on the matter, thought buying was somehow cheating the system.

The RedHENS research, both the surveys and the interviews, found that buying units appears unpopular. Perhaps the personal carbon trading system should be designed in such a way that the only time units are bought is when paying for home or vehicle fuel, or for flights, when one has no allowance left. This may make the whole PCA concept more palatable by simplifying it and not unnecessarily emphasising the buying process. It will also exclude the concept of trading and speculating, and prevent such ideas as being unable to live your life if you run out of units (ibid: p.33 para 4.41 third quote), panic buying (ibid: p.34 paragraph 4.44), and reluctance to trade (ibid: pp. 34-35 paragraph 4.47). There is a possible lesson here for those working on research in the subject area. Referring to the subject as ‘personal carbon trading’ (PCT) may be less preferable than referring to it as ‘personal carbon allowances’ (PCAs). The word ‘rationing’ has potential negative connotations but consideration may need to be given as to whether the term ‘trading’ may be less acceptable to the public than ‘allowances’.

Misunderstandings found only in the DEFRA work (i.e. not in the RedHENS project) were that a system of PCAs would be like war-time rationing (ibid: pp 22-23 para 4.10) and that older people and other vulnerable people would be disadvantaged (ibid: p.25 paragraph 4.19 and Appendix 6 foot of page 3) because of the perceived need to heat their homes more. It is notable that this viewpoint concentrates on home energy issues and overlooks the fact that older people often do not need units for regular car use (because they do not own cars, do not work, or do low mileage) and, if not affluent, would be unlikely to need them for flying. A misunderstanding shown only by interviewees in the RedHENS project was to fail to realise that the developments that would take place in the run-up to a system of personal carbon allowances being implemented. They tended to look at their own, and society’s, situation as it was currently, rather than the situation that would exist when a system of PCAs would commence.

DEFRA's research has been criticised by a number of respected bodies because it is linked with the government's decision to suspend active work on personal carbon allowances on the grounds of perceived high implementation costs and what it sees as public resistance to the concept. Lean Economy Connection (2008) described the 'missed opportunity' of the decision; the Centre for Sustainable Energy talks of the need to fill the gaps in knowledge (CSE 2008a); and the House of Common's Environmental Audit Committee asserted that work on personal carbon trading must be continued if the perceived difficulties are to be overcome. It urged the government to undertake a stronger role, leading and shaping debate and coordinating research, as it believed that without this kind of action it is unlikely that personal carbon trading could become viable (Commons 2008a).

The scope of DEFRA's research was too wide and the sample size was too small (DEFRA 2008a), to use it as a measure of public support for PCAs. The findings here, and from Bristow et al (2008a), suggest that if the government was motivated by perceived high levels of public opposition, then they may have been wrong to do so. The DEFRA work was also intended to investigate how to make a personal carbon trading system more user-friendly (ibid: p.3). Compared to RedHENS, the details of the system were loosely defined, and this possibly negatively influenced the attitudes of the DEFRA participants. The focus group style of the work may also have allowed those with negative views to influence others' declared opinions. Once it has a better definition of PCAs (particularly the interface with the public), it would then be appropriate for the government to ascertain attitudes, and to do so quantitatively. 92 participants in twelve focus groups is insufficient. This was one of the key criticisms of DEFRA's work by the peer reviewers (ibid: pp. 9-10). It is of concern that such results were used to make the decision to discontinue work on the subject. In contrast RedHENS looked at the responses of 317 survey respondents as well as 21 interviewees.

Ipsos MORI (2007: p. 8) found that 54% of people say they would do more about climate change 'if other people did as well'. Therefore the new Department for Energy and Climate Change should resume work on personal carbon trading, in particular defining a potential system more clearly, and testing it against a larger sample.

9.6 Transport

This section discusses firstly issues to do with car use (in particular, commuting) then public transport (including its cost), and finally flying (especially the use of rail as an alternative for some air trips).

9.6.1 Car use

Long commutes were common in the interviewed households. The postal survey showed a lower level of interest in living nearer work (or getting a job nearer home) and home-working than for other carbon reduction measures. The Department for Transport has conducted research about car journey lengths. They found that short trips (under 5 miles) account for under 20% of carbon dioxide emissions from cars; journeys between 5 and 25 miles account for 43%; and those over 25 miles for 38%. Of most interest here are commuting trips between 10 and 25 miles, which have the highest proportion of single occupancy trips, at 91% (DfT 2008b p.7). 59% of people live four or more miles from where they work or attend education (DEFRA 2007f: p.10). The 2006 National Travel Survey suggests the average distance each person travels has increased by more than 50% since the early 1970s, but that the average number of trips has increased by much less (DfT 2008b: p.12). Clearly the relationship between the employer and employee which might benefit from being influenced.

Given the finding that financial incentives strongly influence people's behaviour, then research into some kind of alteration to the taxation system of employment might be considered. Potter et al (2006) found that in some countries governments subsidise commuting through their taxation systems, and thus have experience in collecting and processing the appropriate data. In the UK, the taxes which are specific to the relationship between an employer and an employee are employer's national insurance and employee's national insurance (NI) (whereas income tax is determined by total earnings from all employments and from savings and investments).

Further research into how taxation could influence commuting distance and mode is required. Investigation is required into how any new tax, or change to an existing tax like national insurance, could affect employees and employers in a wide variety of commuting circumstances. These circumstances would vary from those who commute by car alone over long distances, to those using public transport, lift-sharing, walking or cycling. Issues to consider would include home working (and the energy efficiency of

the homes), employees who work fewer but longer shifts, arrangements for remote areas, and the earnings level at which such a taxation system would apply. Practicalities would also need consideration, such as how employees and employers would collect and process the relevant data, the effect on agency work and sub-contracting, how any scheme would be phased in (bearing in mind people might adapt by moving home), how revenues might be spent, and how related taxes would be affected (such as taxes on travel and removal expenses).

The RedHENS research was effectively limited by the lack of time to discuss the opportunities and barriers for substantial reduction in carbon emissions which would stem from people living nearer their work (or getting a job closer to home), or working at home, especially in those cases where people currently have long commutes by car. It is likely that a whole research project would be required to investigate this area, separate from any investigations into taxation changes.

9.6.2 Local public transport

A notable finding of the RedHENS research was that support for personal carbon allowances was higher amongst those who are prepared to use public transport or cycle. Research by Carbon Neutral Newcastle (2005) found a significant proportion claiming they have, or are prepared to, cut back on car use to reduce their emissions - half of car owners said they have already cut back and walk or cycle instead and 31% say they use public transport more. Further research in this area is recommended, particularly to distinguish between those prepared to use public transport (and its different forms) and those prepared to cycle. It would also be worth repeating the research in a non-rural area where public transport is better (and perhaps also with London where public transport is markedly better and more middle class people use it).

The desire for cheaper public transport was prevalent amongst the interviewees. This is confirmed by the Commission for Integrated Transport (CfIT 2002: p.25) and by Carbon Neutral Newcastle (2005: p.12). However the reality is that switching from car to public transport often incurs extra costs for those who already own a car. The costs of bus and train journeys can be less than for private motor vehicles, per passenger mile, when all annual running costs are taken into account. However, most people already have access to a car so public transport is often more expensive than the fuel cost for using a car making the same journey (DfT 2007). Ipsos MORI (2007 p.8) found

that 59% of people support spending more on improving bus services to help prevent climate change, although it is not clear if the respondents were thinking of cheaper fares or better services, or both. For comparison, the same survey found that only 14% supported increasing the tax on petrol. Some participants in DEFRA's research into personal carbon allowances were specific with their ideas, suggesting that the Government could reduce carbon emissions by providing cheaper alternatives to the car without a system of PCAs. They felt they had to use their cars on a daily basis, but were aware of and not comfortable about the emissions caused. PCAs seemed too ambitious when actions could be taken to improve public transport services (DEFRA 2008a: p.29 paragraph 4.32).

Subsidies of local public transport may need to be directed to maximise the reduction of carbon emissions, and there is a need for further research to identify how this can be done. Current subsidies of buses take the form of a Bus Service Operator's Grant (BSOG) which provides for a partial rebate of the duty (tax) on fuel used (DfT 2008d). Further research might look at:

- Should subsidies be paid based on the basis of passenger trips made (rather than the running of services), and what is the effect of passes, transferable tickets and multi-trip tickets?
- Is there any value in encouraging people to travel in groups (families) if they would have been sharing a car with the consequent lower emissions per person?
- Are current fares too high, per passenger kilometre, for short journeys, and if a bus trip is replacing a car journey, might the car operate less efficiently and thus produce more emissions per kilometre than on a longer journey?
- At what point does subsidising the shortest bus journeys become less effective because it is discouraging people from walking and cycling?
- Do the relative per kilometre emissions of cars in urban and rural locations have a bearing on how bus journey subsidies should be directed?
- Should the subsidies be aimed at all bus users, existing and new, or can (and should) they be directed at attracting new users?
- How can the subsidy be directed to ensure higher loading of buses (of varying size) and other vehicles?
- Should subsidies be paid on the basis of the reduction in journeys made by cars along a corridor (compared to 'business as usual)?

There was unprompted admiration for the Nottingham tram system amongst the interviewees partaking in RedHENS. The Department for Transport made similar findings. Several of their respondents suggested introducing more tram systems. They were seen as punctual, accessible and reasonably priced. Stoke-on-Trent participants in particular had positive experiences of the Manchester tram system, and those in Liverpool mention the Newcastle metro and Croydon tram networks. "Trams are very well received, wherever they are located. They don't have much adverse publicity about them, people want to experience them" - Liverpool, ABC1, 45-65. "They seem to be very punctual, easy to get on and off, the fares seem to be reasonable and they have to stop" - Liverpool, C2DE, 18-44" (DfT 2004: pp. 4, 9-10, 36). These comments, and those of the interviewees in the RedHENS project, would suggest that the government should invest in more 'light rail' schemes.

In conclusion, reductions in emissions from cars will be harder to achieve because public transport is perceived as more expensive than using a car, as well as often being perceived as less convenient. When comparing to the home energy situation, where it is much clearer that people save money when making carbon reducing investments or when changing their usage or behaviours, the switch from car to public transport is not so attractive. It appears that public transport fares need to be reduced, and services improved, before large-scale changes in behaviour can be expected. Even with the status quo, there are clear financial advantages to making changes to energy use in the home. However the current situation does not financially encourage people to reduce their carbon emissions from personal transport on land.

