North Devon's Biosphere Reserve
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University of East Anglia

Winkleigh Carbon Reduction Project

United Nations Educational, Scientific and Cultural Organization

UK National Committee of Man and the Biosphere Programme

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1. Executive Summary

This report outlines work undertaken for the North Devon Biosphere Reserve to develop a carbon footprint and subsequent carbon reduction plan for Winkleigh Village Parish in Torridge District, North Devon that meets government carbon reduction targets of 34% and 40% by 2020. Utilising the CRed carbon footprinting tool developed at the University of East Anglia, 61 households in Winkleigh completed questionnaires and provided information on a variety of household related energy consumption and travel habits.

Average CO2 emissions per household surveyed were **13.07 tonnes**, the largest proportion being heating and hot water at 63%, followed by private vehicles at 24% and air and train transport at 8%. Emissions from refrigeration, entertainment and other electrical appliances such as lighting made up less than 5% of emissions surveyed.

Five key factors are contributing to carbon emissions from housing in Winkleigh:

1. high rates of heat loss through lack of building fabric insulation
2. high usage of fuel oil which has a high carbon intensity
3. the fact that inefficient boilersare still very commonplace
4. high use of energy hungry Aga and Rayburn cookers
5. a high proportion of inefficient tungsten filament and halogen lightbulbs still in use

Using a “whole house” approach, which considers not only the key factors driving emissions in the home but also their interactions, a number of “packages” of measures are recommended to be implemented in different homes in the village. The key measures, their carbon savings and costs are as follows:

- a programme of cavity wall insulation and installation of air source heat pumps in 260 homes. Total capital cost of £2.27M with carbon savings of 863 tonnes CO2/year
- a programme of loft insulation, draught proofing and installation of condensing boilers in 84 solid wall homes . Total capital cost of £695,000 with carbon savings of 565 tonnes CO2/year
- the replacement of inefficient boilers with heat pumps in 199 homes. Total capital cost £1.71M with carbon savings of 955 tonnes CO2/year
- the replacement of inefficient boilers with condensing boilers in 139 homes. Total capital cost £222,400, with carbon savings of 212 tonnes CO2/year

In total, the strategy proposed generates annual **CO2 savings of 40.25% by 2020** and has a total **capital cost of£5,058,000**. Its total net cost is **£426,000 or £56/household/year** for ten years.

The report concludes with animplementation plan and community engagement strategy recommending a phased roll out of measures between 2010 and 2020 as well as setting up a Winkleigh Green Team to drive forward initiatives. Given the high capital costs of householders installing some of these measures, but the low net costs after energy savings are accounted for, it is recommended that the use of financing vehicles such as an Energy Services Company (ESCo) for Winkleigh or the wider North Devon Biosphere is now explored.

Reductions in carbon emissions from private vehicles are assumed to happen at no cost to this strategy because of:

- improvements to the fuel efficiency of the vehicle fleet as citizens replace their existing cars with new or new second-hand vehicles. The average CO2

emissions of the overall Winkleigh vehicle fleet is assumed to have reduced to 133g/km in 2020, compared to the national average of 233g/km today, following the introduction of the EU vehicle emission performance directive.

- an annual 1% reduction in private vehicle mileage (10% reduction by 2020) is assumed because of the high likelihood that fuel prices will increase because of further increases in the price of carbon through schemes such as the EU Emissions Trading Scheme.

These two likely changes are assumed to provide an annual saving of 1102 tonnes of CO2 from private vehicles by 2020.

A 10% reduction in air travel from current levels is assumed by 2020 because of the high likelihood that the cost of air travel will increase quite markedly because of the inclusion of aviation in the EU Emissions Trading Scheme. This reduction in travel is assumed to provide an annual saving of 139 tonnes of carbon.

2. Introduction

2.1. Summary of Key Deliverables

This report contains the work of four key deliverables which were agreed with the North Devon Biosphere Reserve in August and October 2009 following submission of a project proposal and progress report, respectively, to the client. The four deliverables are:

1. Identification of a suitable carbon footprinting methodologyto assess carbon impacts in Winkleigh Village Parish, Torridge District, North Devon.

2. An estimate of the actual carbon footprint of Winkleigh Village Parish, to be used as a performance baseline against which improvements can be assessed in future years.

3. Development of a carbon reduction strategy for Winkleigh Village Parish that meets 34% and has the dimension of achieving a 40% reduction target by 2020 in case the target is raised at the Copenhagen Summit in December 2009.

4. Development of detailed implementation plans for each carbon reduction strategy including:

    a. Estimates of the potential for carbon reduction through energy saving measures in Winkleigh Village Parish together with estimates of the potential extent of carbon savings for each key action identified.
    b. The projected costof these actions and what savings might be available through bulk discounts, grant funding or available government support.
    c. Implementation plan for meeting 34% and 40% carbon reduction targets including the roles of different stakeholders.

2.2. Carbon Footprinting in Context

Since the adoption of carbon reduction targets under the UK's 2008 Climate Change Act, the need to establish current and baseline carbon emission levels has become an essential requirement for developing strategies to reduce emissions. As a result, carbon footprinting is a rapidly developing field providing valuable information for individuals, communities and countries in their attempts to tackle climate change.

Calculating carbon footprints can be undertaken in a wide variety of ways, drawing on different assumptions and using different boundaries and types of data. The Stockholm Environment Institute (SEI), leading experts on sustainable consumption in Europe and the UK, provide widely used information through their Resources and Energy Analysis (REAP) Programme, to help UK local authorities and agencies to understand their carbon and ecological footprints. Using consumption categories, based on a classification using individual expenditure by purpose, they provide a carbon footprint breakdown per capita for all local authorities in the UK.

Figures 1 and 2 show the REAP footprint for Torridge District Council, in which Winkleigh village lies, and a brief description of the categories that provide that breakdown. The SEI approach provides a useful context in which to place the work of this report, as it

considers in a comprehensive way, all direct and indirect emissions of goods and services that individuals use and consume.

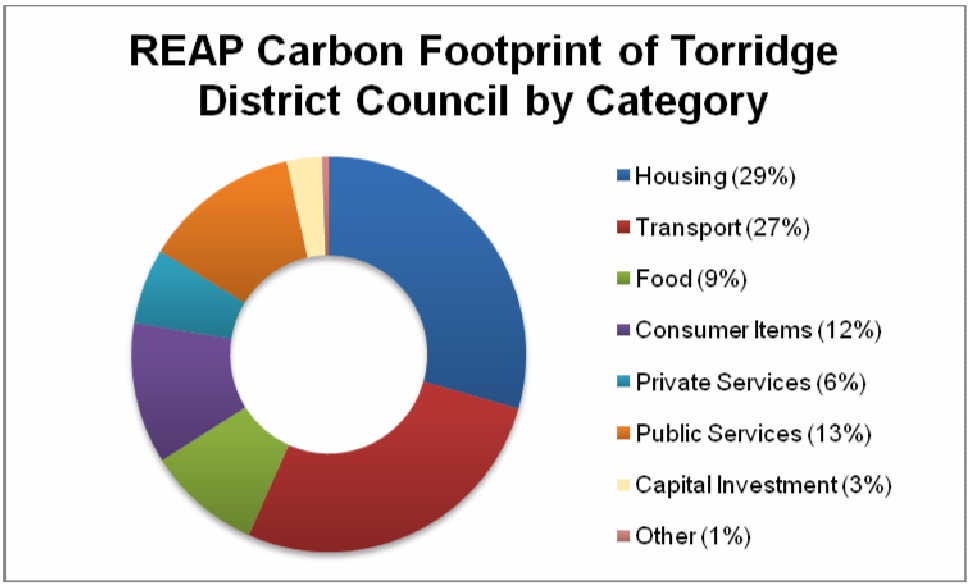


Figure 1 - Per capita carbon footprints by Category for Torridge District Council (from REAP v.2 Stockholm Environment Institute 2004)

Category[1]	**Description**
Housing	Renting of property, payment of mortgages, property maintenance, direct fuel use, impacts of electricity generation and fuel distribution
Transport	Purchase and operation of personal transport equipment, private vehicle fuel use. Road, air, water and ancillary transport. UK residents abroad, capital investment in transport
Food	Food, beverages, capital investment in food
Consumer items	Tobacco, clothing, footwear, furniture, household textiles, appliances, medical products and personal care, audio-visual equipment, newspapers, books and stationery, capital investment consumables
Private Services	Water supply, hospital services, telephone services, recreational & cultural services, Education, Package holidays,Accommodation services, social protection, financial and legal services, capital investment in private services
Public services	Local and central government services, all capital investment associated with public services
Capital investment	Gross fixed capital formation e.g. expenditure on construction, equipment or machinery
Other – non-residents	Non-residents, non profit institutions serving households

Figure 2 – UK Carbon Footprint categories adapted from REAP v.2. Stockholm Environment Institute 2004.

[1] Consumption categories are mostly classified using COICOP: a classification of individual expenditure by purpose. This is internationally recognised by Eurostat and the UN Statistics division

This report is concerned with those impacts that are more easily under the control of individual members of a village community. The degree to which individuals are able to reduce their footprint varies according to activity. For example, carbon impacts associated with public and private sector services are more distant from the individual citizen and harder for them to influence. However, impacts associated with housing, transport, food and consumables are more directly affected and controlled by individual consumer behaviour and decisions. This report focuses mainly on the contribution that actions in these categories can make to reducing emissions and, in particular those actions that can demonstrably meet a 40% carbon reduction target by 2020.

3. Methodology

3.1. Identifying a carbon footprinting methodology- CRed

In order to establish the actions needed for Winkleigh community to reach a carbon reduction target of 40% by 2020, it was necessary for the team to find a quantitative footprinting methodology that would enable an assessment of actual emissions and the ability to model different emission scenarios in order to provide a cost effective carbon strategy and implementation plan.

Research by the team showed that there are a wide variety of methodologies adopted to measure carbon emissions at a personal level. The REAP version 2 SEI method, for example, draws on a very wide variety of national, regional and locally available data to produce a comprehensive assessment of personal carbon footprints. These include direct and indirect emissions (including “embedded” carbon) in all products and services that people consume. Many of these impacts are outside of the direct control of individuals and are embedded into the infrastructural and technological systems that underpin modern life. These represent what consumption theorists such as Sanne (2002) and Ropke (2009) refer to as “systems of provision”. The team felt that a footprinting methodology was needed to generate strategies that would *empower*Winkleigh residents to take tangible and measurable carbon reducing actions.

This led the team to consider the use of the many “carbon calculators” that have become available in recent years to assess the more easily measurableimpacts such as heating and electricity use in the home and personal transport. The majority of these (e.g. Act on CO2, Resurgence)are internet based and do not provide access to the underlying database in order to collate data for further analysis. They also generate very varying results, sometimes by as much as several metric tonnes per individual activity (Padgett et al, 2008). An assessment was undertaken of the *CRed Carbon Footprinting System* developed at the University of East Anglia. This carbon calculator includes heating and electricity use in the home and personal travel. The CRed system requires householders to provide information in the form of a questionnaire, with data then entered into the CRed database for further analysis and scenario modelling as required. Given the requirements of the client, and particularly the need to assess the potential of specific actions that would meet government carbon reduction targets, it was decided that the *CRedCarbon Footprint Assessment System*would provide the most suitable carbon footprint methodology for use in Winkleigh.

The methodology adopted for using the CRed questionnaire in Winkleigh exercised a variety of techniques. These are summarised in Figure 3.

3.2. Pilotand adaptation of CRed questionnaire

The standard template CRed questionnaire is divided into 8 sections:

- Heating, hot water and cooking
- Cooling appliances (electrical)
- Washing Appliances (electrical)
- Lighting (electrical)
- Entertainment and Computing (electrical)
- Carbon Reduction and Renewable Energy
- Private Vehicles and private vehicle hire
- Public travel – air and train

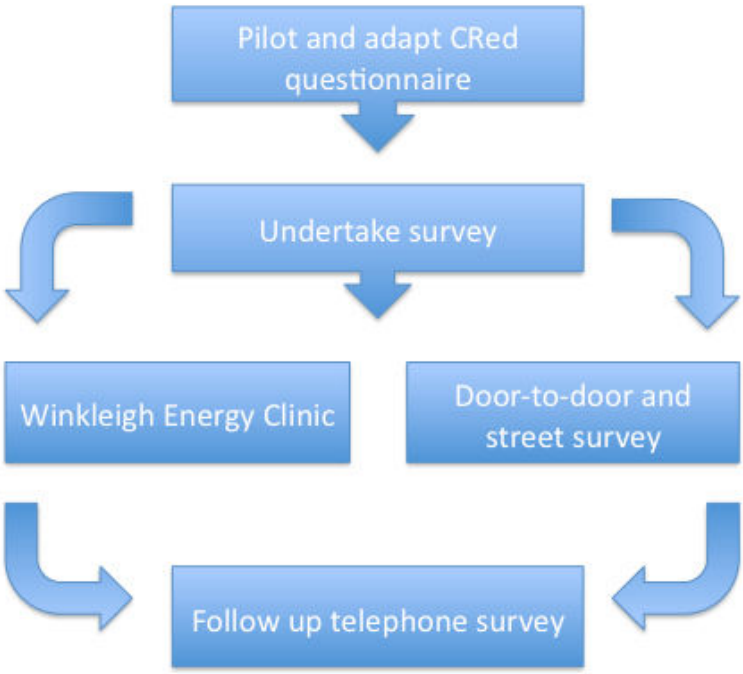


Figure 3: Questionnaire methodology adopted in Winkleigh

This standard template was piloted with three households in Winkleigh to broadly determine its suitability for households there. These households represented the main household construction types in the village including pre war and post 1995. Four key omissions were noted through this process:

- the need to take account of the existence of properties with cob wall and thatched roof construction
- the use of bottled liquid petroleum gas given the absence of mains gas supply in the village
- the use of Aga/Rayburn cookers.