9.6.3 Flying and rail travel

The respondents in the DEFRA research into carbon allowances were more concerned about being able to continue to fly (DEFRA 2008a: pp. 18-19), whereas in the RedHENS survey, respondents were more concerned with continuing to use their cars (wanting to keep carbon units for this activity). This may be explained by the fact that RedHENS was conducted in a rural area whereas DEFRA's covered a variety of rural and urban locations. This might be interpreted as a bias in the RedHENS research towards interviewees that did not fly. However, Brand and Boardman (2008) found that, within Oxfordshire, city dwellers were more likely to fly than rural dwellers. Meanwhile, Holden and Norland (2005) found that residents of Oslo with gardens had a lower

tendency to fly. The dichotomy may not be to do with cities versus rural locations, or homes with gardens versus homes without gardens, but rather with perceived quality of life and localised social norms. However, Carbon Neutral Newcastle (2005) identified no difference between participants from Newcastle (urban) and the rest of the North-east (on average, less urban). Both groups were adamant in their enthusiasm for flying.

Rail emerged as an alternative to flying to the near continent, in conversations with several interviewees. There is an opportunity to encourage those making such journeys to use rail. The European Commission investigated demand side management when examining the impact of aviation, and cited the need to improve international rail ticketing, criticising the tendency for national rail administrations to work in isolation (EC DGE 2005: pp. 31-32). Better information would be part of the solution, as the current best source of information, although much lauded, is predominantly the work of one industry expert (The Man at Seat Sixty-One 2008b). Further research is required, to investigate the barriers preventing those who are willing to use the train from doing so.

A small number of interviewees were clear in their criticism of the government's aviation policy (particularly taxation of flying) and the cheapness of flying. The Green Fiscal Commission found that 60% of people in Great Britain support green taxes which would significantly increase air fares, while 20% opposed the plan. The figures for the East Midlands were 49% in support versus 40% opposing (GFC 2008).

If, in the absence of a system of personal carbon allowances, price signals are to be given for personal transport, then in order to reduce emissions, the price of flying would rise and the price of public transport on land would fall. Although none of the interviewees linked the two issues, there is the possibility that taxes on flying could be used to subsidise public transport (hypothecation). The government is somewhat constrained in how it can tax international flights due to the need to observe international conventions, although APD (air passenger duty) is already in place and can be manipulated appropriately. As regards internal flights, the government has more flexibility in revenue raising. Other sources of revenue are likely to be necessary in order to subsidise of public transport on a large scale. Estimating the effects of different levels and types of taxation and subsidy on carbon emissions would require further

research to model various scenarios, in order to investigate the validity of such a measure.

9.7 Home energy efficiency measures

In the context of the apparent enthusiasm for home energy efficiency measures, as discussed in 9.1, this section looks at some of those specific measures and highlights the barriers to and opportunities for their adoption. It looks at lighting, refrigeration, heating and finally insulation.

9.7.1 Lighting

The interviewees lacked awareness of the range of compact florescent lightbulbs. This finding is confirmed by research carried out by the Open University (OU DIG 2007: p.16). The Government is working with all major retailers, the lighting industry and UK energy suppliers to phase out traditional bulbs, and replace them with CFLs (DEFRA 2008b) and there is a considerable level of support from the public for the banning of incandescent bulbs (Ipsos MORI 2007). However there is still an opportunity to encourage householders to replace old fashioned lightbulbs with compact fluorescent ones much earlier than they would have otherwise done so. Furthermore, there are no plans to phase out halogen lighting for homes. The recommendations stemming from the RedHENS research are that publicity needs to be given to the variety of lightbulbs available in compact fluorescent form. There are virtually no light fittings where an incandescent bulb is currently used that cannot take an appropriate compact fluorescent lightbulb.

The interviewees indicated that no retailer had a comprehensive range of compact fluorescent lightbulbs, nor were they aware of the outlets with the widest range. There is an opportunity for a retailer to stock a wider variety of CFLs, and claim that they can replace any incandescent or halogen bulb with a compact fluorescent one. It is surprising that no retailer has previously attempted this, given that RedHENS has highlighted that a major barrier to CFL use is the perception that the appropriate lightbulbs are not available.

A further recommendation is that CERT schemes should subsidise a much greater variety of CFLs, including a variety of shapes and powers, various mountings (small and standard Edison screw, and small and standard bayonet caps), reflector bulbs,

dimmable bulbs, outdoor bulbs and replacements for halogen as well as incandescent bulbs. The risk of a householder purchasing or receiving a bulb through a subsidised scheme, and then finding that it is not suitable for use in their home, is significant. Bulbs are harder to match to the fitting when the bulb and fitting are not physically together. This is a barrier to using mail-order to buy CFLs, and mail-order is currently often the only way to locate a full variety of CFLs. One potential solution is lightbulb libraries which have been tried out by some voluntary organisations (Oxford Climate Exchange 2008). This involves either a volunteer salesperson taking a varied collection of lightbulbs to a potential customer's home, or simply the lending of the 'library' of lightbulbs to a household so they can try out the range themselves, and afterwards paying for the bulbs they have retained. It may be that utilities could subsidise such lightbulb libraries through their CERT schemes, perhaps using part-time agents who could visit households in their spare time, to assist them in the selection of appropriate bulbs.

9.7.2 Cold devices

Further research is required in order to ascertain just how many old cold devices there are in households, and how many secondary cold devices there are, and how they are used. If the numbers are as high as the RedHENS research indicates, then a campaign is required to inform the public and to dispose of the older and surplus devices. The campaign would emphasise the cost of having so many fridges and freezers, and of running old ones, and would perhaps operate an 'amnesty' (i.e. disposal) scheme. Such a scheme could be CERT funded and operated in conjunction with local authorities which have responsibility for waste disposal. There might be a pre-arranged day when unwanted cold devices could be left out for collection. There would need to be advance warning of any free disposal service to give people time to use up the contents of freezers.

9.7.3 Heating

The research indicates that a sizable minority of householders continue to run very old and inefficient boilers. The simple design of them makes them long-lasting but also makes them highly inefficient. The English House Condition Survey found that in 2006, over 40% of homes had heating systems more than twelve years old (CLG 2008c: p.111). Action by the government and appropriate organisations is recommended. Awareness raising is likely to be a major part of this. The resistance to changing

heating systems is high - the Department for Communities and Local Government found that generally only around 5% of home owners consider the heating of their home to be ineffective and therefore in need of improvement (CLG 2006d: p.17). Raising the profile of the Boiler Efficiency Database (SEDBUK 2008), which lists all gas and oil boilers, both past and present, and making it easier for householders to navigate, would be beneficial. That facility includes a summary table of typical ages and types of boiler, and their efficiencies and typical running costs in the common types of home. This type of easily understandable data should be made more widely available. Note that boilers which have continuous pilot lights are now reaching the age (around fifteen years) where most can be replaced with a model which is significantly more efficient, and this presents an opportunity for awareness raising, as most householders should be able to identify a boiler with a continuous pilot light. The mandatory nature of condensing or grade A and B boilers means that the step reduction in emissions is now much more pronounced.

Another means of dealing with old boilers is to effectively force them out of use, starting with the oldest boilers first. The possibilities for achieving this are, in the gas industry, through the gas regulations (as exercised by Transco and others involved in gas safety), restricting the supply of spare parts, or altering the CORGI rules on boiler servicing for registered gas engineers (e.g. the registration for gas engineers). Similar opportunities can be exploited in the oil heating industry. Such actions would require careful cooperation from the grant schemes run by WarmFront and by the suppliers (CERT). It would be inappropriate for a vulnerable person to have their boiler condemned because of its age and inefficiency without a replacement being offered. For the ‘able to pay’ sector (i.e. those who do not get 100% grants), the suppliers operating CERT schemes might be willing to subsidise installation of replacement boilers, as long as occupants also take the full set of other energy efficiency measures, and thus contributing to achieving CERT targets.

See also the recommendations in 9.2.1 Grants by suppliers.

9.7.4 Insulation

An issue which affected some of the interviewees was the insulation of non-standard roof designs, such as dormer bungalows, which do not fit well with the commonly available grants, insulation products and advice. It is recommended that further

research is carried out into the number of homes with such non standard roofs. The additional elements that might be involved include insulating inaccessible roof spaces, and insulating dwarf walls (internal walls separating living space from an uninsulated roof space which is typically triangular in vertical cross section). Solutions which may be appropriate could include multi-foils which can be used against dwarf walls or under pitched rooves, as well as polystyrene beads (as used in some retrofit installations of cavity wall insulation) or blown cellulose, which might be used to fill roof spaces that are not easily accessible. If there are significant savings to be made in insulating types or parts of roofs which were previously overlooked, grants and advice should be altered. As a minimum, the Energy Saving Trust should produce a guidance booklet on this topic.

9.8 New homes

Although only one interview took place in a new home, the issues raised were significant enough to prompt a suggestion for further research. It may be the case that building regulations are being interpreted in such a way as to cause wastage of energy. Firstly, the requirement to ensure that 30% of light fittings in a new home must be of the type that take only low energy fittings needs examining. It may be that because there is such a limited range of bulbs that go into the two-pin fittings that owners are replacing the light fittings with fittings that use expensive and inefficient halogen bulbs. Secondly, it may be the case that the requirements of SAP ratings and daylight illumination of rooms are not working well with each other, and may be leading to rooms which are not being properly day-lit, and require powered illumination even in the middle of the day. It is recommended that further research is conducted in the area of new homes, to establish what other unintended consequences are caused by developers' interpretations of the latest building regulations. Once the issues are established, their extent can be measured through quantitative research.

10 Conclusions

This chapter begins with a section summarising the research findings of the RedHENS project. A section giving policy recommendations follows. There are then sections discussing the limitations and the success of the research. Finally there is a section giving recommendations for further research.

10.1 Summary of research findings

This section summarises the main research findings, including those that did not lead to research or policy recommendations.

The research findings on climate change are:

- There was emphasis amongst the interviewees on the alleged ‘natural’ causes of climate change, reflecting a lack of basic knowledge of the subject.
- There was emphasis put by interviewees on past and present observations of the weather.

The research findings on footprinting and information are:

- Amongst the interviewees, there was enthusiasm for discussing the component parts of household carbon footprints, and when specifically discussed, support for the idea that all households should have a carbon footprint produced for them. There was a great deal of discussion of specific carbon reduction measures such as installing insulation or using public transport.
- The carbon footprinting exercises during the interviews showed that one-off investments in the home (such as heating, lighting, cavity wall insulation and loft insulation) provided much greater opportunities for carbon savings than the continuous behaviours (such as not over-filling a kettle).
- Some of the interviewees showed a lack of willingness to invest in expensive measures like new heating systems, as well as less expensive measures like cavity wall insulation, and even very low cost measures like compact fluorescent lightbulbs.
- Amongst the survey respondents, booklets were the most popular source of advice on home energy efficiency (preferred by almost two thirds of

respondents), around half as many more people than preferring to use the internet. A sixth of people wanted a DVD.

The research findings on personal carbon allowances (PCAs) are:

- When interviewees were presented with the concept of PCAs they quickly show a good level of understanding, and the response rates to the PCA questions in the survey were high.
- More interviewees and survey respondents were in favour of PCAs than against. The research checked for a wide variety of group differences amongst the survey respondents, regarding support of PCAs, in a variety of categories of question including home, household, past behaviour, actions in response to PCAs, keeping units, and buying and selling units. Only three statistically significant group differences were found:
    - Those with more favourable attitudes to household renewable energy (as opposed to energy efficiency) were more supportive of PCAs.
    - Those who would ‘probably’ use public transport, or cycle, had a higher level of support.
    - Those who indicated they would be unlikely to sell units had a lower level of support.
- Support for PCAs tends to be moderate.
- The concept of the buying of carbon units, separately from the purchase of fuel or flights, to enable one to use more energy, may be unpopular and potentially unnecessary, and thus could affect the definition of a system of PCAs.
- In the survey, the most popular of a list of six general actions in response to the prospect of a system of PCAs was making the home energy efficient, with 97% saying they already did this, or would probably or possibly do this. The next most popular were using a small or fuel efficient car (86%), using public transport or cycling (64%), taking holidays which don’t involve flying (56%), and living nearer one’s workplace or getting a job closer to home (53%). The least favoured response was working at home (39%).

The research findings on financial issues are:

- In the interviews, financial savings mattered more to people than carbon savings.
- In Newark and Sherwood District, the survey showed that over half of energy efficiency grants were referred through local authority activities, but only a third of households responding to the survey had received a grant.
- There was almost as much support for subsidy of expensive energy efficiency measures as there was for subsidy of home renewable energy installations.
- There was a lack of awareness amongst the interviewees of the energy efficiency grants given by gas and electricity suppliers.

The research findings on carbon reduction measures in the home are:

- The survey showed that a third of homes with cavity walls do not have them insulated.
- The vast majority of water meter users believed they save money, compared to paying water rates.
- The interviewees lacked awareness of the range of compact florescent lightbulbs, and indicated that no retailer had a comprehensive range of compact fluorescent lightbulbs.
- The interviewees had a high number of old and secondary cold devices in their homes.
- A sizable minority of householders continue to run very old and inefficient boilers.
- An issue which affected some of the interviewees was the insulation of non-standard roof designs, such as in dormer bungalows.

The research findings on transport are:

- There was extensive interest in discussion of transport issues in the interviews.
- The interviews indicated that long commutes were common.
- The desire for cheaper and better public transport was prevalent amongst the interviewees.
- Rail emerged as an alternative to flying to the near continent.

- A small number of interviewees were clear in their criticism of the government's aviation policy (particularly the low taxation of flying) and the cheapness of flying.

The other research findings are:

- The interviews showed a high level of interest in recycling despite it not being raised by the interviewer.
- It is possible that, in some cases, building regulations for new homes are being interpreted in such a way as to cause wastage of energy.
- The survey provided findings about respondents' relationships with gas and electricity suppliers. Over a third of households showed a propensity of avoiding switching supplier. Over a fifth of respondents had switched but felt uncertain as to whether they were saving money.

10.2 Summary of policy recommendations

Policy recommendations, as discussed in detail in the chapters 5 and 9, are summarised in this section. Recommendations about the role of organisations are given in the knowledge that many organisations are constrained by government policy; this can be especially true of local authorities which are often influenced by the availability of funding from central government.

The policy recommendations on information and footprinting issues are:

- A carbon footprint should be produced for all households, possibly by electricity suppliers (assuming issues relating to distrust of suppliers are addressed).
- The Act On CO2 and other carbon calculators should give financial savings from taking actions to reduce carbon emissions.
- Act On CO2 does not appear, in any variety of circumstances used for testing, to recommend the user installs an updated boiler or improved heating system. This omission, which may be a design or software error, needs rectifying.
- Advice about energy saving or carbon emission reduction in the home should, for the moment, put emphasis on getting people to do one-off measures which have a long term effect, such as the installation of insulation or improved heating systems, in preference to attempting to influence continuous

behaviours, such as switching off lights or turning down thermostats. Amongst the one-off actions, policies should concentrate on the most effective measures, those relating to heating, loft and cavity wall insulation, and lighting.

- Booklets containing home energy efficiency advice are popular, and local authorities are well placed to make them available.

The policy recommendations regarding personal carbon allowances (PCAs) are:

- Given that people show understanding of PCAs, and support for and opposition to PCAs is relatively equal, the government should resume its own research work on personal carbon trading.
- Given the public's interest in individual measures that reduce their carbon emissions, there are many opportunities relating to types of measure (such as heating, lighting, insulation and using public transport) which should be encouraged. Such opportunities should be exploited as part of a planned run-up to a system of PCAs, should such a system be implemented.

The policy recommendations regarding individual carbon reducing measures in homes are:

- Publicity needs to be given to the variety of lightbulbs available in compact fluorescent (CFL) form. CERT (Carbon Emission Reduction Target) schemes should subsidise a much greater variety of these CFLs. There is an opportunity for a retailer to stock a wider variety of CFLs and claim that they can replace any incandescent or halogen bulb.
- The Energy Saving Trust should raise the profile of summary data about typical ages and types of boiler, and their efficiencies, thus emphasising the need to replace them. Old boilers could be forced out of use, starting with the oldest boilers first, possibly through the gas regulations. Suppliers operating CERT schemes might consider subsidising installation of replacement boilers, if occupants also take the full set of other energy efficiency measures.
- The Energy Saving Trust should consider producing a guidance booklet on the insulation of non-standard roof designs, such as those on dormer bungalows, and grants should be altered to accommodate them.
- On cavity wall insulation (CWI), the guidance on ascertaining whether a home has CWI should be clarified. Forms for gathering home energy efficiency

information should allow an option for the respondent to state they have cavity walls but that they are not sure whether the cavities are insulated.

The policy recommendations regarding transport are:

- People should be financially encouraged to reduce their carbon emissions from personal transport to mirror the way that there are clear financial advantages to making changes to energy use in the home.
- The government should give consideration to changing the taxation of employees and employers to reflect employees' commuting distances and modes, in order to discourage car use and long-distance commuting.
- Public transport should be improved and fares reduced.
- Those travelling to nearer parts of the continent of Europe should be encouraged to use rail.

The policy recommendations regarding financial matters are:

- Grant schemes are not reaching as many people as they could. The potential of local authorities to refer residents to home energy efficiency grants, and to provide advice on reducing carbon emissions, should be exploited.
- A standardised text could be used in the marketing literature for CERT grants provided by the gas and electricity suppliers, explaining the obligation placed upon the supplier, thereby reducing any suspicions on the part of potential recipients of the grants.
- Funding of more expensive home energy efficiency measures, especially solid wall insulation, should be considered.
- Consideration should be given to introducing a system of council tax surcharges to penalise the owners of homes where there is a failure to install the energy efficiency measures that give the biggest carbon emission savings. The funds raised could be directed at subsidising improvements to heating systems.

10.3 Limitations of the research

There was a number of limitations to the RedHENS research, and those limitations are described in this section.

It was recognised that the qualitative results from the second data collection stage, involving semi-structured interviewing, were inherently not representative of the population as a whole. Furthermore, the second data collection stage also involved the collection of quantitative data, used in the carbon footprinting exercise. The sample size of fifteen households limited the representativeness of this data.

Although the researcher monitored, where possible, socio-economic factors (including using two methods of recruitment to interviews and three different methods of distributing survey forms), both data collection stages avoided the explicit collection of socio-economic data. For the interviews, a much larger sample would have been required to fully address this. To some extent there was self-selection by respondents and interviewees which would have been addressed by much larger and more intensive recruitment, but probably lower recruitment rates.

The RedHENS research was inspired and influenced by Newark and Sherwood District Council and therefore the research mainly took place in its area. However, in order to generalise it to the whole of the population of the country, similar research might be necessary in other areas.

The exploration of the role of organisations, especially local authorities and suppliers, in the field of reducing household carbon emissions, was limited during the interviews, somewhat restricting the findings in these areas. This was due to the semi-structured nature of the interviews, and the ways in which they progressed ‘on the day’. For example, the situation could have varied on different days or with different interviewees or an alternative interviewer, or if the emphasis of the interview questionnaire had been slightly changed to give more attention to these types of organisation.

There was little opportunity to discuss the reductions in carbon emissions which might stem from people living nearer their work (or getting a job closer to home), or working at home, in those cases where people currently have long commutes by car.

10.4 The success of the research and its contribution to knowledge

The main research question for this PhD project was ‘How can carbon emissions by households be reduced?’. A considerable number of findings, policy recommendations,

and recommendations for further research, which provide answers to this question, resulted from the research, as evidenced by other sections within this chapter. As regards the first subsidiary research question, 'What are the opportunities for people to reduce their household carbon footprints, and the barriers that prevent them from doing so?', the two data collection stages provided extensive findings. The findings that fit with this question include those to do with households' enthusiasm for carbon footprints, attitudes towards, and understanding of, climate change, measures to reduce household footprints, energy efficiency grants, information sources, and the importance of financial savings and incentives. Many of these findings lead to policy recommendations. The second subsidiary research question, 'How can organisations such as councils and energy suppliers help people reduce their carbon emissions?' also provided findings, including suggestions for further research, such as the role of gas and electricity suppliers. The third subsidiary research question 'What are people's attitudes towards personal carbon allowances?' produced perhaps the most important findings of the project, the conclusions from which challenge government policy. The survey questions and interview conversations generated findings about the public's responses to a system of personal carbon allowances, as well as their attitudes towards them.

This PhD research project had a number of unique features. It used a combination of quantitative and qualitative data collection techniques which had been not previously tried before in the research subject area, both academically and more generally. Collecting quantitative data about attitudes to personal carbon allowances, using a sample of more than 300, has not been previously attempted. Gathering attitudes about personal carbon allowances, and calculating household footprints, whilst in the homes of interviewees, was also a new technique. Additionally, the discussion of measures to reduce households' carbon footprints, as part of the interview process, had not been attempted before. The greater length of the interviews that took place, providing findings that would not be revealed by shorter or more structured interviews, enhances the unique nature of the research.

10.5 Summary of recommendations for further research

This section provides a concise summary of the recommendations for research discussed throughout this thesis.

The recommendations for further research on climate change and footprinting are:

- On people's perceptions of climate change, further research is required into whether and how people look for evidence of climate change from the past (and in the present). This may help to improve education programmes about climate change.
- There is a need for government and researchers to move on from exploring people's beliefs about climate change, to understanding people's understanding of, and intentions regarding, the responses they can make to mitigate climate change.
- Stakeholders like the government, and the research community, should aspire towards identifying a standard set of personal and household measures to respond to climate change. This set of responses should include major home energy efficiency measures, and behaviour changes in the home and in transport use (for example moving nearer work, and working at home). A standard set of responses will facilitate the comparison of findings across research efforts.
- The concept of calculating household carbon footprints (including emissions from personal transport), while in the participants' homes, should be replicated on a larger scale. Such research, if it includes carbon savings from measures, would provide a larger sample upon which to base average potential carbon savings from households, especially if it is conducted over wider geographical areas.