The pilot respondents were positive about the survey, but given the level of some of the technical information needed, it was clear that householders would require support in completing it. It was noted that the questionnaire could be completed by the householder (with assistance from the survey team) in approximately 25 minutes.

This information was incorporated in the final survey design (see Appendix 1) and the team worked with CRed to implement software changes to ensure that subsequent emission calculations from the database would reflect the carbon impacts of all Winkleigh relevant fuel sources and property construction types.

3.3. Undertaking the Survey

In order to obtain as representative sample as possible of Winkleigh properties, the questionnaire survey was undertaken using three main techniques:

- A face to face energy clinic “hall” survey
- Additional face to face doorstep and street surveysand

- Follow up telephone surveys

Energy Clinic

An event survey was selected in order to make the most efficient use of survey time available. The primary objective of the “energy clinic” was to collect survey data, although the event also provided an opportunity to raise awareness and profile among the community of the existence and work of the North Devon Biosphere Reserve and of climate change and carbon issues more generally.

During the two hour event, attendees worked in groups with the support of three “energy clinicians” to complete all eight sections of their carbon footprint questionnaires. The clinic was followed by a short presentation on options for reducing energy consumption at home, followed by an open discussion. The clinic was held at Winkleigh Community Centre on Friday 30th October at 7pm.

Promotional flyers and posters were distributed throughout the village(see Appendix 2), leading up to the event, with the assistance of the project supporter, the Winkleigh Society as well as contact made with all members of the Winkleigh Society. A press release was issued to local press by the client and resulted in coverage in the Okehampton Times.

Householders were invited to bring the following key pieces of information to the energy clinic:

- Energy bills (e.g. electricity, gas, oil, wood, solid fuel)
- Vehicle mileage
- Flights and use of public transport
- Energy ratings of appliances (e.g. fridge/freezer, washing machine, dishwasher)
- Quantity and type of lights in each room (e.g. standard bulbs, low energy bulbs, fluorescents)
- Presence and thickness of loft insulation

It was recognised that those attending the energy clinic would be self selecting and so additional door to door surveys were carried out to ensure a more representative sample.

Door-to-door and street survey

Whereas respondents at the energy clinic were required to complete all eight sections of the questionnaire, it was decided in the door to door and street surveys not to collect data on the 4 sections that covered the use of electrical appliances in the home (refrigeration, clothes washing, lighting and entertainment/computing). This was for the following reasons:

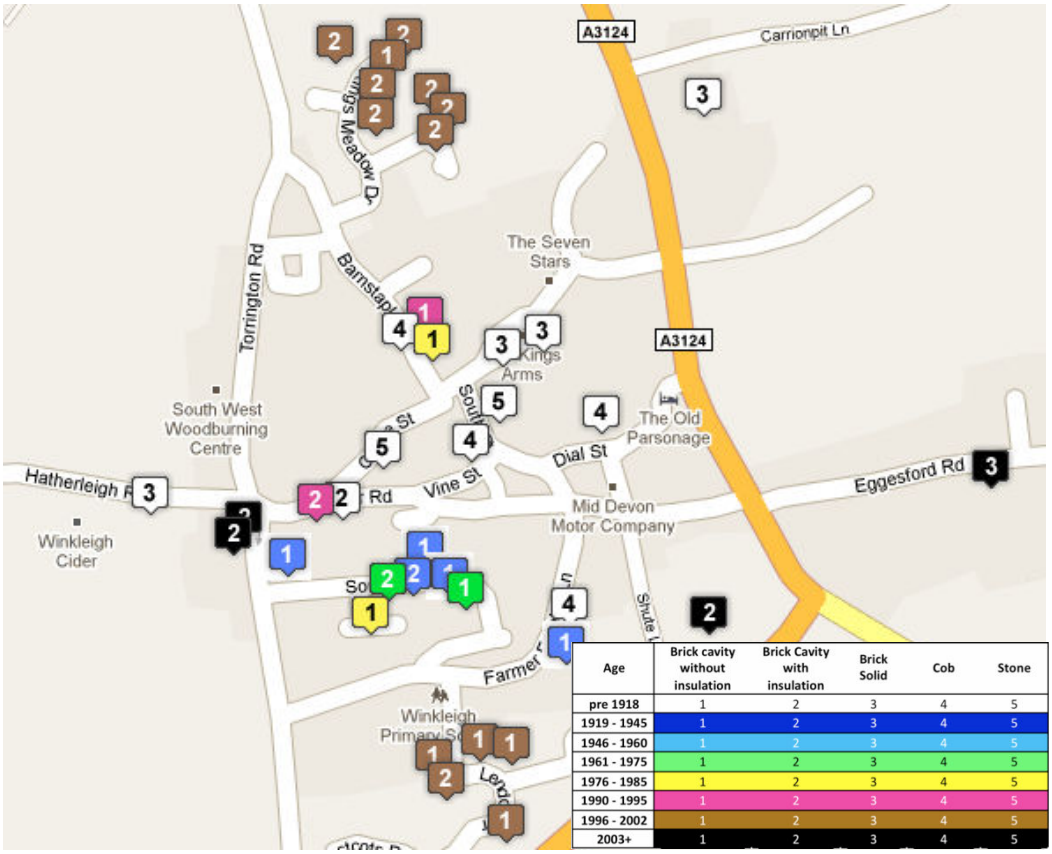
- evidencefrom both the pilot surveys and previously collected CRed data that electrical appliances do not produce more than circa 5% of carbon emissions
- estimates that collecting this data would likely take up more than 50% of the time required to complete the questionnaire
- residents on the street would not have access to all the detailed electrical information required
- residents on the street and doorstep would likely be reluctant to participate in such a detailed, time consuming survey

Instead, the door-to-door and street surveys focused on heating, hot water, cooking and personal transport which collectively produce the highest material emissions. This also enabled the team to survey a larger number of properties and obtain a more representative sample in the time available.

4. Carbon FootprintSurvey Results

4.1. Properties Surveyed

In total, 61 surveys were completed in Winkleigh during the weekend of 30th/31st October 2009. This equates to 8% of the 763 total Winkleigh (parish) households (The Valuation Office 2009).21 surveys were fully completed (all 8 sections) and 40 were partially completed (4 sections completed which comprised approximately 95% of emissions in the fully completed surveys). Figure 4 below shows the approximate locations of the core concentrations of properties surveyed, their ages and construction types. The legend provides details about the colour coding and numbering system used to classify these properties.



Age	Brick cavity without insulation	Brick Cavity with insulation	Brick Solid	Cob	Stone
pre 1918	1	2	3	4	5
1919 - 1945	1	2	3	4	5
1946 - 1960	1	2	3	4	5
1961 - 1975	1	2	3	4	5
1976 - 1985	1	2	3	4	5
1990 - 1995	1	2	3	4	5
1996 - 2002	1	2	3	4	5
2003+	1	2	3	4	5

Figure 4 - Main location area of properties surveyed in Winkleigh

4.2. Energy Clinic evaluation

20 people attended the energy clinic. 15 evaluation feedback forms were completed (see Appendix 3 for sample form). Key findings were as follows:

- 87% rated the evening as “good” or “very good”.
- Following the event, 86% had a better understanding of how to reduce their carbon footprint

- When asked whetherthey would be taking steps from today to reduce their carbon footprint, 64% said yes, 36% said maybe, with nobody saying they would not be taking action.

Individual carbon footprint reports were subsequently generated by the CRed database and sent individually with a covering letter (Appendix 6) to all energy clinic participants.

4.3. Footprint Summary

Average CO2 emissions generated per person surveyed in Winkleigh was**7.1 tonnes**. This compares to an equivalent 6.97 tonnes per capita *for total housing and transport category* emissions from the Stockholm Environment Institute's REAP figures for Torridge District Council (2004), and compares to a national UK average figure of 6.78 tonnes (Goodall, 2007). This indicates that the survey findings are broadly in line with other calculations, although these housing and transport related emissions are slightly higher than the national average.

Surveyed figures equate to **13.07 tonnes** of CO2 per household. As can be seen in Figure 5 below, CO2 emissions from heating and hot water form the largest proportion of emissions at 63%, followed by private vehicles at 24% and air and train transport at 8%. Emissions from refrigeration, entertainment and other electrical appliances such as lighting make up less than 5% of emissions surveyed.

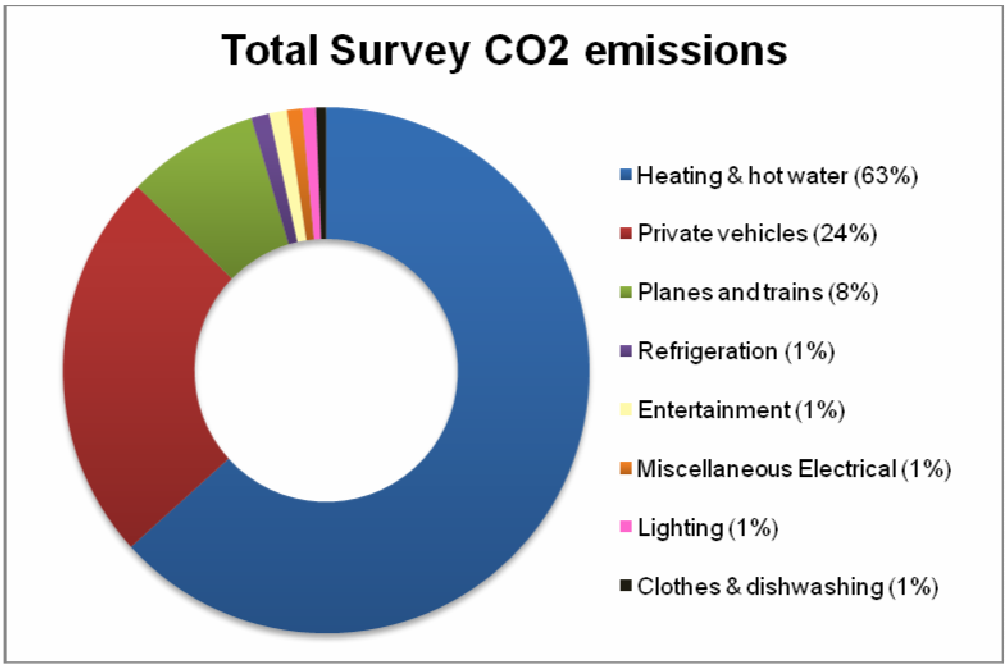


Figure 5 - CO2 emissions by activity covered by survey

4.4. Property types

The properties surveyed reveal a high degree of variety in property age, construction type and construction material. Figures 6 – 9 provide an illustration of this. Notable trends in property type are as follows:

- Almost one third of properties are pre WW1, many of cob walled construction, some with thatched roofs

- One third of properties have been built recently, since 1996
- 52% of properties are of cavity wall construction, but the remainder are highly mixed including cob, stone, and solid brick