The recommendations for further research on personal carbon allowances (PCAs) are:

- The most important research recommendation emerging from this thesis is that the UK government should resume research into a wide variety of aspects of personal carbon trading (PCT), as there is no evidence that a large majority of the public would be against them. At the very least there should be quantitative research into the public's views, on a larger scale than in RedHENS.
- Research councils should make specific funding streams available to research PCAs.
- The difference in responses by the public to the terms personal carbon allowance (PCA) and personal carbon trading (PCT), and to any underlying system differences, should be researched.

- Given the higher level of support for PCAs amongst those willing to switch to public transport or cycling, researchers should attempt to distinguish between these two modes (and between different forms of public transport) to ascertain whether there are any differences in support for PCAs. Differences between rural and non-rural areas might also be worth exploring.

The recommendations for further research on carbon-reducing measures in the home are:

- Non-standard roofs on homes (such as dormer bungalows) present a challenge to conventional insulation techniques. Further research is required into the extent of problems in this area, and how they can be solved in terms of information provision, grant schemes and technical solutions.
- A large scale data collection exercise is recommended, to establish the number of old and secondary cold devices currently being used in homes. This should establish whether there is a problem with energy wastage by old and additional fridges and freezers, and if publicity and recycling campaigns are needed, how such campaigns might operate.
- A worthwhile project might be to investigate whether contemporary building regulations are triggering rebound effects. This might look at how regulations concerning lighting, SAP ratings, etc. in new homes, are having unintended consequences. The research might start with qualitative data collection to establish if there are issues, and then quantitative data collection to measure their extent.
- Academic research is required into how much money people save, or can potentially save, by switching to water metering, and how this reduces carbon emissions. The use of actual consumption data is preferable.

The recommendations for further research on transport are:

- Regarding commuting behaviour, and use of alternatives to the car, research is required to investigate the opportunities and barriers associated with reducing carbon emissions from car use, through people living nearer work, getting a job nearer to home, or working at home.
- Research is required into how airline flights might be taxed, and ‘surface’ public transport subsidised, to maximise the reduction of carbon emissions from

personal transport. Further work is also required to encourage the use of low carbon transport to the near continent, as an alternative to airline use.

The recommendations for further research on financial issues are:

- Further research, especially academic, is required regarding the success of energy efficiency grant systems in general, and about the success of various organisations in referring householders to them. Findings should help to maximise the take-up of grants.
- There is a need for quantitative research into how householders perceive the gas and electricity suppliers (and possibly other organisations such as insulation manufacturers) in the context of energy efficiency grants, as well as issues such as footprinting.
- Research might look at how subsidies for more expensive energy efficiency measures (such as solid wall insulation) would work.

These recommendations for further research conclude this thesis.

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12 Appendices

12.1 Appendix - NSDC's HECAmon questionnaire

This was the first questionnaire used in the survey of pre-1995 private housing.

Energy Survey Questionnaire

NEWARK & SHERWOOD DISTRICT COUNCIL

Please help us to report by completing the form and sending it back in the **freepost** envelope (no stamp needed).

1. Do you own your home or are you renting?

Own home	Renting from housing association	Renting privately	Other
☐1	☐2	☐3	☐4

2. What type of property do you live in?

Detached house	Semi detached	End terrace house	Mid terrace house	Ground floor flat	Mid floor flat	Top floor flat (roof directly above)
☐1	☐2	☐3	☐4	☐6	☐7	☐8

3. How many floors (storeys) are there in your home?

(e.g. bungalow = 1) ☐

How many bedrooms? ☐

4. When was your home built?

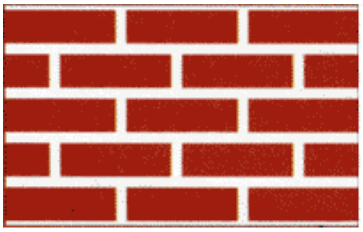
Pre-1900	1900-29	1930-49	1950-65	1966-76	1977-81	1982-90	1991-95	1995 on
☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

5. How deep is the insulation in the roof space (loft)?

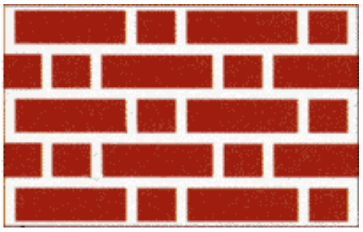
None	2” / 50 mm	3” / 75 mm	4” / 100 mm	6” / 150 mm	8” / 200 mm	Don’t know	No loft
☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8

6. Which best describes the walls of your house?

Solid brick/stone	Cavity walls (unfilled)	Insulated cavity walls	Timber frame walls
☐1	☐2	☐3	☐4



Typical cavity wall



Typical solid brick wall

Notice the different brick arrangements

7. Which best describes the windows of your house?

Wood single glazed	Wood double glazed	Metal single glazed	Metal double glazed	uPVC single glazed	uPVC double glazed
☐1	☐2	☐3	☐4	☐5	☐6

8. What is the main heating and fuel used in winter?

	Heating			**Fuel**		
1	Central heating with radiators and combi boiler		1	Gas		1
2	Central heating with radiators and back boiler		2	Electricity		2
3	Central heating with radiators and standard boiler		3	Oil		3
4	Central heating with radiators/ condensing boiler		4	LPG		4
5	Warm air system		5	Coal		5
6	Electric storage heaters		6	Smokeless fuel		6
7	Individual heaters or fires					

9. What heating controls do you have? (tick all that apply)

None	Programmer	Room thermostat	Thermostatic radiator valves
☐1	☐2	☐3	☐4

10. What is the main way of heating water for baths and washing up?

From central heating	Off peak immersion (electric) heater	On peak immersion (electric) heater	Gas instantaneous
☐1	☐2	☐3	☐4

11. Do you have a hot water cylinder?

No cylinder	Cylinder not insulated	Cylinder with loose jacket	Cylinder with foam coating
☐1	☐2	☐3	☐4

12. Do you have a hot water cylinder thermostat?

YES	NO
☐1	☐2

13. How many people live in your house in total?

How many are over 60?	
How many are under 16?	

14. Please tick if any of the following have been carried out in the last 12 months:

Cavity wall insulation			New boiler or heating system	
Loft insulation			New heating controls	
How much was added? 4”		1	Double glazing (more than 5 windows)	
6”		2	New hot water cylinder or jacket	
			Two or more low energy lights	

15. If you are willing to complete a research questionnaire, for De Montfort University, concerning energy use by households, please tick:

☐1

Thank you.

12.2 Appendix - Text of covering letter for 'post-HECA' questionnaire

The following text was printed on pre-printed stationery for IESD (the Institute of Energy and Sustainable Development) featuring IESD's address and the De Montfort University logo, etc.:

To the householder.

Dear Sir or Madam,

Please help with our research into electricity & gas bills and related subjects

We are writing to you because you completed a survey for Newark and Sherwood Energy Agency (NSEA), and ticked the box saying you would be happy to complete another survey.

Could you please complete the attached survey questionnaire and post it back in the reply paid envelope. Your responses and those of others will help us review the policies of NSEA on household energy, climate change and similar matters.

We recognise that there are four pages of questions to answer, so please answer as many as you are willing to do so. If you get tired of answering them, just send us what you have completed in the reply paid envelope. Miss out any question that you feel uncomfortable answering.

If you have any questions regarding this survey, please email Andrew Wallace at awallace@dmu.ac.uk or ring him on 0116 257 7976 or Paul Fleming on 0116 257 7963, and they will try to help you. Note that just because we ask a question on a particular subject, we don't necessarily imply support for a particular policy.

We hope you enjoy filling in the questionnaire and look forward to receiving your completed form.

If you would like more details on energy efficiency grants, consult the details you received in the same package as this questionnaire, or ring NSEA on 01636 655598.

Yours sincerely,

Professor Paul Fleming.
Assistant Director, IESD.

Dr. Andrew Wright
Senior Research Fellow

Andrew Wallace, MSc
INREB Faraday Associate

Data protection statement

Our data protection policy, designed to protect you and your household, is as follows.

Any information you supply will be used exclusively for the purposes of our research programme and will not be passed to others or used for any other purpose. Information, if published, will be in aggregated form so that individuals cannot the identified. The data will be held securely and disposed of when its purpose for collection is over.

Any personal information used will be handled under the terms of the Data Protection Act. We are not interested in details of individuals, that's why we do not ask you to give us your name (although optionally you may give it). We do not and will not store the name or any other details of individuals. We may merge your responses with those given regarding your household in previous NSEA energy surveys, for the purposes of analysis.

IESD is part of De Montfort University (DMU), Leicester. NSEA in part of Newark and Sherwood District Council and is headed by David Pickles OBE Architect. IESD is a supplier to NSEA and is also covered by their data protection policies, which were outlined in their own surveys. DMU has established ethics policies which control how we conduct surveys and other research, and this project has been reviewed appropriately.

12.3 Appendix - Post-HECA Questionnaire

This was the second questionnaire used in the Pre-1995 private housing survey.

De Montfort University - Household Energy Survey

Please see covering letter for data protection statement.

Name (optional)	

Address	

Postcode	

Please complete as many questions as possible, skipping any that you don't feel comfortable answering. A partially completed form is better than returning no form at all!

Energy Efficiency Grants

1. Have you ever received a grant or grants to improve the energy efficiency of your current home? Check the list below (in question 2) if you are unsure. Remember, an installer may have obtained the grant for you.

Yes		No	

If your answer was yes, please answer questions 2 to 5, otherwise go to question 6.

2. What was the grant for? Tick all that apply. Please also indicate which year it took place.

	Tick	Year		Tick	Year
Cavity wall insulation			Central heating installation		
Roof / loft insulation			Given a free hot water tank jacket		
Replacement fridge or fr-freezer			Cheap or free low energy light-bulbs		
Draught-proofing			Other, please specify below		

---

3. Did the grant pay for most or all of the work? If you had more than one grant, please refer to the most valuable. (tick one):

Yes, I paid nothing (or only for minor aspects e.g. concealing pipes)	
No, the grant only paid for *part* of the cost	

4. Who was the grant given by? (tick one)**:**

WarmFront (usually operated by EAGA. Formerly HEES - Home Energy Efficiency Scheme)	
An electricity or gas supplier	
Other, please specify below	

---

5. How did you find out about the grant(s)? Tick all that apply.

	Tick
Leaflet with gas or electricity bill	
From an installer	
Temporary energy advice stand	
Presentation at a meeting	
Newark and Sherwood Energy Agency	
Another NSDC (Newark and Sherwood District Council) department	
Another local council	
Leaflet at a library or other public building	
Energy efficiency advice centre (EEAC), e.g. the one in Buxton	
Energy Saving Trust (EST) phone line or website (or radio ad or other ad for EST)	
Warm Zone	
Through a charity or community organisation	
Other, please specify below	

Loft Conversions

6. Does your current home have a loft conversion? Yes ☐ No ☐

If your answer was yes, please answer these questions, otherwise go to question 7.