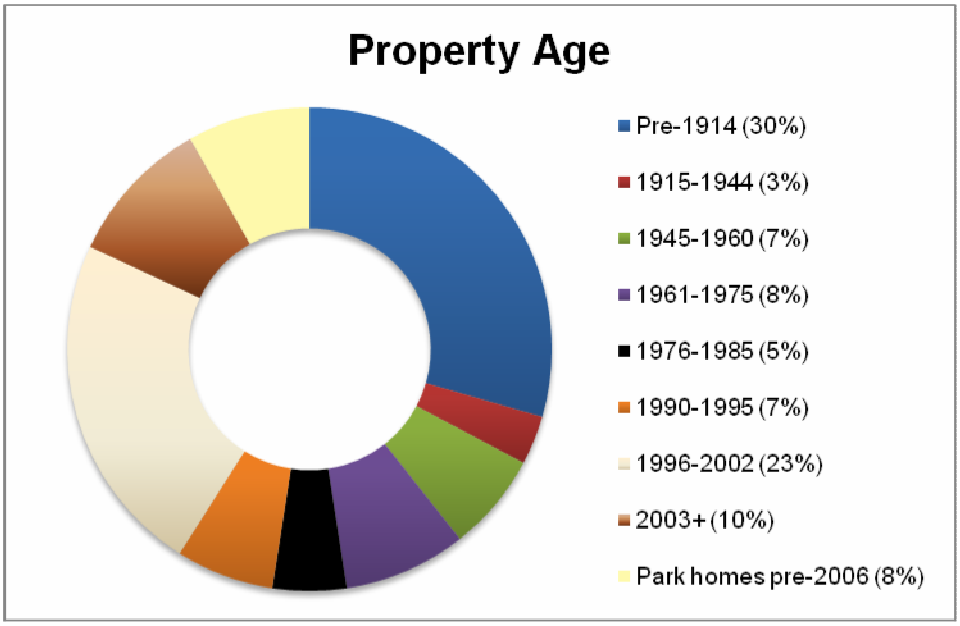


Figure 6 - Ages of houses surveyed

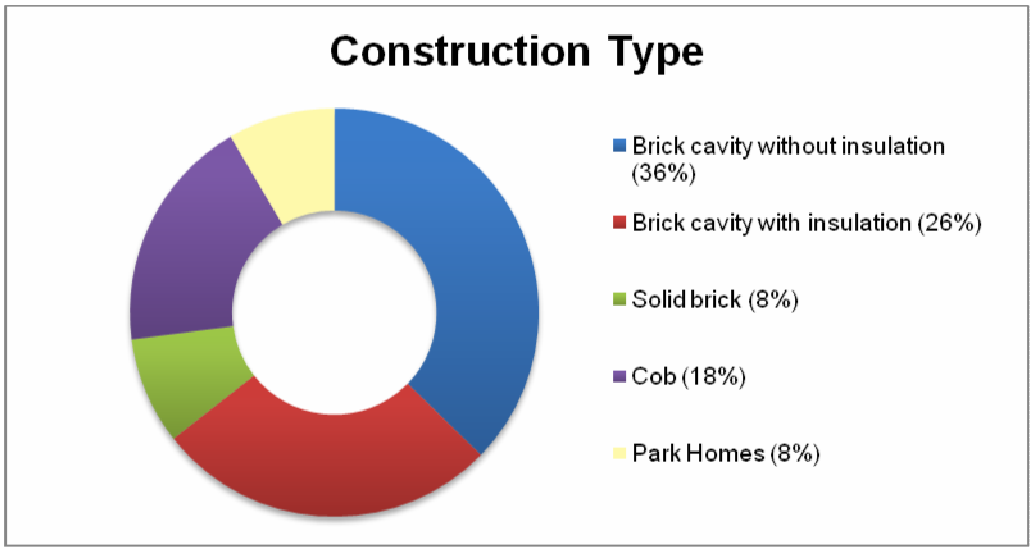


Figure 7 - Construction type of houses surveyed

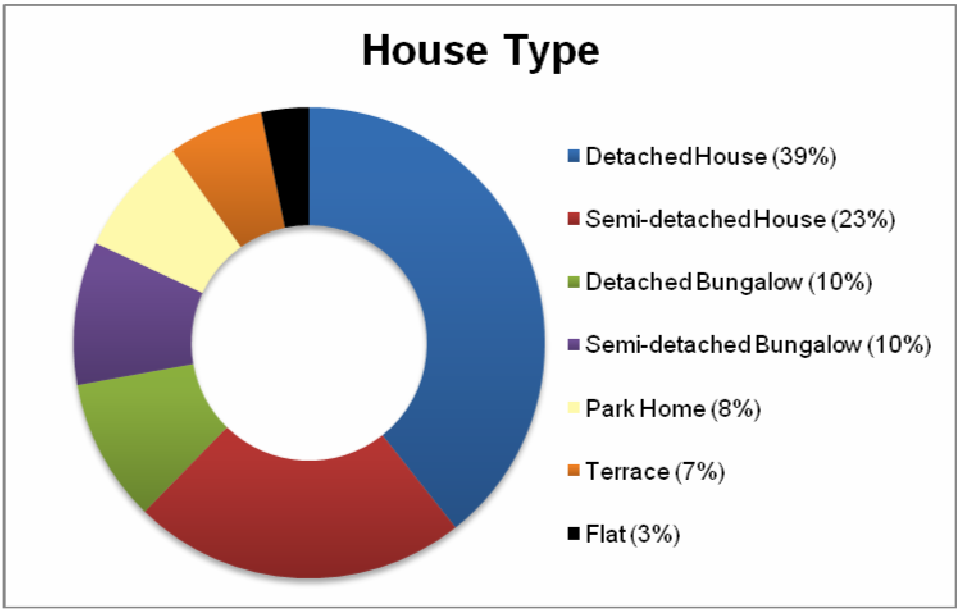


Figure 8 - House types surveyed

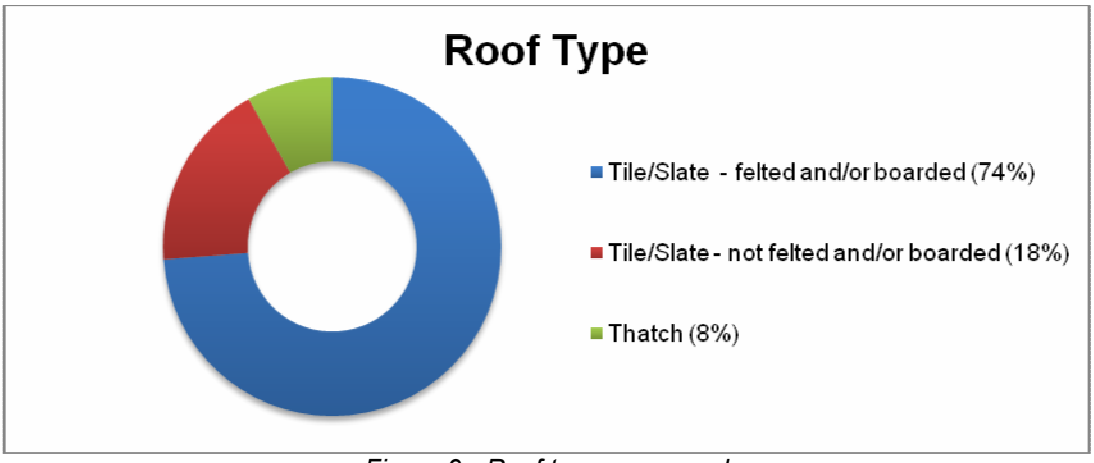


Figure 9 - Roof types surveyed

4.5. Insulation characteristics

The key attributes surveyed for insulation properties were wall type, presence and thickness of loft insulation and type of window glazing. As illustrated in Figure 7, Winkleigh properties are constructed from a wide variety of materials. 36% of properties are of brick cavity construction without cavity insulation. As shown in Figure 10, these represent properties constructed since WW1 and also include some buildings erected around 1996, which may have escaped the 1994 Building Regulations requiring new standards of cavity wall insulation.

These survey results are broadly consistent with other earlier surveys in the region, such as the 2003 English House Condition Survey which found that 43% of all households in the SW region had unfilled cavity walls (Government Office for the South West 2006, p. 2). More recent national figures quoted by DECC (2009) though, show that almost two-thirds of cavity walls had been filled (DECC 2009, p. 83).

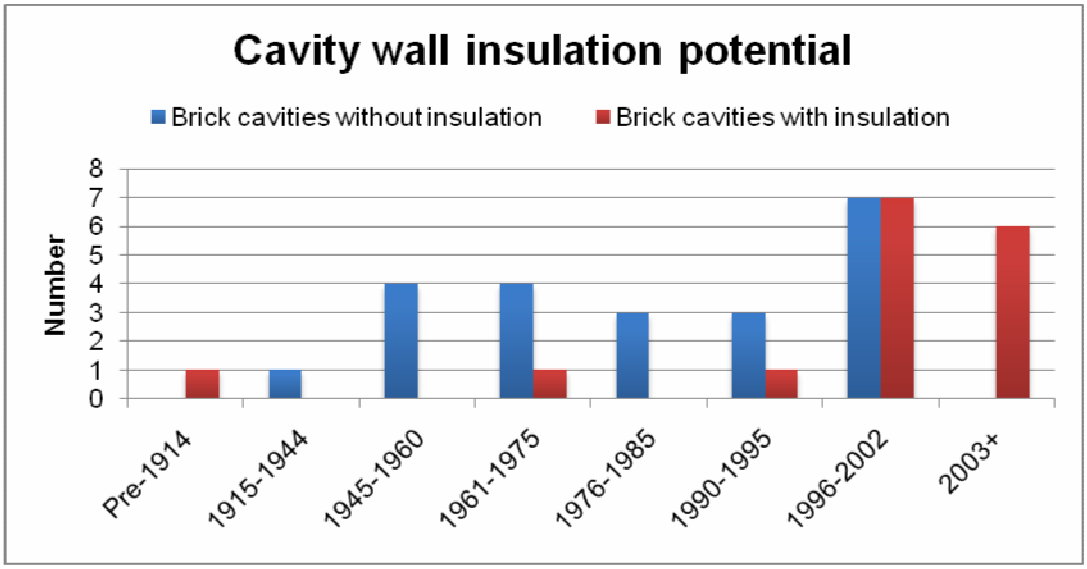


Figure 10: Properties surveyed with and without cavity wall insulation

Whereas 52% of properties surveyed have loft insulation that meet or approach current standards, 15% have no loft insulation and a further 22% have 100mm insulation or less (see Figure 11). The majority of properties in Winkleigh have double glazing.

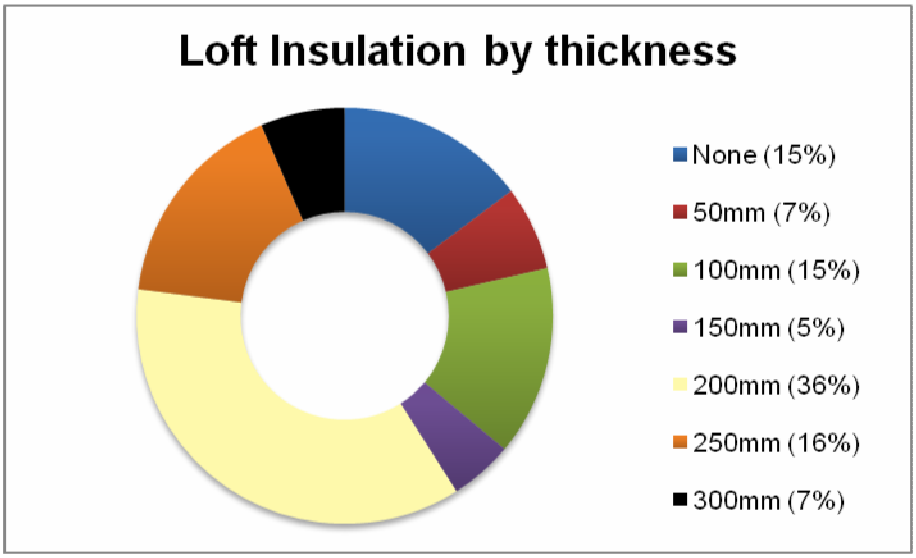


Figure 11 - Presence of loft insulation and thickness in properties surveyed

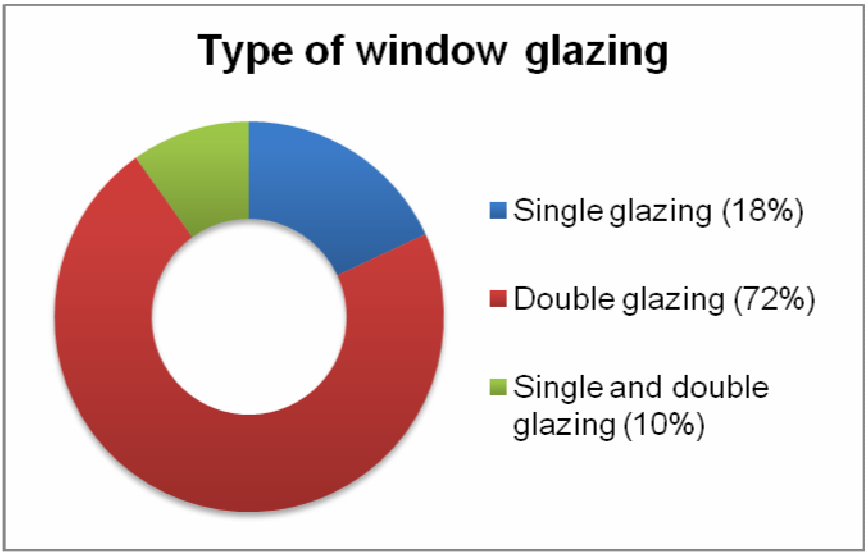


Figure 12 - Types of window glazing in properties surveyed

4.6. Fuel source and boiler type

Winkleigh's major fuel sources for heating and hot water are oil (34%) and LPG - Liquid Petroleum Gas (38%). LPG is either bottle stored at the individual property level or is stored in local tanks and utilised communally. Electricity provides 21% of heating and hot water – see Figure 13.

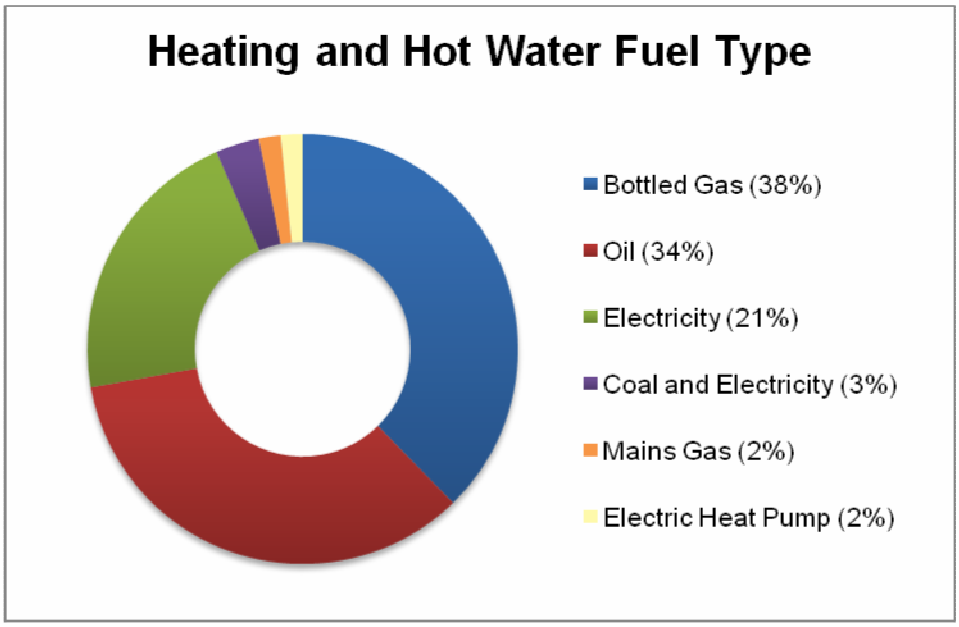


Figure 13 - Heating and hot water fuel type in properties surveyed

Modern efficient condensing and condensing-combi boilers only make up 13% of units in the properties surveyed, with the majority (61%) consisting of less efficient non-condensing units. There are a significant proportion of electric boilers (see Figure 14 below).

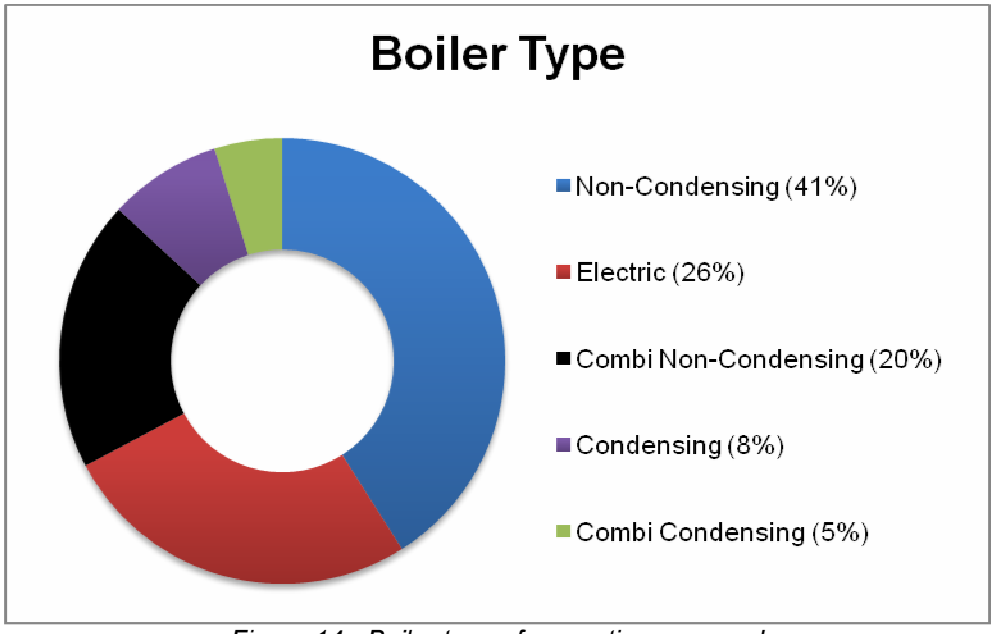


Figure 14 - Boiler type of properties surveyed

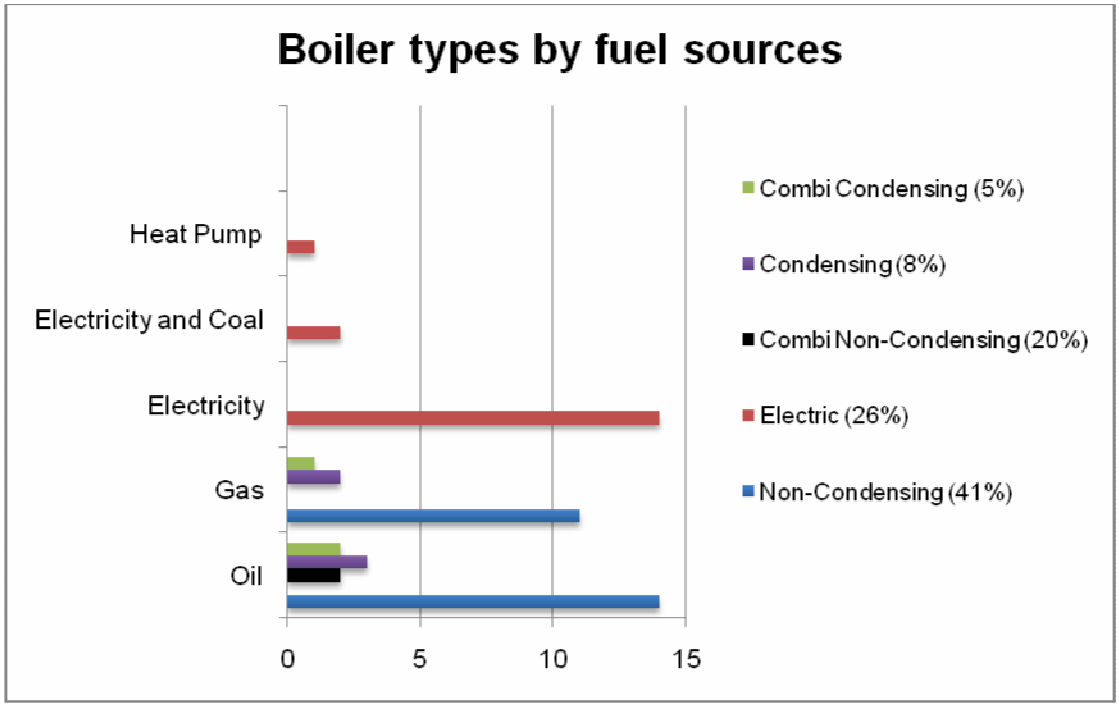


Figure 15 - Fuel used by boiler type of properties surveyed

4.7. Cooking

A particularly interesting result was the prominence of Aga/Rayburn used for cooking (and hot water in some cases also) at 15%. Whereas gas and electric cookers represent the majority of cooking stoves surveyed, Aga and Rayburn cookers generate extremely high levels of carbonemissions as can be seen in Figure 17 below.

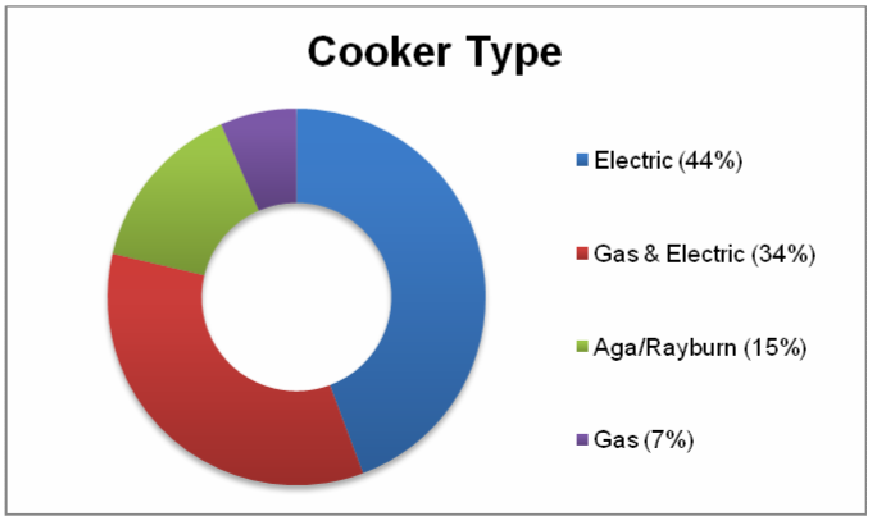


Figure 16 - Cooker type by fuel of properties surveyed

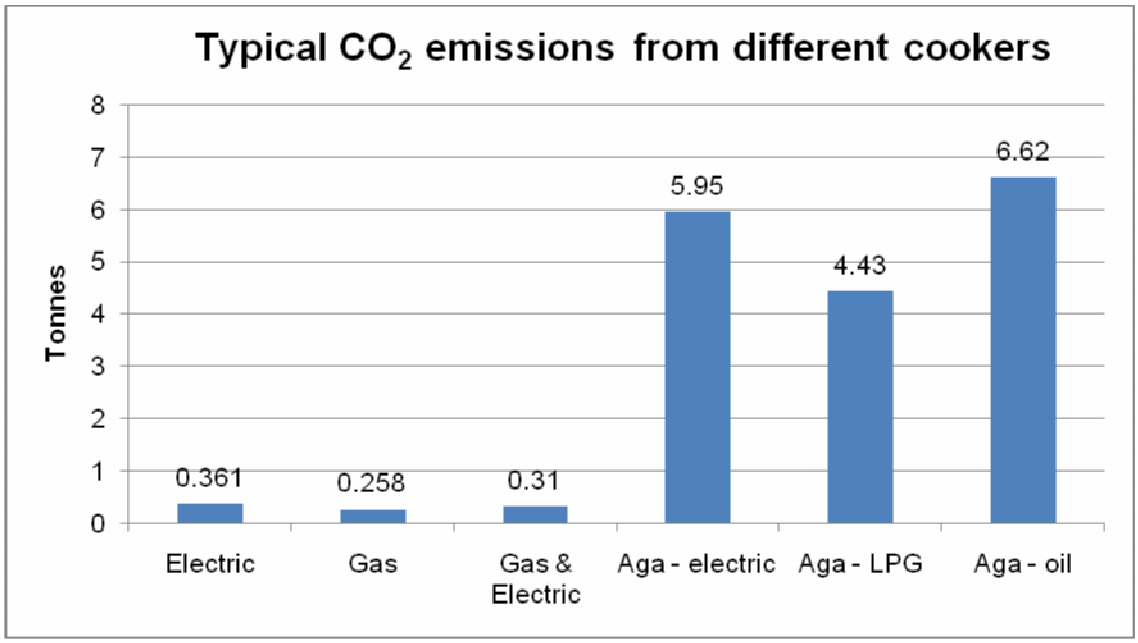


Figure 17 – Typical CO2 emissions from different types of cookers.

N.B. Figures for Aga cookers are for a typical modern Aga/Rayburn 2 oven cooker used for cooking only from manufacturers' energy consumption figures. Energy consumption and carbon emissions of older Aga/Rayburn cookers areeven higher.

4.8. Lighting

The survey found a reasonable uptake of low energy lights in Winkleigh households, as can be seen in Figure 18 below. Of the total number of light bulbs in use, 50% are low energy and 27% are tungsten filaments. Although lighting only accounts for 1% of the Winkleigh carbon footprint, EU legislation taking effect in 2012 will prevent the sale of tungsten filament bulbs, thus providing considerable potential for further take up of low energy bulbs and emissions reductions in Winkleigh and across the North Devon Biosphere Reserve .