When was your loft conversion made? If you don't know, give an approximate year: ☐ How many rooms are there? ☐

How is your loft conversion heated? Please tick one:

Not heated: ☐ Connected to main heating system: ☐ Heated separately: ☐

Conservatories

7. Does your current home have a conservatory? Yes ☐ No ☐

If your answer was yes, please answer these questions, otherwise go to question 8.

When was your conservatory built? If you don't know, give an approx. year: ☐

How is your conservatory heated? Please tick one:

Not heated: ☐ Connected to main heating system: ☐ Heated separately: ☐

How is your conservatory connected to the main part of the house? Please tick one:

Open direct into a room: ☐ Separated from the nearest room by a door / window / wall: ☐

Approximate size of conservatory? Please give length and width. If you need to go and measure, please do the rest of this survey first! If necessary, skip this question.

☐ X ☐ metres / feet - *delete as appropriate*

Understanding Heating Systems and Insulation

Household heating systems and insulation can be difficult to understand. **8. Which methods should be made available to inform people about using (and installing) heating systems and insulation for maximum comfort and economy? And which method would you use to learn more?** Tick all that apply in each column.	Should be available	I would use
Colour booklets		
A basic website with text and photos		
An interactive website with video and sound		
A DVD or video presented by a television personality		
Special facilities for the visually or aurally impaired		
A telephone helpline		
None		
Other, please specify		

Water Usage

Providing tap water and taking away sewage uses energy (e.g. for pumping and treatment) and thus contributes to carbon emissions.

9. Tell us about how you pay for your water supply. Please tick only *one* option:

The water is paid for by fixed water rates	
The water is paid for with the rent	
There is a water meter and the bill is a *lot less* than on water rates	
There is a water meter and the bill is a *bit less* than on water rates	
There is a water meter and the bill is about the same as on water rates	
There is a water meter and the bill is more than on water rates	
There's been a water meter in the property for a long time, so can't compare with rates	
Not sure how the water bill is paid	
Other, please specify below	

Personal Carbon Allowances

Almost all human activity involves using energy - or “power” or “fuel”. In most cases this involves using a fossil fuel - oil, gas or coal. Sometimes they are used indirectly in the form of electricity. Using fossil fuels adds carbon dioxide - a greenhouse gas - into the atmosphere which, the vast majority of scientists believe, causes climate change (also known as global warming or the greenhouse effect).

Some electricity comes from nuclear power stations. However this produces waste which is radioactive and therefore dangerous to human health and the environment for thousands of years, although it does not produce any carbon dioxide.

Only a small amount of our energy currently comes from renewable sources, such as wind or wood, which do not put extra carbon dioxide into the atmosphere. Therefore many believe that energy use needs to be better managed to cut ‘carbon emissions’.

It has been suggested that everyone in the UK should be given an annual “carbon allowance” to allow them to buy units of household energy / power, vehicle fuel, and airline mileage. If a person does not use all their units, they could sell them to other people who need more units.

10. What do you think of such proposals? Tick one:

		No feelings either way	
Support them strongly		Moderately opposed to them	
Support them moderately		Strongly opposed to them	

11. Leaving aside your views on carbon allowances, how would you act if such a system was in place? Tick one column against each action (note, only a selection of actions can be given here):

	Probably	Possibly	Unlikely	Don’t know	Already do this
Use a small or fuel efficient car					
Use public transport or cycle					
Make your home energy efficient					
Take holidays which don’t involve flying					
Live nearer your workplace, or get a job near to home					
Work at home					
Keep as many units as possible for car use					
Keep as many units as possible for flying					
Buy other people’s units to enable you to use more energy					
Try to use as few units as possible so you could sell them					

Energy Efficiency and Renewable Energy

We are interested in your views on the relative merits of household energy efficiency, and renewable energy in homes.

Energy efficiency involves the better use of energy supplies. Some household energy efficiency measures are cheaper, such as insulating cavity walls, but others are more expensive, such as insulating older pre-1930s solid walls (using ‘insulated dry-lining’ or external cladding).

Renewable energy is energy generated from environmentally friendly sources, and domestic systems include small wind turbines, wood boilers, and electric or hot-water solar panels. Currently they can be expensive per unit of energy supplied.

12. Should government and local councils... (tick only one):

	Tick
Switch significant resources *now* from *energy efficiency* to *renewable energy* subsidies	
Complete cheaper household *energy efficiency* measures first and then assist *renewable energy*	
Complete cheaper *and* more expensive *energy efficiency* measures first, and then assist *renewable energy*	
Take other actions, please specify:	

Gas and Electricity Suppliers

13. Have you switched electricity OR gas supplier in the last 12 months? Yes ☐ No ☐

If your answer was yes, please answer this questions 14 and 15. Otherwise go to question 16.

14. How did your switch of supplier occur? Tick all that apply for each fuel:

	Gas	Elec
Fraudulent transfer		
The company approached you (doorstep sales; salesperson in a street or shop; mailshot, telesales, brochure or advertisement etc)		
Friend or relation mentioned or recommended the new supplier		
Chose to go to a "green" or environmentally friendly tariff		
Investigated alternatives through a web or telephone service which advised the best deal		
Moving home forced a change of supplier		
Other, please specify below		

Gas..... Elec.....

15. When switching, did you change *to* direct debit *from* another payment method?

	Yes	No
Gas		
Elec		

16. Have you had problems with your electricity or gas supplier in the last twelve months? Tick all that apply for each fuel. Before answering no, please check the possible answers!

	Gas	Elec
I can't be sure that I saved money following a switch of suppliers (e.g. charges went up shortly after transferring, or potential savings were exaggerated / not properly explained)		
Wrong amount billed (e.g. estimate too high, charged for someone else's usage)		
Billed by two or more companies for the same period, or by no company at all		
Things went wrong when moving home		
Had unexpected debit taken from my bank account, or excessive amount taken		
Problems occurred that wasted a lot of time or caused me increased phone bills		
Threatened with, or subjected to, debt collection, legal action or disconnection		
The company did not take fully into account that I am disabled or a "priority" user		
No, everything has gone smoothly		
Other problems, please specify below		

Gas..... Elec.....

17. If you have never switched gas or electricity supplier, other than when moving, please tell us why. Tick all that apply for each fuel:

	Gas	Elec
I / we didn't know you could change		
We are on a pre-payment meter (PPM) and other suppliers aren't interested		
On a budget plan and other suppliers won't offer that		
Don't want to pay by direct debit and that's what the other suppliers encourage		
Have heard about things going wrong when switching		
Concerned that my / our budgeting will be disrupted		
Not convinced that I / we will save money		
Not interested in switching		
Other reason, please specify below		

Gas..... Elec.....

Further Contact

18. Are you /your household willing to be contacted again? Please indicate by ticking below:

I / we would be willing to answer other surveys of this type by IESD or NSEA	
No more contact or surveys, thank you	

Many thanks for completing this survey. Please send it in the reply-paid envelope provided, to De Montfort University (or if that has been mislaid please send it in a stamped envelope to NSEA Survey, Institute for Energy and Sustainable Development [IESD], De Montfort University, The Gateway, Leicester, LE1 9BH).

12.4 Appendix - New Homes Questionnaire

De Montfort University - Household Energy Survey

Please see covering letter for data protection statement.

Name (optional) _____

Address _____ _____ Postcode

Please complete as many questions as possible, skipping any that you don't feel comfortable answering. A partially completed form is better than returning no form at all!

Household details

1. Do you own your home or are you renting? *Please tick one*:

Own home		Renting from housing association		Renting from council		Renting privately		Other	

2. How many people live in your home?		How many over 60?	

3. Which year was your home built? (if not sure, please state approximately)	

4. What type of property do you live in? *Please tick one*:

Detached house		Semi detached		End terrace		Mid terrace		Ground floor flat		Mid floor		Top floor flat *	

5. How many floors (storeys) (e.g. bungalow = 1)		How many bedrooms?	

Energy efficiency publicity

6. Have any of the following have made you aware of energy efficiency, and energy efficiency grants? *Tick all that apply*:

	Tick		Tick
Leaflets with gas or electricity bills		Ad for Energy Saving Trust (EST)	
Ads by insulation installers		Warm Zone	
Temporary energy advice stand		Charity or community organisation	
Presentation at a meeting		Friend	
Newark and Sherwood Energy Agency		Neighbour	
Another Newark & Sherwood Council dept		Relation	
Another local council		Media coverage (newspaper, radio, TV etc)	
Leaflet at a library or other public building		None of these	
Energy efficiency advice centre (EEAC)		Other, please specify below	

Understanding Heating Systems and Insulation

Household heating systems and insulation can be difficult to understand.

7. Which methods should be made available to inform people about using (and installing) heating systems and insulation for maximum comfort and economy? And which method would you use to learn more? *Tick all that apply in each column*.

	Should be available	I would use
Colour booklets		
A basic website with text and photos		
An interactive website with video and sound		
A DVD or video presented by a television personality		
Special facilities for the visually or aurally impaired		
A telephone helpline		
Home visit by an expert		
None		
Other, please specify		

Loft Rooms

8. Does your current home have a loft room (or rooms)?	Tick
No	
Yes, the loft room(s) was/were put in when the house was built	
Yes it was / they were added since the house was built	
Yes but not sure of the history	

If your answer was one of the 'yes' options, please answer these questions.

When was your loft conversion made? If you don't know, give approx year: ☐ How many rooms? ☐

How is your loft conversion heated? Please tick one:

Not heated: ☐ Connected to main heating system: ☐ Heated separately: ☐

Conservatories

9. Does your current home have a conservatory?	Tick
No	
Yes, the conservatory was constructed when the house was built	
Yes the conservatory was added since the house was built	
Yes but not sure of its history	

If your answer was yes, please answer these questions.

When was your conservatory built? If you don't know, give an approx year: ☐

How is your conservatory heated? Please tick one:

Not heated: ☐ Connected to main heating system: ☐ Heated separately: ☐

How is your conservatory connected to the main part of the house? Please tick one:

Open direct into a room: ☐ Separated from the nearest room by a door / window / wall: ☐

Approximate size of conservatory? Please give length and width. If you need to go and measure, please do the rest of this survey first! If necessary, skip this question.

☐ X ☐ metres / feet - *delete as appropriate*

Energy Efficiency and Renewable Energy

We are interested in your views on the relative merits of household energy efficiency, and renewable energy **in homes**.

Energy efficiency involves the better use of energy supplies. Some household energy efficiency measures are cheaper, such as insulating cavity walls, but others are more expensive, such as insulating older pre-1930s solid walls (using 'insulated dry-lining' or external cladding).