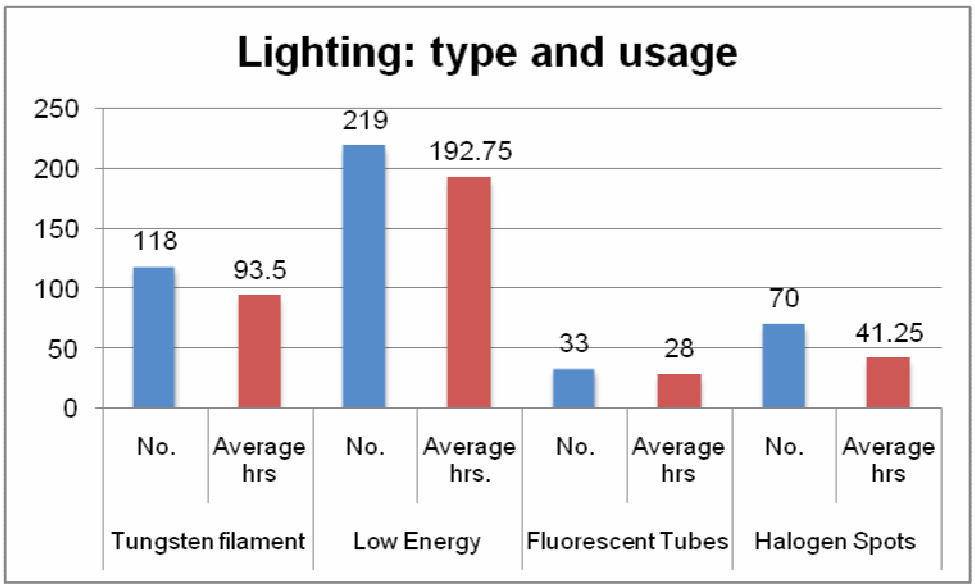


Figure 18 – Lighting types and usage in property surveyed

4.9. Transport

Transport was the second largest source of CO2 emissions in the households surveyed. Private vehicle usage was responsible for 24% of CO2 emissions, while planes and trains were responsible for a further 8%, with planes being responsible for the overwhelming majority of these. Figure 19 and 20 below shows average number of cars per household, average mileage figures per vehicle, and estimated levels of CO2 emissions from different forms of transport, while Figure 21 shows the distribution of engine types and sizes in the households surveyed.

Average number of cars per household	1.2 cars
Average mileage per vehicle	8973 miles
Average CO2 emissions from private vehicles per household	3.26tonnes
Average CO2 emissions from planes and trains per household	1.82tonnes

Figure 19 – Summary Transport Statistics for households surveyed

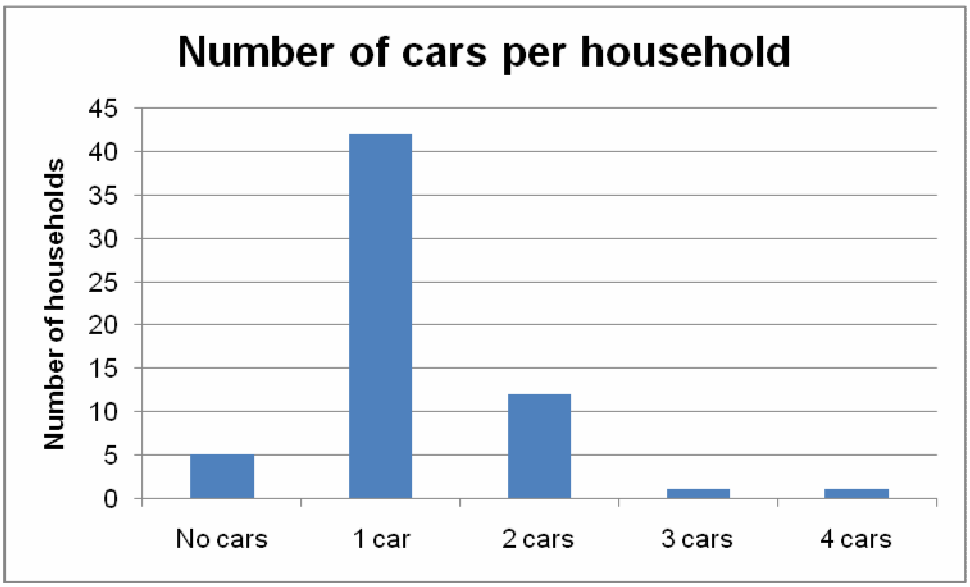


Figure 20 – Number of cars per households surveyed

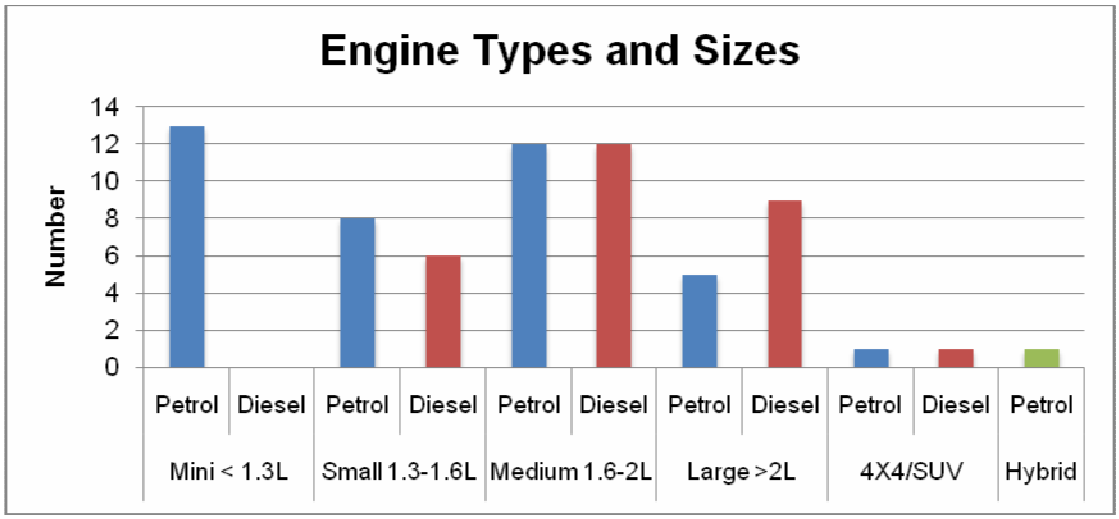


Figure 21 - Engine types and sizes surveyed

5. Strategy development

The process of analysing the survey results and developing the carbon reduction plan for Winkleigh is summarised below in Figure 22:

Figure 22 – Strategy development process for the Winkleigh Carbon Reduction Plan (based on Johnson et al, 2008)

5.1. Strategic Analysis

From Figure 5, it can be seen that heating and hot water at 63% make the biggest contribution to carbon emissions, followed by private vehicles at 24% and planes and trains at 8% with the remainder mostly generated by household appliances. Before any analysis of the data was undertaken, it was important to gain an understanding of the key factors driving these emissions and some of their interactions. Boardman et al. (2005, p. 8) identify a range of key factors determining UK residential sector emissions. Theseinclude firstly the carbon intensity of energy and fuels, secondly household level factors such as the efficiency of the building fabric and of energy using equipment and thirdly, individual and societal factors such as the number of households and the behaviour of individuals (see Figure 23) The Winkleigh survey data was cross-tabulated using some of the key factors in Figure 23. These were:

- Building fabric based e.g. wall construction type, roof construction type and insulation
- Equipment based e.g. boiler, cooker, and lighting type and
- Heating fuel e.g oil, gas etc

Through this analysis, we identified five key carbon emission drivers for Winkleigh. These are:

1. High rates of heat loss through lack of**insulation**
2. High usage of **fuel oil** which has a high carbon intensity (0.27kgs CO2/kwh compared to natural gas at 0.185)
3. Inefficient **boilers** still commonplace
4. High use of energy hungry **Aga/Rayburn cookers**
5. High proportion of inefficient **tungsten filament** and **halogen lightbulbs**

Further analysis of the survey data identified a further key transport-related driver:

6. **Private vehicle** usage and **flying**

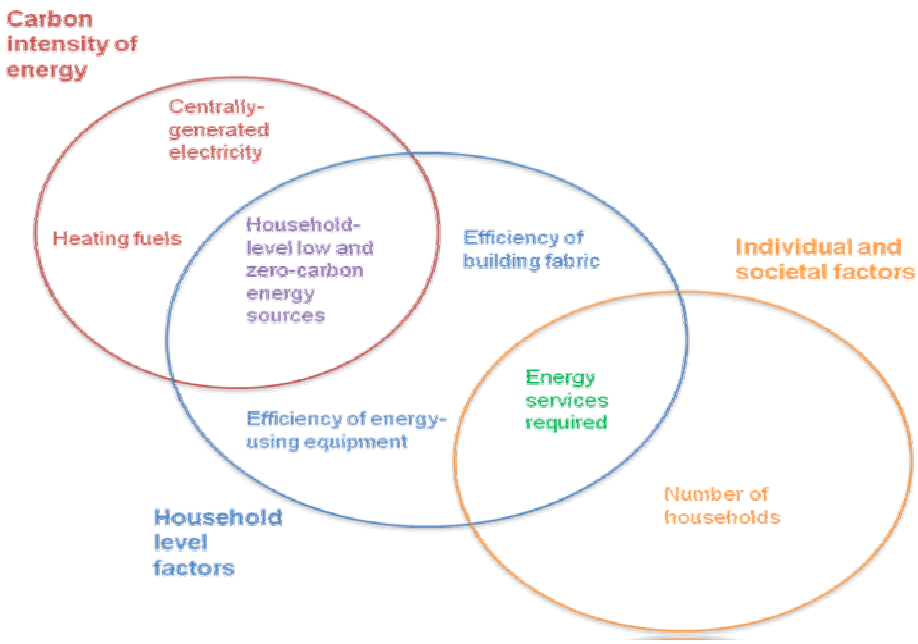


Figure 23 – Key factors determining UK residential sector emissions (Boardman et al. 2005, p. 8)

5.2. Strategic Options

Taking the key emission drivers identified in 5.1, our approach in developing strategic options to address ways of reducing them has been informed by six key factors:

1. **the need to reduce CO2 emissions produced in the UK by 34%,** or 40% under a revised target, **by 2020** as demanded by the UK *Climate Change Act*

2. **the need to reduce fuel poverty in the south-west of England** – which includes Winkleigh – as this region has a higher proportion of households in fuel poverty than is average in England. The 2006 *South West Low Carbon Housing and Fuel Poverty Strategy and Action Plan* found that the south west of England (which includes Winkleigh) has:

    - the most energy inefficient housing of all the English regions
    - the highest proportion across all English regions of homes failing the decent homesstandard on thermal performance
    - a higher proportion of households in fuel poverty than the average for England as a whole
    - a significant proportion of 'hard to treat' properties, with 16% of properties off the gas grid
    - huge potential for energy efficiency improvements, especially cavity wall and loft insulation and low energy lighting (Government Office for the South West 2006, p.7)

3. **the concept of least-cost carbon abatement** which allows a determination of the extent to which different measures can contribute to carbon reduction by a specified date (Jackson, 1991). This concept has been developed extensively in recent years, especially by management consultants such as McKinsey who have developed marginal abatement cost curves for a range of different countries (McKinsey, 2009) including the UK (CBI, 2007)

4. **UK government strategies to reduce carbon emissions**, such as the UK Low Carbon Transition Plan (DECC, 2009). In the *UKLow Carbon Transition Plan*, DECC identifies the need to 'radically reduce' the demand for energy and decarbonise the energy we use in our homes (DECC, 2009, p. 80). Boardman et al. (2005, p. 38) note that carbon reduction targets can only be met if there is a step-change improvement in the quality of the fabric of the housing stock, as the current poor quality of the housing stock means that space heating is responsible for roughly 60% of total delivered residential demand, whereas zero-carbon homes show that it is possible for homes to have zero space heating demand. Boardman et al. (ibid., p.40) identify the need for an extensive programme of home refurbishment and demolition for carbon reduction targets to be met and to deliver decent homes that can help reduce the high incidence of fuel poverty in the UK.

5. **the whole-house approach to reducing carbon emissions from housing**by considering a household's energy consumption and carbon emissions as a whole, and establishing a comprehensive package of measures to address them. The objective of this approach is to include all the measures available that are suitable for a property and which could pay back through energy bill savings over their lifetime. The benefits of this approach are that: it provides a coordinated approach, and allows measures to be implemented in the right order and with minimum disruption (DECC 2009, p. 85)

6. **a desire to develop a pragmatic strategy that has the potential to be adopted** – in whole or in part – by recommending strategies that have the potential to win support and not be immediately opposed locally in Winkleigh and more widely in North Devon. In our first visit to Winkleigh, we learnt from some Winkleigh community leaders of widespread local opposition to a biomass plant proposal for the Winkleigh airfield that had led to it not going ahead (Winkleigh Parish Opinion Report 2004), and heard opinions from a number of local community leaders that were against large-scale on-shore wind turbines. While it is hard to know whether their views are representative of the wider Winkleigh community without carrying out an opinion survey, we have certainly noted these views and kept them in mind when formulating (but did not let them dictate) this strategy.

These objectives and approaches led us to begin developing strategic options that:

- reduce carbon emissions from housing and private transport by 40% by 2020
- reduce the impacts of some of the underlying causes of fuel poverty, particularly high rates of heat loss due to poor insulation
- are as cost-effective as possible and implemented in order of cost effectiveness
- are household-scale, pragmatic solutions that are likely to win community support

We aimed to develop options that could meet all of these objectives and see if we could meet the overriding objective of reducing emissions by 40% by 2020, before considering larger-scale strategic options, e.g., combined heat and power, energy from waste, on-short wind turbines etc, as we felt these larger scale options would likely encounter more objections and have less chance of successful implementation by 2020 at this point in time.

Strategic option development process

1. A range of measureswith high potential for cost-effective carbon reduction were identified from a selection of recent, widely-cited reports, including Boardman et al. (2005), DECC (2009) and CBI (2005: Figure 4, p. 13) and then screened according to the criteria above.

2. Measures which passed the initial screening process in 1) were then assessed further for their cost-effectiveness by calculating the marginal cost of abatement for each tonne of carbon saved from the implementation of the measure. These abatement costs were developed by:

    a. obtaining and comparing costings for the implementation of each measure from suppliers, manufacturers, installers and/or independent authorities, e.g., Energy Saving Trust.
    b. estimating operating costs/savings of housing-related measures by using the CRed calculator to model the effectiveness of each of these measures to reduce energy consumption and carbon savings. The estimated current average price of fuels in the south-west was used as the fuel cost of each fuel, as the dynamic nature of energy prices combined with the uncertain impact that energy demand reduction policies and the timing of their actual implementation may have on energy prices makes it extremely difficult to predict energy prices in 2020 with any confidence (Boardman et al. 2005, p. 9)
    c. estimating likely carbon savings from transport-related measures by analysing the impact of measures such as: the EU vehicle emissions performance regulations (Europa 2009) which mandate average new car

vehicle emissions of 130g CO2/km by 2015, and the inclusion of aviation in the EU Emissions Trading Scheme (Europa 2008)

d. calculating the marginal abatement cost per tonne of carbon saved from each measure to allow both individual and package measures to be objectively compared and ranked. These were calculated by:
    i. obtaining capital costs from suppliers and manufacturers of procuring and installing each measure
    ii. estimating annual energy savings by using the CRed calculator to identify kWh and CO2 savings of measures
    iii. obtaining kWh costings of energy from energy suppliers (British Gas was used as the standard reference for electricity, and comparison sites were used to obtain average costs of fuel oil and LPG in Winkleigh)
    iv. calculating the value of energy savings as an annual figure

e. Net Present Value calculation – discounting the marginal abatement costs by 3.5% as per HM Treasury Green Book discounting rate

3. The effectiveness of individual measures in reducing carbon emissions was assessed initially on one 'model' house that matched the CO2 emissions profile of an average house in Winkleigh, in overall CO2 emissions with the mostcommon attributes of houses in the survey, e.g., most common fuel source, insulation thickness etc.

4. These options were then assessed further in an iterative assessment process through a holistic, whole-house approach to assessing and reducing carbon emissions from housing. After determining that individual measures could not meet the overall 40% carbon reduction target cost-effectively, packages of measures (e.g., installation of cavity wall insulation and condensing boilers together) were then modeled further to assess their impact, as can be seen below in Figure 24.

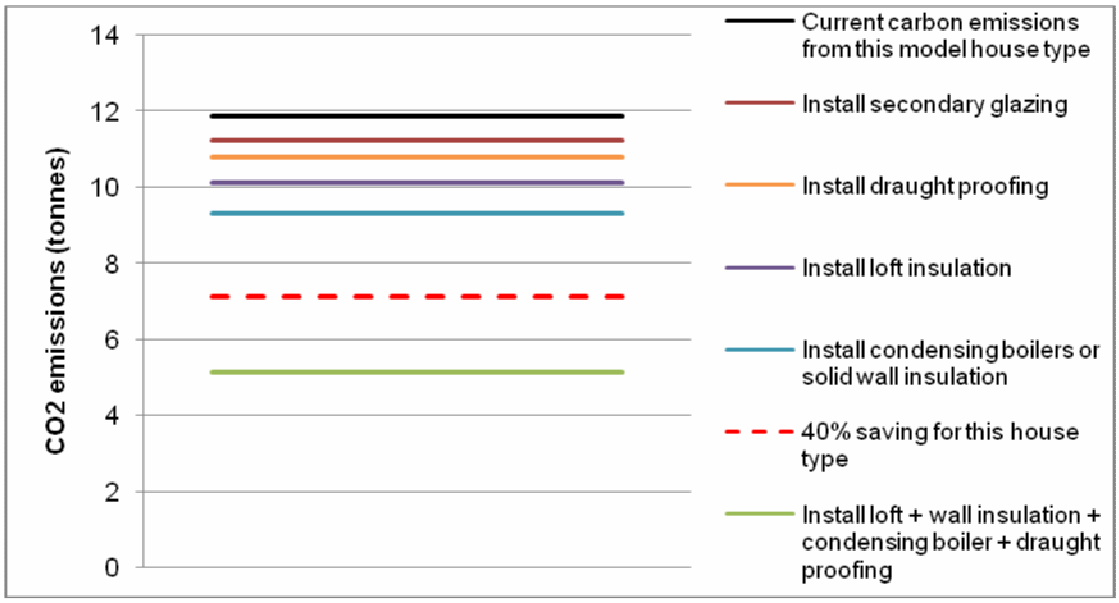


Figure 24: The contribution of individual measures in reaching a 40% carbon reduction target, in comparison with a "package" of measures.

5. A number of different types of 'model' houses were developed and modeled in the CRed calculator to permit the impact assessment of a wider variety of measures in reducing energy consumption and carbon emissions.

   The 'average house' used initially in modeling contained a number of different

assumptions, e.g., construction typeof this ‘average house’ was cavity wall, loft insulation thickness was 50mm etc. and this did not allow the impact of other commonly recommended measures, e.g., installation of solid wall insulation to be assessed in terms of their ability to reduce energy consumption and carbon emissions. The objective at this stage of the analysis was to identify a range of “model” Winkleigh properties that displayedcommon combinations of key variables that are driving emissions. The key variables that were modeled included: house type (detached, bungalow etc), building construction type (cavity, solid wall etc), roof type (tiled, thatched etc), age of property, and methods for heating and cooking. The information used to develop the choice of “model” property type included the following:

- Cross tabulation of survey data to identify key correlations between survey attributes
- Key construction characteristics that the CRed calculator showed to have particular impacts on carbon emissions
- Secondary research into key emissions drivers from heating and hot water (e.g. Boardman et al. 2005; DECC 2009; Energy Saving Trust)

6. The model of residential housing in Winkleigh was then refined iteratively until it closely matched as many of the key construction characteristics identified in the survey data as possible. Figure 25 below shows the key attributes of the five types of housing that were used in the model of Winkleigh housing that was developed in this project.

7. Annual CO2 emissions from the ‘model’ homes and transport (private vehicles and air travel) was estimated at 11,297 tonnes, which is within 7.5% of the extrapolated total of 10,507 tonnes of CO2.

Model	Key attributes							
	Age of property	**Construction type**	**Fuel type**	**Boiler type**	**Loft and cavity wall insulation**	**Percentage**	**CO2 emission profile tonnes/hhld/yr**	**Notes**
1	Pre 1st WW1	Solid wall	Oil	Non-condensing	none	11%	11.2	
2	1976 - 85	Cavity wall	LPG	Non-condensing	50mm loft, no cavity insulation	34%	6.1	
3	Pre 1st WW1	Solid wall	Oil	Aga	100mm loft insulation	11%	14.2	
4	Park home	Mobile home	LPG	Non-condensing	n/a	8%	3.4	Model assumed no hot water tank insulation as no park homes that were surveyed had this
5	Inter war	Cob & thatch/other	Oil	Non-condensing	50mm loft insulation	36%	7.9	

Figure 25 - Key attributes of model houses

The model developed in this strategy will be provided separately as an Excel spreadsheet to allow further examination of the key assumptions used in these model houses, estimates of carbon savings and the costs of different measures.

6. Carbon Reduction Strategy

Our analysis has found that it is possible toreduce carbon emissions from housing and private transport[2] by 40% by 2020, and reduce the impact of heat loss on fuel poverty by implementing a number of pragmatic, household-scale, package measures.

6.1. Housing

A package measure approach is recommended, as while individual household-scale measures will definitely help move Winkleigh towards the 40% carbon reduction target, none of them are individually sufficient to achieve the target, and only packages of measures have the potential to help Winkleigh achieve this carbon reduction target from household scale measures.

Reducing carbon emissions from housing though will require a near-universal rollout of a series of package measures tailored to different house types in Winkleigh. If a near-universal rollout of these measures is not considered feasible, then larger-scale measures such as renewable energy generation projects (e.g., onshore wind, energy from waste etc) will need to be implemented if the 40% reduction in carbon emissions is to be achieved in Winkleigh by 2020.

The five packages of measures that are recommended in this strategy are:

Package 1–for unfilled cavity wall homes
Our survey found that 36% of homes in Winkleigh have unfilled cavity walls and that 87% of homes in Winkleigh have inefficient non-condensing boilers. This package is targeted at homes which meet both of these criteria, and will include two measures:

- Fill unfilledcavity walls with insulation
- Replace inefficient, non-condensing boilers with air-source heat pumps. Air source heat pumps are a low carbon source of heat, as for each unit of electricity they consume, they produce 3-3.75 units of heat.

<u>Assumptions</u>

- This package will be applied to 260 homes – i.e., 34% of all homes in Winkleigh
- The model house assumes this house type uses LPG for heating, hot water and cooking and currently emits 6.14 tonnesof CO2 annually
- Average annual carbon saving per house from these measures will be 3.32 tonnes
- Total carbon savings from this package of measures is 863 tonnes/year
- Cost per home will be £8735 (£135/home on average for cavity wall insulation, and £8600/home to purchase and install a heat pump, 180L electric hot water cylinder and replace some existing wall radiators
- Annual energy savings per house is estimated at £1364
- The capital cost of this package of measures is estimated at £2.27m

[2] We have not considered how to reduce carbon emissions from food, consumer items, private services, public services, capital investment and other sources (e.g., non-residents) due to: the difficulties of accurately measuring emissions from these sources; and the fact that many of these major sources of emissions have separate carbon reduction programmes already in place, e.g., CRC Energy Efficiency Scheme is mandatory for large public and private sector energy consumers, and will reduce carbon emissions from private and public services.

Package 2 – for solid-walled homes
Our survey found that 11% of all homes in Winkleigh have solid walls (i.e., solid brick and/or stone), 22% have less than 100mm of loft insulation, 18% have single-glazingand 87% have inefficient non-condensing boilers. As there is a strong correlation between these attributes, this package is targeted at homes which meet all of these criteria, and will include the following measures:

- install loft insulation
- install draught proofing on single-glazed windows which lack draught proofing
- replace inefficient, non-condensing boilers with condensing boilers - air source heat pumps were found to be unsuitable for these types of homes due to the high rates of heat loss they experience because of their lack of air tightness
- install solid wall insulation

Assumptions

- This package will be applied to 84 homes – i.e., 11% of all homes in Winkleigh
- The model house assumes this house type uses oil for heating, hot water and cooking and currently emits 11.88 tonnes of CO2 annually
- Average annual carbon saving per house from these measures will be 6.73 tonnes
- Total carbon savings from this package of measures is 565 tonnes/year
- Cost per home will be £8270 (£170/home on average for loft insulation, £1600/home to install a condensing boiler, £1500/home to install draught proofing, and £5000/home to install solid wall insulation)
- Annual energy savings per house is estimated at £1066
- The capital cost of this package of measures is estimated at £694,680

Package 3 –replace inefficient boilers with heat pumps
Assumptions

- This package will be applied to 199 homes in total - i.e., 26% of all homes in Winkleigh
- The model house assumes this house type uses oil for heating, hot water and cooking and currently emits 7.87 tonnes of CO2 annually
- Average annual carbon saving per house from these measures will be 4.7 tonnes
- Total carbon savings from this package of measures is 935 tonnes/year
- Cost per home will be £8600 (£8600/home on average to install an air source heat pump)
- Annual energy savings per house is estimated at £633
- The capital cost of this package of measures is estimated at £1.71m

Package 4 – replace inefficient boilers with condensing boilers
Assumptions

- This package will be applied to 139 homes in total, comprised of:
    - 77 average homes – i.e., 10% of all homes in Winkleigh
    - 62 park homes – i.e., 8% of all homes in Winkleigh
- The model house types assume:
    - the model average home uses oil and emits 7.87 tonnes of CO2 annually
    - the model park home uses LPG and emits 3.38 tonnes of CO2 annually
- Average annual carbon saving per house from these measures will be:
    - 1.67 tonnes for average homes
    - 1.35 tonnes for park homes
- Total carbon savings from this package of measures is 212 tonnes/year
- Cost per home is estimated to be £1600 (to install a condensing boiler)
- Annual energy savings per house is estimated at:
    - £409 for average homes

    - £614 for park homes
- The capital cost of this package of measures is estimated at £222,400

Note re: packages 3 + 4
Our survey found that 87% of all homes in Winkleigh have inefficient non-condensing boilers. Those properties which have inefficient, non-condensing boilers and which do not fit the profile of cavity wall and solid-walled homes above should have these inefficient boilers replaced with a heat pump, if the home is relatively air tight and an air-source heat pump is appropriate for that home's heating system and occupancy. If not, we recommend that the inefficient boiler be replaced with a modern condensing boiler.