Renewable energy is energy generated from environmentally friendly sources, and domestic systems include small wind turbines, wood boilers, and electric or hot-water solar panels. Currently they can be expensive per unit of energy supplied.

10. Should government and local councils... *(tick only one):*	Tick
Switch significant resources *now* from *energy efficiency* to *renewable energy* subsidies	
Complete cheaper household *energy efficiency* measures first and then assist *renewable energy*	
Complete cheaper *and* more expensive *energy efficiency* measures first, and then assist *renewable energy*	
Take other actions, please specify:	

Personal Carbon Allowances

Almost all human activity involves using energy - or "power" or "fuel". In most cases this involves using a fossil fuel - oil, gas or coal. Sometimes they are used indirectly in the form of electricity. Using fossil fuels adds carbon dioxide - a greenhouse gas - into the atmosphere which, the vast majority of scientists believe, causes climate change (also known as global warming or the greenhouse effect).

Some electricity comes from nuclear power stations. However this produces waste which is radioactive and therefore dangerous to human health and the environment for thousands of years, although it does not produce any carbon dioxide.

Only a small amount of our energy currently comes from renewable sources, such as wind or wood, which do not put extra carbon dioxide into the atmosphere. Therefore many believe that energy use needs to be better managed to cut 'carbon emissions'.

It has been suggested that everyone in the UK should be given an annual "carbon allowance" to allow them to buy units of household energy / power, vehicle fuel, and airline mileage. If a person does not use all their units, they could sell them to other people who need more units.

11. What do you think of such proposals? *Tick one*:

Support them strongly		No feelings either way	
Support them moderately		Moderately opposed to them	
		Strongly opposed to them	

12. Leaving aside your views on carbon allowances, how would you act if such a system was in place? *Tick one column against each action (note, only a selection of actions can be given here):*

	Probably	Possibly	Unlikely	Don't know	Already do this
Use a small or fuel efficient car					
Use public transport or cycle					
Make your home energy efficient					
Take holidays which don't involve flying					
Live nearer your workplace, or get a job near to home					
Work at home					
Keep as many units as possible for car use					
Keep as many units as possible for flying					
Buy other people's units to enable you to use more energy					
Try to use as few units as possible so you could sell them					

Gas and Electricity Suppliers

13. Have you switched electricity OR gas supplier in the last twelve months? Yes ☐ No ☐

If your answer was yes, please answer the next question.

14. How did your switch of supplier occur? *Tick all that apply for each fuel*:

	Gas	Elec
Fraudulent transfer		
The company approached you (doorstep sales; salesperson in a street or shop; mailshot, telesales, brochure or advertisement etc)		
Friend or relation mentioned or recommended the new supplier		
Chose to go to a "green" or environmentally friendly tariff		
Investigated alternatives through a web or telephone service which advised the best deal		
Moving home forced a change of supplier		
Other, please specify below		

Gas..... Elec.....

15. Have you had problems with your electricity or gas supplier in the last 12 months?
Tick all that apply for each fuel. Before ticking 'no', please check all possible answers!

	Gas	Elec
I can't be sure that I saved money following a switch of suppliers (e.g. charges went up shortly after transferring, or potential savings were exaggerated or not properly explained)		
Wrong amount billed (e.g. estimate too high, charged for someone else's usage)		
Billed by two or more companies for the same period, or by no company at all		
Things went wrong when moving home		
Had unexpected debit taken from my bank account, or excessive amount taken		
Problems occurred that wasted a lot of time or caused me increased phone bills		
Threatened with, or subjected to, debt collection, legal action or disconnection		
The company did not take fully into account that I am disabled or a "priority" user		
No, everything has gone smoothly		
Other problems, please specify below		

Gas..... Elec.....

16. If you have never switched gas or electricity supplier, other than when moving, please tell us why. *Tick all that apply for each fuel:*

	Gas	Elec
I / we didn't know you could change		
We are on a pre-payment meter (PPM) and other suppliers aren't interested		
On a budget plan and other suppliers won't offer that		
On a fixed payment plan e.g. Powergen Staywarm		
Don't want to pay by direct debit and that's what the other suppliers encourage		
Have heard about things going wrong when switching		
Concerned that my / our budgeting will be disrupted		
Not convinced that I / we will save money		
Not interested in switching		
Other reason, please specify below		

Gas..... Elec.....

Home's physical details

17. How deep is the insulation in the roof space (loft)? *Please tick one:*

No loft		None		2"/5 cm		4"/10 cm		6"/15 cm		8"/20 cm or more		Don't know	

18. Which best describes the walls of your house? *Please tick one:*

Cavity walls (unfilled)		Insulated cavity walls		Timber frame walls		Solid wall	

19. Which best describes the glazing of the windows of your house? *Please tick all that apply:*

Wood single		Wood double		Metal single		Metal dbl.		uPVC single		uPVC dbl.	

Heating

20. What is the main heating and fuel used in winter? *Tick one for each*:

Heating		Fuel	
Central heating with radiators and combi boiler		Gas	
Central heating with radiators and standard boiler		Electricity	
Central heating with radiators/ condensing boiler		Oil	
Warm air system		LPG	
Electric storage heaters		Coal	
Individual heaters or fires		Smokeless fuel	

21. What heating controls do you have? *Please tick all that apply*:

None		Programmer		Room thermostat		Thermostatic radiator valves	

22. What is the main way of heating water for baths and washing up? *Please all that apply*:

From central heating		Off peak electricity		Peak electricity		Gas instantaneous	

Further Contact

23. Are you /your household willing to be contacted again? *Please indicate by ticking below*:

I / we would be willing to answer other surveys of this type by IESD or NSEA	
No more contact or surveys, thank you	

Many thanks for completing this survey. *Please send it in the reply-paid envelope provided*, to De Montfort University (or if that has been mislaid please send it in a stamped envelope to NSEA Survey, Institute for Energy and Sustainable Development [IESD], De Montfort University, The Gateway, Leicester, LE1 9BH).

12.5 Appendix - Council Homes Questionnaire

De Montfort University - Household Energy Survey

Please see covering letter for data protection statement.

Name _____ (giving your name is optional)

Address _____ _____ Postcode

Please complete as many questions as possible, skipping any that you don't feel comfortable answering. A partially completed form is better than returning no form at all!

Household details

1. Do you rent, or own your home? *Please tick one*:

Own your home		Renting from housing association		Renting from council		Renting privately		Other	

Name of housing association _____

2. How many people live in your home?		How many over 60?	

3. Which year was your home built? (if not sure, please state approximately)	

4. What type of property do you live in? *Please tick one*:

Detached house		Semi detached		End terrace		Mid terrace		Ground floor flat		Mid floor		Top floor flat *	

5. How many floors (storeys) (e.g. bungalow = 1)		How many bedrooms?	

Home's insulation

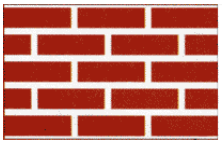
6. How deep is the insulation in the roof space (loft)? *Please tick one:*

No loft		None		2"/5 cm		4"/10 cm		6"/15 cm		8"/20 cm or more		Don't know	

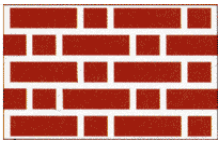
7. Which best describes the walls of your house? *Please tick one:*

Cavity walls (unfilled)		Insulated cavity	
Timber frame walls		Solid wall	

Most houses built since 1930 have cavity walls.



Typical cavity wall



Typical solid brick wall

8. Which best describes the glazing of the windows of your house? *Please tick all that apply:*

Wood single		Wood double		Metal single		Metal dbl.		uPVC single		uPVC dbl	

Heating

9. What is the main heating and fuel used in winter? *Tick one for each*:

Heating		Fuel	
Central heating with radiators and combi boiler		Gas	
Central heating with radiators and standard boiler		Electricity	
Central heating with radiators/ condensing boiler		Oil	
Warm air system		LPG	
Electric storage heaters		Coal	
Individual heaters or fires		Smokeless fuel	

10. What heating controls do you have? *Please tick all that apply*:

None		Programmer		Room thermostat		Thermostatic radiator valves	

11. How is water for baths and washing-up heated? *Please all that apply*:

From central heating		Off peak electricity		Peak electricity		Gas instantaneous	

12. How easy is it to keep your home the right temperature? *Tick all that apply:*

All parts of the home are warm in winter		There are problems with condensation	
There are problems during coldest parts of winter		There are problems with damp or mould	
There's not enough hot water		It gets too hot in summer	
It costs a large part of my / our income to pay the fuel bills		I / we have problems with ensuring we have fresh air while also keeping warm	
Some parts of the home are difficult to heat up			

Lofts and conservatories

13. Does your current home have a loft room (or rooms)?	Yes		No	
14. Does your current home have a conservatory?	Yes		No	

Understanding Heating Systems and Insulation

Household heating systems and insulation can be difficult to understand.

15. Which methods should be made available to inform people about using (and installing) heating systems and insulation for maximum comfort and economy? And which method would you use to learn more? *Tick all that apply in each column*.

	Should be available	I would use
Colour booklets		
A basic website with text and photos		
An interactive website with video and sound		
A DVD or video presented by a television personality		
Special facilities for the visually or aurally impaired		
A telephone helpline		
Home visit by an expert		
None		
Other, please specify		

Energy efficiency grants

16. Have you ever received a grant to improve energy efficiency in your current home? Check the list in the next question if you are unsure. Remember, the provider may have obtained the grant for you.

Yes, and I arranged it		Yes, but the landlord arranged it		No	

If your answer was yes, please answer the following four questions, otherwise go to the next section.

17. What was the grant for? Tick all that apply. Please also indicate which year it took place.

	Tick	Year		Tick	Year
Replacement fridge or fridge-freezer			Hot water tank jacket		
Low energy light-bulbs			Draft proofing		
Cavity wall insulation			Central heating installation		
Roof / loft insulation			Other, please specify below		

---

18. Did the grant pay for most or all of the cost? If you had more than one grant, please refer to the most valuable. (tick one):

Yes, I paid nothing (or only for minor aspects)	
No, the grant only paid for *part* of the cost	

19. Who was the grant given by? (tick one)**:**

An electricity or gas supplier	
Other, please specify below	

---

20. How did you find out about the grant(s)? *Tick all that apply.*

	Tick		Tick
Leaflets with gas or electricity bills		Energy Saving Trust (EST)	
Ad by provider		Warm Zone	
Temporary energy advice stand		Charity or community organisation	
Presentation at a meeting		Friend	
Newark and Sherwood Energy Agency		Neighbour	
Another Newark & Sherwood Council dept		Relation	
Another local council		Media coverage (paper, radio, TV etc)	
Leaflet at a library or other public building		None of these	
Energy efficiency advice centre (EEAC)		Other, please specify below	

Energy Efficiency and Renewable Energy

We are interested in your views on the relative merits of household energy efficiency, and renewable energy **in homes**.