Package 5 – for homes with Agas/Rayburns
Our survey found that 15% of all homes in Winkleigh had an Aga, Rayburn or other similar cooker, used for cooking, heating and/or hot water. This package of measures is targeted at these homes, and aims to replace these cookers either with an electric cooker (if the Aga/Rayburn is only used for cooking) or with an electric cooker and a condensing boiler (if the Aga/Rayburn is used for cooking, hot water and/or heating).

<u>Assumptions</u>
- This package will be applied to 84 homes in total, comprised of:
    - 38 homes would have an Aga replaced with an electric cooker– i.e., 5% of all homes in Winkleigh
    - 46 homes would have an Aga replaced with an electric cooker and a condensing boiler – i.e., 6% of all homes in Winkleigh
- The model house types assume the model Aga home uses oil and emits 14.16 tonnes of CO2 annually
- Average annual carbon savings per house from these measures will be:
    - 6.26 tonnes for Aga homes which replace an Aga with an electric cooker
    - 7.94 tonnes for Aga homes which replace an Aga with an electric cooker and a condensing boiler
- Total carbon savings from this package of measures is 305 tonnes/year
- Cost per home is estimated to be either £1000/home (to buy & install an electric cooker) or £2600 (£1000/home for electric cooker and £1600/home to install a condensing boiler)
- Annual energy savings per house is estimated at:
    - £830for those homes that replace an Aga with an electric cooker
    - £1179 for those homes that replace an Aga with an electric cooker and a condensing boiler
- The capital cost of this package of measures is estimated at £158,600

Smart meters
DECC has recently announced that all homes will have a smart meter by 2020. This measure is assumed to have been implemented in all households Winkleigh by 2020, and reduce electricity usage by 5% on current levels, as studies have shown that smart meters typically provide annual electricity savings of 5-15% (Darby 2006).

Lighting
The phasing out of tungsten filament lightbulbs in the UK in 2012 is estimated to reduce CO2 emissions by 57 tonnes annually by 2020. See also section 7.2 below.

6.2. Transport

Private vehicles
Reducing carbon emissions from private vehicles is assumed to happen at no cost to this strategy because of:

- Improvements to the fuel efficiency of the vehicle fleet that are ongoing all the time as citizens replace their existing cars with new or new second-hand vehicles. A 10% annual replacement rate is assumed in the fleet, and the average CO2 emissions of the overall Winkleigh vehicle fleet is assumed to have reduced to 133g/km in 2020, compared to the national average of 233g/km today, following the implementation of the EU vehicle emissions performance regulation (Europa 2009).

- A 1% reduction in current annual private vehicle mileage (10% reduction by 2020) is assumed because of the high likelihood that fuel prices will increase quite markedly because of further increases in the price of carbon through schemes such as the EU Emissions Trading Scheme. Average annual mileage in Winkleigh was found to be 8973 miles/vehicle, and average number of vehicles in Winkleigh was 1.2 vehicles per household.

These two changes are assumed to provide an annual saving of 1102 tonnes of carbon.

Air travel
A 10% reduction in air travelfrom current levels is assumed by 2020 because of the high likelihood that the cost of air travel will increase quite markedly because of the inclusion in aviation in the EU Emissions Trading Scheme (Europa 2008). Marked increases in the cost of air travel would likely lead to reductions in the overall amounts of air travel by households in Winkleigh, so a 10% reduction in air travel seems quite reasonable and conservative.

This reduction in travel is assumed to provide an annual saving of 139 tonnes of carbon.

6.3. Summary of CO2 savings

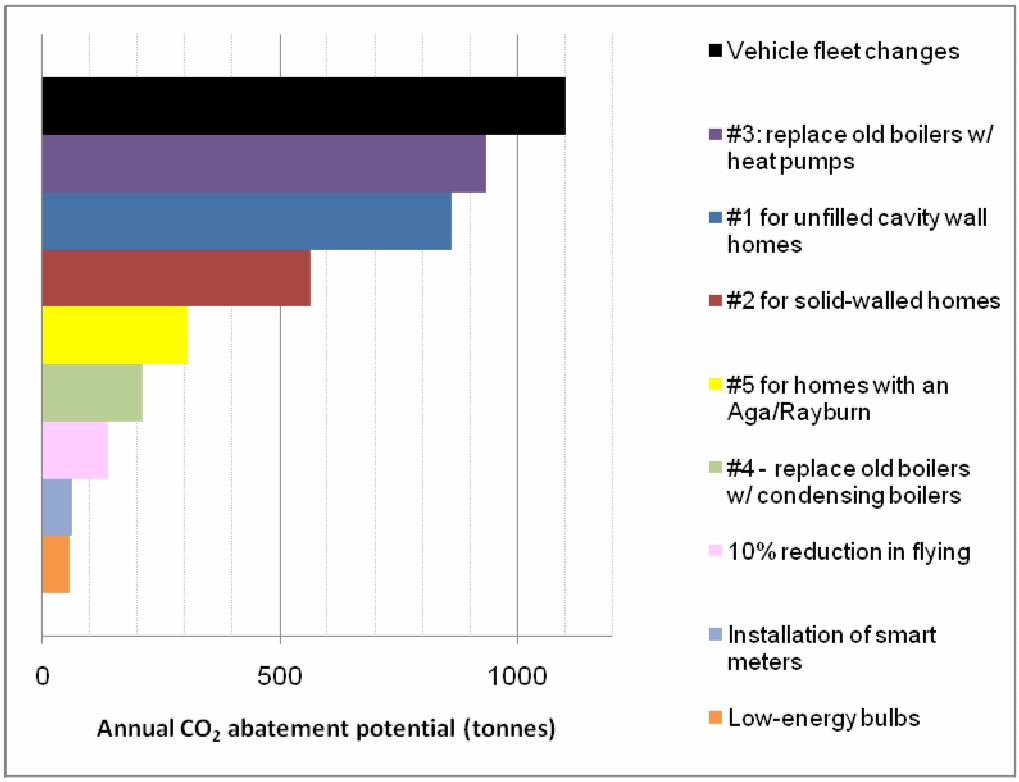


Figure 26 – Annual CO2 abatement potential of different measures in strategy

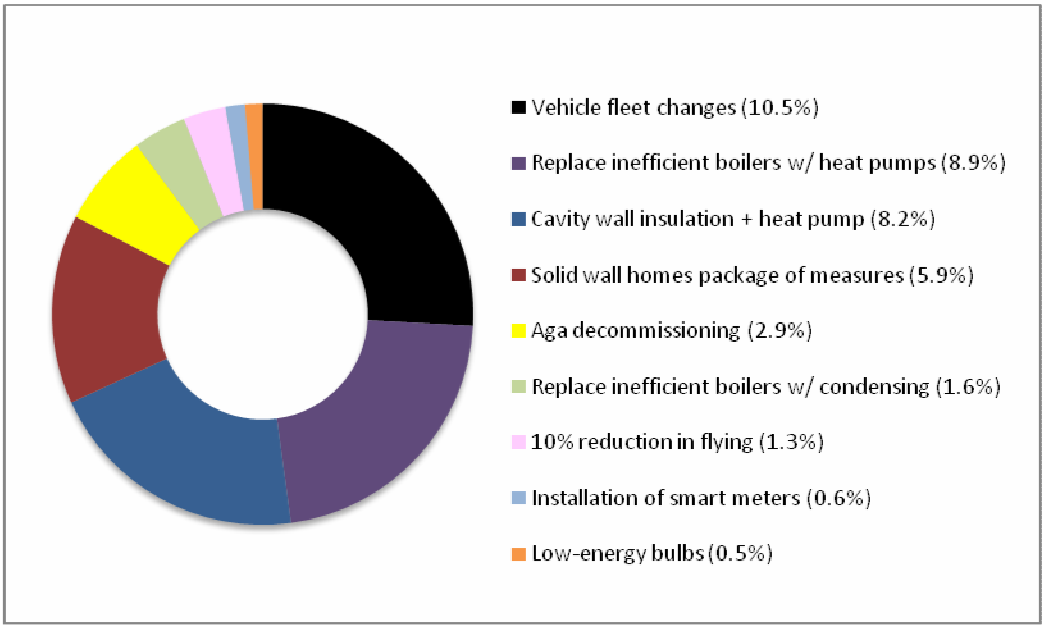


Figure 27 – Breakdown of CO2 savings included in strategy as a contribution to reaching a reduction target of 40%

7. Carbon Reduction Implementation Plan

7.1. Overview

Our recommendation is for a staggered implementation plan of a number of proposed measures to 2020, to achieve the 40% emission cuts in Winkleigh. The key motivation for this staggered approach is to take account of building momentum and a sense of achievement within the community by primarilytargeting those options that are easily achievable and have high impact (so called 'low hanging fruit'), leaving other measures until later. Figure 28summarises those measures that make up the implementation plan to 2020.

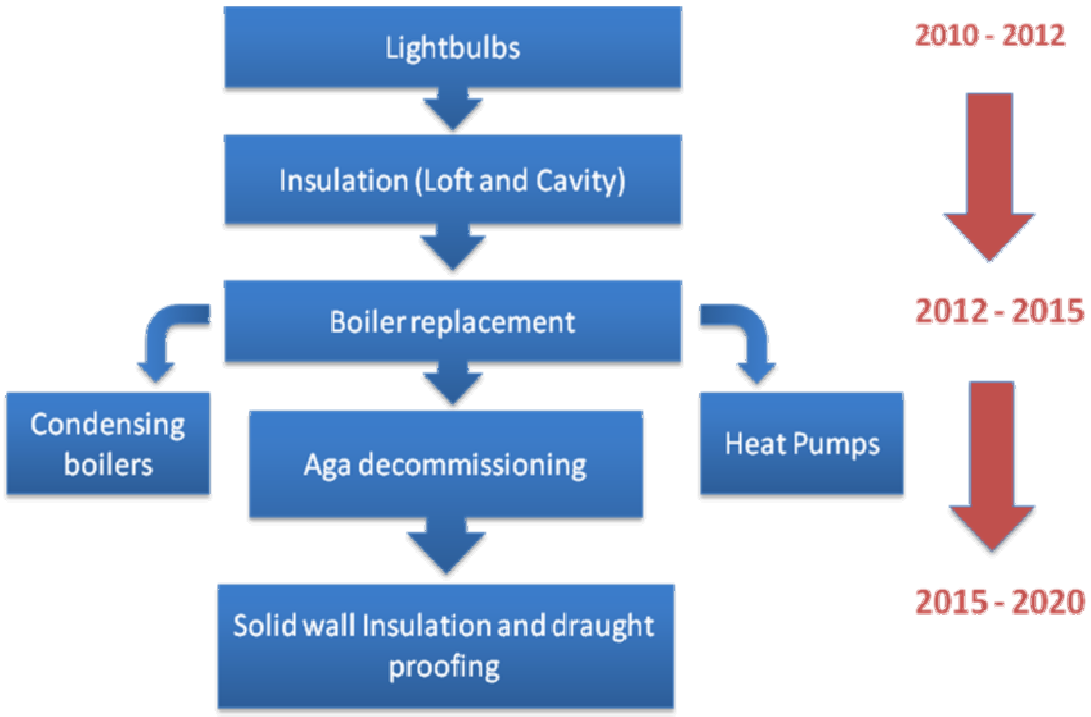


Figure 28: Overview of Winkleigh Carbon Reduction Implementation Plan to 2020

7.2. Light bulbs

Inefficient Tungsten Filament (TF) bulbs, which only convert 5% of energy into light (Environment Watch), are being phased out in 2012. Replacing all TF bulbs with low energy bulbs is a small and easy action to implement, that will deliver immediate financial returns to residents. As McKenzie-Mohr (2008) suggests, by obtaining an agreement from an individual to a *smaller* request will lead to that individual agreeing to a much *bigger* request, later in time, as long as it is in the same context.