Energy efficiency involves the better use of energy supplies. Some household energy efficiency measures are cheaper, such as insulating cavity walls, but others are more expensive, such as insulating older pre-1930s solid walls (using 'insulated dry-lining' or external cladding).

Renewable energy is energy generated from environmentally friendly sources, and domestic systems include small wind turbines, wood boilers, and electric or hot-water solar panels. Currently they can be expensive per unit of energy supplied.

21. Should government and local councils... *(tick only one)*:	Tick
Switch significant resources *now* from *energy efficiency* to *renewable energy* subsidies	
Complete cheaper household *energy efficiency* measures first and then assist *renewable energy*	
Complete cheaper *and* more expensive *energy efficiency* measures first, and then assist *renewable energy*	
Take other actions, please specify:	

Personal Carbon Allowances

Almost all human activity involves using energy - or "power" or "fuel". In most cases this involves using a fossil fuel - oil, gas or coal. Sometimes they are used indirectly in the form of electricity. Using fossil fuels adds carbon dioxide - a greenhouse gas - into the atmosphere which, the vast majority of scientists believe, causes climate change (also known as global warming or the greenhouse effect).

Some electricity comes from nuclear power stations. However this produces waste which is radioactive and therefore dangerous to human health and the environment for thousands of years, although it does not produce any carbon dioxide.

Only a small amount of our energy currently comes from renewable sources, such as wind or wood, which do not put extra carbon dioxide into the atmosphere. Therefore many believe that energy use needs to be better managed to cut 'carbon emissions'.

It has been suggested that everyone in the UK should be given an annual "carbon allowance" to allow them to buy units of household energy / power, vehicle fuel, and airline mileage. If a person does not use all their units, they could sell them to other people who need more units.

22. What do you think of such proposals? *Tick one*:			
		No feelings either way	
Support them strongly		Moderately opposed to them	
Support them moderately		Strongly opposed to them	

23. Leaving aside your views on carbon allowances, how would you act if such a system was in place? *Tick one column against each action (note, only a selection of actions can be given here):*	Probably	Possibly	Unlikely	Don't know	Already do this
Use a small or fuel efficient car					
Use public transport or cycle					
Be more energy efficient at home					
Take holidays which don't involve flying					
Live nearer your workplace, or get a job near to home					
Work at home					
Keep as many units as possible for car use					
Keep as many units as possible for flying					
Buy other people's units to enable you to use more energy					
Try to use as few units as possible so you could sell them					

Gas and Electricity Suppliers

24. Have you switched electricity OR gas supplier in the last 12 months? Yes ☐ No ☐

If your answer was yes, please answer the next question.

25. How did your switch of supplier occur? *Tick all that apply for each fuel*:

	Gas	Elec
Fraudulent transfer		
The company approached you (doorstep sales; salesperson in a street or shop; mailshot, telesales, brochure or advertisement etc)		
Friend or relation mentioned or recommended the new supplier		
Chose to go to a "green" or environmentally friendly tariff		
Investigated alternatives through a web or telephone service which advised the best deal		
Moving home forced a change of supplier		
Other, please specify below		

Gas..... Elec.....

26. Have you had problems with your electricity or gas supplier in the last 12 months?
Tick all that apply for each fuel. Before ticking 'no', please check all possible answers!

	Gas	Elec
Can't be sure that I saved money following a switch of suppliers (e.g. charges went up shortly after transferring, or potential savings were exaggerated or not properly explained)		
Wrong amount billed (e.g. estimate too high, charged for someone else's usage)		
Billed by two or more companies for the same period, or by no company at all		
Things went wrong when moving home		
Had unexpected debit taken from my bank account, or excessive amount taken		
Problems occurred that wasted a lot of time or caused me increased phone bills		
Threatened with, or subjected to, debt collection, legal action or disconnection		
The company did not take fully into account that I am disabled or a "priority" user		
No, everything has gone smoothly		
Other problems, please specify below		

Gas..... Elec.....

27. If you have never switched gas or electricity supplier, other than when moving, please tell us why. *Tick all that apply for each fuel:*

	Gas	Elec
I / we didn't know you could change		
We are on a pre-payment meter (PPM) and other suppliers aren't interested		
On a budget plan and other suppliers won't offer that		
On a fixed payment plan e.g. Powergen Staywarm		
Don't want to pay by direct debit and that's what the other suppliers encourage		
Have heard about things going wrong when switching		
Concerned that my / our budgeting will be disrupted		
Not convinced that I / we will save money		
Not interested in switching		
Other reason, please specify below		

Gas..... Elec.....

Landlord activity

If you rent from the council or from a housing association, please answer these this question. De Montfort University will not release your answers to the council or your landlord:

28. How good is your landlord in ensuring your home can achieve the right temperature? *Tick all that apply:*

The landlord has improved the heating or insulation (other than boiler servicing) in the last five years	
I / we have been shown by the landlord how to operate the heating controls, keep warm, etc	
The landlord doesn't do anything	

Comments.....

Further Contact

29. Are you /your household willing to be contacted again? *Please indicate by ticking below*:

I / we would be willing to answer other surveys of this type by IESD or NSEA	
No more contact or surveys, thank you	

Many thanks for completing this survey. *Please send it in the reply-paid envelope provided*, to De Montfort University (or if that has been mislaid please send it in a stamped envelope to NSEA Survey, Institute for Energy and Sustainable Development [IESD], De Montfort University, The Gateway, Leicester, LE1 9BH).

12.6 Appendix - Delivery locations for questionnaires

12.6.1 Locations of new homes that questionnaires were delivered to

A mix of property types was delivered to in the following locations:

- Tudor Close area;
- Syerston Way;
- Swinderby Close;
- Cannon Close;
- Cludd Avenue,
- Sea Croft;
- Adwalton Close;
- Bristol Close;
- Stirling Drive;
- Youngs Close;
- Youngs Avenue;
- Williams Lane;
- Goldstraw Lane.

12.6.2 Locations of council homes that questionnaires were delivered to

Around 100 of the council housing survey questionnaires were delivered to the following streets in Newark on 19/09/06:

- Pierson Street;
- Orston Avenue;
- Elizabeth Road (a few only, near junction with Orston Avenue);
- Cleveland Square / Carswell Close;
- Saint Mary's Close;
- Beech Avenue (a few only).

It proved very difficult to identify homes which belonged to the council and those which had been bought by occupants (or previous occupants). Although certain types of property e.g. old people's bungalows, three storey houses, and flats were apparently easier to identify as council owned, ordinary two-storey semis and terraces were much harder to classify. In the end, only nine responses were received from the above, with one of these being an owner-occupied home.

Thus Newark and Sherwood Homes provided the data that gave the addresses of their properties, and basic fabric and heating details. This was loaded into Excel and from there into a Palm Tungsten T1 handheld computer, which was used during hand delivery. This ensured delivery of the remaining 300 packs only to council owned homes. The streets delivered to, on 21/11/06, were:

- Forster Avenue;
- Philip Road;
- Churchill Drive;
- Belvoir Crescent;
- Ash Road
- Stafford Avenue;
- Wilfred Avenue;
- Mount Road;
- Belvoir Road;
- London Road;
- Moulton Crescent;
- Landsbury Road.
- Grange Road and five blocks of flats thereon e.g. Clifton House, Gill House, Wilson House.

12.7 Appendix - Interview covering letter

_____ 200___

To the interviewee(s) _____.

Dear Sir or Madam,

Thank you for helping with our research into climate change

Thank you for assisting our research, which is being carried out in conjunction with Newark and Sherwood Energy Agency (NSEA) and supported by the Pilkington Energy Efficiency Trust.

If you have any questions regarding this research, please email Andrew Wallace at awallace@dmu.ac.uk or ring him on 0116 2 551 551 extension 6848, or Professor Paul Fleming (Assistant Director, IESD) on 0116 257 7963, or Dr Andrew Wright (Senior Research Fellow) on 0116 257 7960, and they will try to help you. Note that just because we ask a question on a particular subject, we don't necessarily imply support for a particular policy.

We hope you enjoy the interview.

Yours sincerely,

Andrew Wallace, MSc
INREB Faraday Associate

Data protection statement

Our data protection policy, designed to protect you and your household, is as follows.

Any information you supply will be used exclusively for the purposes of our research programme and will not be passed to others or used for any other purpose. Information, if published, will be in aggregated form so that individuals cannot the identified. The data, including recordings, will be held securely and disposed of when its purpose for collection is over.

Any personal information used will be handled under the terms of the Data Protection Act. We are not interested in details of individuals, and we will de-personalise your responses. We may merge your responses with those given regarding your household in previous NSEA energy surveys, for the purposes of analysis.

IESD is part of De Montfort University (DMU), Leicester. NSEA in part of Newark and Sherwood District Council and is headed by David Pickles OBE Architect. IESD is a supplier to NSEA and where appropriate is also covered by their data protection policies. DMU has established ethics policies which control how we conduct surveys and other research, and this project has been reviewed appropriately.

12.8 Appendix - Interview questionnaire

This is in effect the plan used during the interviews.

Turn off mobile phone!

Question Set 1 - Basics

Day	Date	Time

Name	
Address	
Other contact details	

Participant	M/F	Age	

OK to record?	Advised re confidentiality?

House type and number of bedrooms	
Period and no. of storeys	
Heating system and fuel, and controls.	
Meters - when do you look at them?	
Vehicles	

Question Set 2 - Background

Tell me briefly what you think about climate change?
If interviewee struggles, offer these five options:

- Don't' believe it's happening;
- Do believe it's happening but it's not man made;
- Do believe it's happening and it is caused by man;
- Do believe it's happening and I can do something about it;
- Do believe it's happening but don't believe I can do anything about it.

Do you think you spend more than 10% of your household income on fuel for your home?

What energy saving measures have you got in your home (including appliances)?

Which home energy saving measures do you think are the most effective?
(If interviewee cannot think of any examples, use: loft insulation, wall insulation, modern boiler, low energy light bulbs, draught-proofing, floor insulation, double glazing, energy efficient appliances)

Describe PCAs using PowerPoint slide-show.

Question Set 3 - Attitudes

Do you support the ideas of personal carbon allowances?
Use likert scale: strongly support, moderately support, neither supportive nor against, moderately against, strongly against.

Can you tell me why?

Go through the footprint spreadsheet, excluding measures.

Now that we have looked at your footprint, has your view of personal carbon allowances changed?

If so, how and why?

How will PCAs affect members of your household and family?

Question Set 4 - Your response to PCAs

While looking these questions, use the spreadsheet again, this time considering measures.

Would you react by changing how you do things in the home, the sort of things that don't cost you anything to do? If yes, how?
(If interviewee cannot think of any examples, use: turning down the heating, keeping an eye on energy usage)

Would you react by taking measures in the home to reduce energy consumption? I mean the sort of things that cost money, or you might get a grant for. If yes, how?

What would need to change, and what information would you like, to help with these?

Would you react by changing how you travel? If yes, how?
(If interviewee cannot think of any examples, use: buy a more efficient or smaller car, flying less, cycling, using public transport, moving closer to work)

What would need to change, and what information would you like, to help with this?

Obtain the final footprint figure from the spreadsheet, which should take into account measures implemented (and reduced car / airline usage, etc.).

Now that we have looked at some measures to reduce your footprint, has your view of personal carbon allowances changed? If so, how and why?

Question Set 5 - Governance

What do you think the government and local councils could do to help?

12.8.1 Abandoned questions

These questions, under the headings given, were dropped after the third interview.

Background:
Tell me about what you think the effect of a home's age has on its energy use?
Tell me about what you think the effect that a home's type (e.g. flats versus terraces vs. detached houses) has on its energy use?
Tell me about what you think the effect that a home's size has on its energy use?

Attitudes
What would make you - or other people - more accepting of PCAs?
Leaving aside climate issues, what other benefits do you think might come from rationing of energy?

Chronological issues - questions
Which changes would you make without a system of PCAs being in place?
Would you act to reduce your carbon emissions as soon as possible or would you wait until you had to start buying units?

Other people's responses to PCAs:
How would your elderly friends and relations cope - what needs to be done for them?
How do you think would your friends, colleagues and relations would be affected by PCAs and how might they react?
How do attitudes within your household vary and how might that affect the way you respond?

Information provision.
Would you like someone to come to visit you in your home to advice you on how to reduce your emissions? Or would information sources such as leaflets and the Internet be sufficient to provide you with advice?

Broader issues
Who should run the systems?
How might the system cope with those with dementia or learning difficulties?
About grown up children - how to stop them keeping all their allowance, and not contributing to the parental home budget?

12.9 Appendix - Interview slide show

Personal carbon allowances

Andrew Wallace

Researcher

Institute of Energy and Sustainable Development,

De Montfort University.

awallace@dmu.ac.uk

What is climate change?

- Greenhouse effect, global warming, carbon or CO_2 emissions.
- Main cause: fossil fuels (coal, oil, gas) burnt, releasing carbon (dioxide) into atmosphere.
- We all cause climate change.
- Caused by homes, industry, transport.
- Also methane from waste, agriculture.
- Some other gases from industry.
- Traps more of sun's rays, altering climate.
- Effect on sea levels, storms, food production, economy.

What are PCAs?

- Equal allocation for home and car fuel, & flying;
- For energy from fossil fuels (gas, oil, coal);
- Not a tax;
- Reducing annual total – towards 60% - 80% cut;
- Part of international contraction and convergence (C&C).
- Annual allocation – in monthly issues;
- Would still pay for energy / fuel;
- Parallel business system;
- Carbon card for petrol / diesel and flights;
- Unit price likely to vary and generally rise;
- Sell excess to those who need more.

Some points

- There are no wrong answers.
- Even a "don't know" can be a helpful answer.
- Ask me questions – I want to know what you don't know or don't understand.
- Anyone in the home can join in.
- I have no opinions on these subjects – I am researching.
- Try to assume the system will work, although ideas for its details are welcome.

Personal carbon allowances

Thank you



Andrew Wallace
Institute for Energy and Sustainable Development,
De Montfort University, Leicester
awallace@dmu.ac.uk
0116 2 551 551 x 6848.

12.10 Appendix - Footprinting spreadsheet

The following three pages contain representations of the worksheets from the Excel spreadsheet used to calculate interviewees footprints.

Sheet: CO2 Footprint.

No. adults	2.0

Home

Gas

£ gas p.c.m.	£30.00	kWh gas p.a.:	14,618	kg CO2 from gas p.a.:	2,777

Elec

£ elec p.c.m.	£25.00	kWh elec p.a.:	3,203	kg CO2 from elec p.a.	1,377

Oil

Litres heating oil p.a.	0	kg CO2 from oil p.a.:	0

Coal

Tonnes coal p.a.	0	kg CO2 from coal p.a.	0

Overall emissions from home kg:	4,155	tonnes:	***4.15***

Car use

EITHER: By mileage	Miles p.a.		Miles per litre	Litres p.a.	Litres to kg CO2	kg CO2
Car 1 (petrol)	9,000	miles, at	6.622	1,359	2.315	3,146
Car 2 (diesel)	0	miles, at	8.69	0	2.63	0
Car 3		miles, at	6.622	0	2.315	0

OR: By fuel purchase	Spend per week	Price per litre	Litres per week	Litres p.a.	Litres to kg CO2	kg CO2
Car 1 (petrol)	£0	£0.95	0.0	0	2.315	0
Car 2 (diesel)	£0	£0.95	0.0	0	2.63	0
Car 3	£0	£0.95	0.0	0	2.315	0

Overall emissions from car use: ***3.15*** tonnes kg CO2: 3,146

Air travel

Journey type	No. trips (return =2)	**Total kg CO2**
Domestic	0	0
Short haul	4	624
Long haul	0	0

Overall emissions from air travel: tonnes ***0.62*** kg 624

(60% over 20 years)

Year	Surplus / shortfall	Year	Surplus / shortfall
1	3.32	11	-0.16
2	2.97	12	-0.50
3	2.63	13	-0.85
4	2.28	14	-1.20
5	1.93	15	-1.55
6	1.58	16	-1.90
7	1.23	17	-2.24
8	0.89	18	-2.59
9	0.54	19	-2.94
10	0.19	20	-3.29

Total Household Emissions

	tonnes
Total current emissions:	***7.92***
Savings from measures:	0.00
Total after measures:	***7.92***
Total allowance:	11.59
Surplus / shortfall:	**3.67**
Value of surplus / shortfall:	£146.74

Sheet: Measures.

Measures to reduce emissions

From EST's "Energy Saving Assumptions" unless otherwise specified.
Financial savings assume average home, and gas used for heating fuel.

Measure	Saving (kg pa)	Saving (£ pa)	No. installed	Overall saving (kg pa)	Overall saving (£ pa)	
Upgrades in home						
Loft insulation (from 0 to 27 cm)	1,500	£192		0	£0	
Loft insulation (from 5 to 27 cm)	410	£52		0	£0	
Cavity wall insulation	1,000	£126		0	£0	
Double glazing	680	£86		0	£0	
Floor insulation	340	£43		0	£0	
Internal wall insulation	2,250	£284		0	£0	
External wall insulation	2,400	£305		0	£0	
Draught-proofing inc. skirting boards	265	£34		0	£0	
Hot water tank jacket	150	£19		0	£0	
Low energy lightbulb	47	£10		0	£0	
			Total:	*0*	*£0*	
Replacements - home						
New boiler	810	£102		0	£0	
Heating controls upgrade	490	£62		0	£0	
Fridge (A+ or A++)	80	£17		0	£0	
Fridge-freezer (A+ or A++)	185	£41		0	£0	
			Total:	*0*	*£0*	
Behavioural - home (from Act On CO2)						
Turn off standby on multiple devices	173	£38		0	£0	*
Don't tumble dry in spring / summer	99	£22		0	£0	*
Don't fill the kettle (4 times a day)	27	£6		0	£0	*
Lower thermostat by 1 C	80	£10		0	£0	*
			Total:	*0*	*£0*	

Behavioural - car (from Act On CO2)	**Saving ratio**	**Select =1, not=0.**	***Current car CO2 (kg):***	**CO2 saving (kg)**	**Fuel saving (petrol, litres)**	**£ saving (petrol)**
Eco driving	8%		3,146	0	0	£0
Drive at 70 rather than 60 mph	9%		3,146	0	0	£0
Don't use aircon	5%		3,146	0	0	£0
			Total:	*0*	*0*	*£0*
Total savings from measures						
tonnes:	***0.00***		1	kg		
monetary:			*£0*			

* from Act On CO2

Sheet: Constants.

Constants

Average personal use and thus allowance

	Adults only	Half for kids	Whole pop.
Av. use home	2.591	2.260	2.004
Av. use appliances	0.883	0.770	0.683
Av. use for travel	2.322	2.025	1.796
Annual allowance tonnes CO2:	**5.796**	**5.056**	**4.483**

(4.483 total is from Act On CO2)

(Pop. figures from www.statistics.gov.uk/glance)	millions	
Whole population, 2001 census	58.789	
Children under 20, 2001 census	14.800	
Assumed under-18s (90% of above)	13.320	22.7%

(assume proportion unchanged)

Value of carbon per tonne: £40 from Stern Report, USD $82 with £1 at $2.04, rounded.

Gas Southern Electric (E. Mids. costs from Uswitch)

kWh to kg CO2 conversion factor	Standing charge	Basic units	Cut off kWh p.a.	Cheaper units
0.19	£0.00	£0.03380	4572	£0.02400

kWh to kg CO2 conversion factor (from NEF calculator)

Electricity Powergen (E. Mids. costs from Uswitch)

kWh to kg CO2 conversion factor	Standing charge	Basic units	Cut off kWh p.a.	Cheaper units
0.43	£0.00	£0.17168	900	£0.09419

kWh to kg CO2 conversion factor (from NEF calculator)

Oil (from NEF calculator)	litres to kg CO2 conversion factor:	2.68
Coal (from NEF calculator)	tonnes to kg CO2 conversion factor:	2,548

Sample flight distances

	km	miles
East Midlands to Edinburgh	370	231
East Midlands to Paris	499	312
East Midlands to Malaga	1,808	1,130
London to Istanbul	2,480	1,550
London to New York	5,536	3,460
London to Los Angeles	8,704	5,440
London to Melbourne	16,800	10,500

Airline distance to kg CO2:	0.18 kg/km	0.29 kg/mi	(from NEF calculator)

Typical air journey types	g CO2 / person km	Distance, av. (km)	Journey CO2 (kg)
Domestic	158	425	67
Short haul	130	1200	156
Long haul	105	7000	735

(from Act On CO2)

Car fuel consumptions (from Act On CO2)

	Petrol mpg	Diesel mpg	Petrol mpl	Diesel mpl
Small	35.5	49.3	7.81	10.846
Medium	30.1	39.5	6.622	8.69
Large	21.9	28.2	4.818	6.204

(Fuel prices from observation, July 2007)	Petrol	Diesel
Cost per litre	£0.95	£0.95
litres to kg CO2 conversion factor	2.315	2.63

Average annual mileage	9,000	(from Act On CO2 calculator)

12.11 Appendix - Post-interview form

Post-interview form

Name and date	
Interview interaction (e.g. level of interest).	
Location and length of visit	
Interruptions and difficulties	
Any requests or follow-ups?	
How could future interviews be done better?	
Observations	

END.