Replacing TF bulbs with low energy bulbs is expected to encounter low levels of resistance and is achievable by most community residents and therefore represents the first encouraged measure. While individually this action offers little in the way of emission reduction, collectively it will deliver good emission savings in Winkleigh and substantial savings among the North Devon Biosphere Reserve.

7.3. Insulation (loft and cavity wall)

The installation of loft and cavity wall insulation can be made at zero or low cost, depending on householder circumstances. Home insulation will deliver substantial financial and carbon savings for each resident and are one of the first key implementing actions we suggest. The community engagement strategy, detailed in section 7.8 and identified through the 'RIP CO2' initiative in Reepham, Norfolk (see Appendix 4),highlights a proven approach to the high take up home insulation offers. We recommend a similar model for Winkleigh and are therefore suggesting the creation of a Winkleigh Home Insulation Project (WHIP CO2) as a keyplank in the implementation plan and engagement strategy.

The time line for rolling out WHIP CO2 is early into 2010, with installation works starting in the spring/summer. This offers ideal climatic conditions for work of this nature. It is recommended that a second promotional campaign is run during the summer/autumn, to pick up those interested residents who were unaware or unwilling to participate during the first phase. With 25% of residents aged 65+, many household incomes below the £18,000 threshhold eligibility for free insulation or on government support benefits (Torridge District Council, Ward Profiles 2009), there is real opportunity to capitalise on the identified grant schemes from Torridge District Council and the 'Cosy Devon' initiative.

7.4. Boiler Replacement and Heat Pumps

It is expected that the anticipated success of 'WHIP CO2' will prepare Winkleigh residents for the format and structure of a further mass community home improvement measure.Should the marketing of acronyms help in driving community projects, we suggest 'BERP CO2' for the 'Boiler Efficiency Replacement Project'.

Condensing boilers

In line with the UK Government pre-budget report (December, 2009) and the green boiler incentive program which aims to update old inefficient boilers from 2012, we suggest that between 2012 and 2015, Winkleigh residents begin upgrading inefficient boilers to the latest efficient condensing and combi condensing boilers. From the data analysis, a combined 86% of inefficient boilers (non-condensing, non-condensing combi's and electric boilers) exist in Winkleigh and represent a significant opportunity for emissions reduction and efficiency gains. By 2012, with the success of WHIP behind them, residents will be galvanized to take further action to becoming a low carbon community. With anticipated higher fuel costs and government support measures acting as a key driver towards boiler improvements, residents will be more incentivised to act.

Heat Pumps

For the newer cavity wall properties, we are suggesting an air source heat pump as the most efficient upgrade. Older properties with solid walls will require structural improvements to bring the heat loss rates down to a commercially viable option and should only be considered in conjunction with renovation works, thus bringing the temperature gap between the heat source and the heat demand to a minimum. For this reason, we are recommending condensing boilers be used for solid walled properties, and older, less airtight cavity-walled properties.

7.5. Aga Decommissioning

The carbon emissions from Aga and Rayburn use are very significant in comparison to other more conventional methods (see Figure 17 in section 4.7). Of those surveyed, 15% use an Aga in their home, offering a substantial emissions saving through their phasing out. As a strong lifestyle choice, we anticipate high resistance from residents in switching away from this method of cooking and hot water provision. We recommend that this measure is presented for discussion early in 2013, or certainly before 2015 through a 'focused' community engagement program of firstly identifying the residents who own and use Aga's in their home and working with them to identify a cost effective change over.

7.6. Solid Wall Insulation and Draft Proofing

Solid Wall Insulation

Of properties surveyed, 26% were of solid wall construction. Solid wall insulation is expensive and when approached internally, it can be disruptive to the home owner and may only be considered acceptable when combined with additional home improvement works, such as redecorating or boiler and heating system replacement works, such as those recommended in 5.4. Solid walls have a greater heat loss rate to those with cavity walls but when insulated, offer £400 financial savings and 2.1tonnes of CO2 savings on a typical 3 bedroom house (Energy Saving Trust, 2009). However, given the high costs of works and the lack of grants available to support this measure, we propose it should not be considered for implementation until 2015 at the earliest. Anticipated higher fuel costs and future government support may at such time provide sufficient incentives for action.

Draught Proofing

Draught proofing is a low cost and easy to implement measure for home owners that compliments solid wall insulation works. For those who will not install solid wall insulation, draught proofing also provides a cost effective "stop gap" solution that, according to the Draught Proofing Advisory Association, will pay for itself within a year. Because of its low cost and ease of installation, we also recommend that this measure represent an early action opportunity to be included in the promotion of WHIP CO2.

7.7. Energy Services Company

Given the high capital costs of householders installing some of these measures, but the low net costs after energy savings are accounted for, it is recommended that the use of financing vehicles such as an Energy Services Company (ESCo) for Winkleigh or the wider North Devon Biosphere is now explored.

7.8. Community Engagement Strategy

The question of who should be responsible for taking forward the implementation of our recommended measures is a crucial one. We believe, given the need to galvanise widespread support behind an ambitious low carbon strategy such as this, that this support must be built by the community and for the community if it is to achieve lasting and sustainable impact.

We recommend an eight stage process of community engagement[3] to under pin the proposed implementation plan. This includes, in the initial stages at least, for the setting up of a Winkleigh Green Team (WGT) to drive the plan forward. Ensuring a continual loop of resident empowerment, short-term wins and regular meetings will drive forward low carbon living and embed behaviour change into the community. The process is outlined in Figure 29.

Winkleigh Green Team (WGT)

Run by the community and for the benefit of the community, a green team is a group of like minded people working towards common "green'" objectives. Friends, family, colleagues, and community members unite to form a team sharing a passion for low carbon and "green" projects. By working as a group of people towards individual actions, simple but tangible actions can amount to significant savings. Indirectly, the WGT might also serve as a social networking tool working toward overcoming any community trust barriers to action.

In our research of successful engagement strategies and green team initiatives, the Reepham Green Team in Norfolk, presents itself as an ideal mentor to the WGT. In the initial set up of the WGT it is suggested that contact is made with the leader at Reepham Green Team to seek advice and guidance (contact name: Mr. Rex Warner, email: exploreint@aol.com) Forging relationships with other green teams can promote information sharing and best practice. The WGT can also act as an exemplar to other communities in the North Devon Biosphere Reserve.

A proven community engagement strategy has been identified through the Reepham Green Team and the Reepham Insulation Project (see Appendix 4). In summary, the Reepham Insulation Project (RIP) in partnership with the Reepham Green Team and a local insulation company, effectively commercialised 50 leads after 6 months engagement to insulate loft space. We endorse this process and with some adaptations for Winkleigh, recommend it as a best practice strategy to implement all low carbon projects.

[3] based on Kotter's (1990) 'Eight phases of change' model

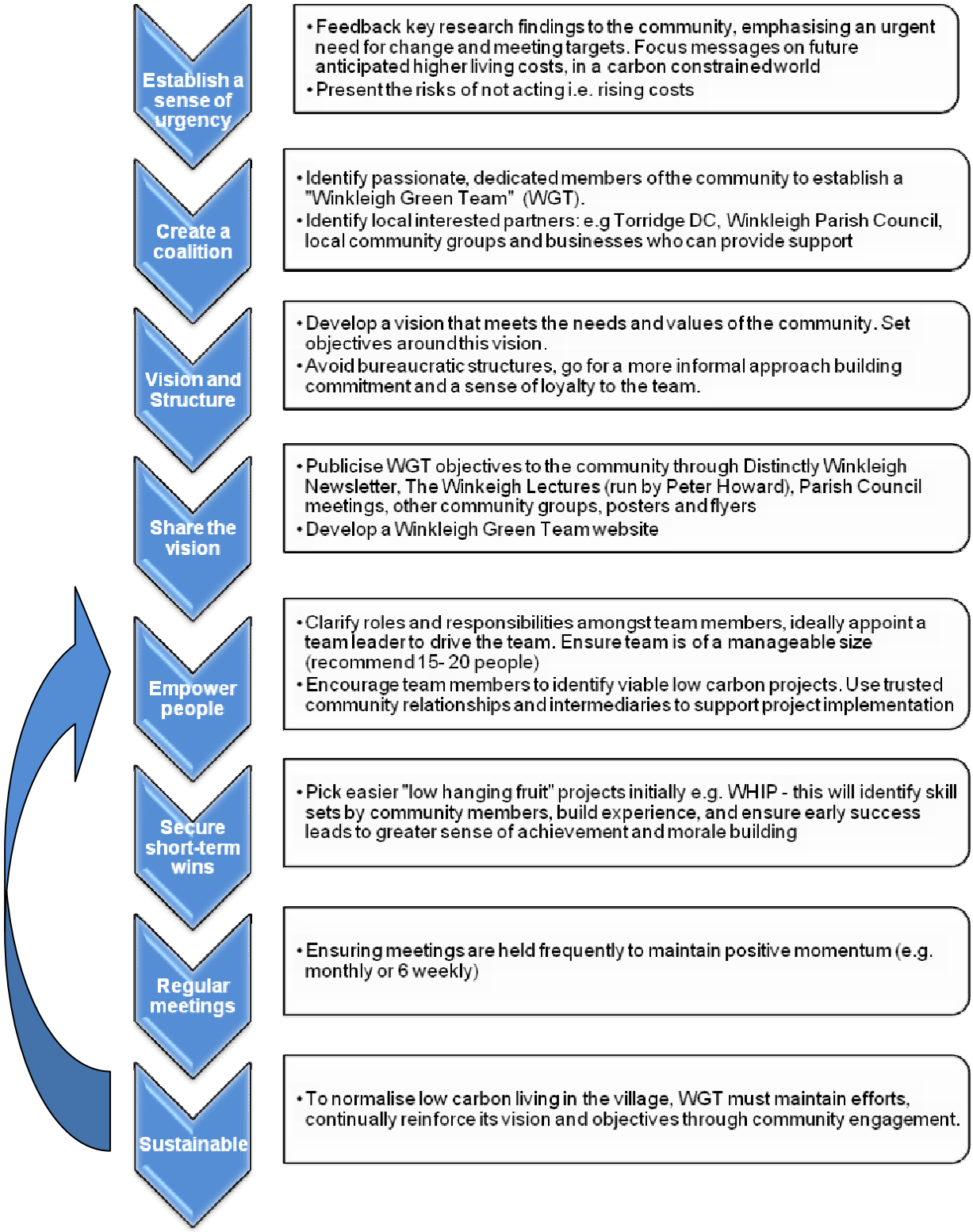


Figure 29: A suggested Community Engagement Strategy for Winkleigh

8. References

Boardman, B., Darby, S., Killip, G., Hinnells, M., Jardine, C.N., Palmer, J., Sinden, G. (2005) *40% house*, Oxford: Environmental Change Institute.

Confederation of British Industry (CBI) (2007) *Climate change: everyone's business*, www.climatechange.cbi.org.uk
[last accessed: 2nd December 2009]

Darby, S. (2006) *The effectiveness of feedback on energy consumption: A review for DEFRA of the literature on metering, billing and direct displays*, Oxford: Environmental Change Institute.

Department for Energy and Climate Change (DECC) (2009), *The UK Low Carbon Transition Plan. National Strategy for Climate and Energy*.

Draft Proof Advisory Association, (2009) www.dpaa-association.org.uk
[last accessed: 3rd December 2009]

Energy Saving Trust (2009) www.energysavingtrust.org.uk
[last accessed: 1st December 2009]

Environment Watch (2009) www.environment-watch.co.uk/index.htm
[last accessed: 30th November 2009]

Europa (2008), *Directive 2008/101/EC of the European Parliament and of the Council of 19 November 2008 amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community,*
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0101:EN:NOT
[last accessed: 1st December 2009]

Europa (2009) *Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO2 emissions from light-duty vehicles*,
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009R0443:EN:NOT
[last accessed: 1st December 2009]

Goodall, C. (2007) *How to live a low-carbon life. The individual's guide to stopping climate change*. Earthscan.

Government Office for the South West (2006) *The South West Low Carbon Housing and Fuel Poverty Strategy and Action Plan*.

Jackson, T. (1991) 'Least cost greenhouse planning supply curves for global warming abatement', *Energy Policy*, [Online], 19:1, pp. 35-46, doi:10.1016/0301-4215(91)90075-Y,
http://dx.doi.org/10.1016/0301-4215(91)90075-Y,
[last accessed: 1st December 2009]

Johnson, G Scholes, K Whittington, R (2008*) Exploring Corporate Strategy. Text and Cases*. Prentice Hall.

Kotter, J (1990) A *Force for Change: How Leadership Differs from Management*. New York. Free Press.

McKenzie-Mohr D, Smith W., (2008) Fostering Sustainable Behavior, '*AnIntroduction to Community Based Social Marketing'.* New Society Publishers,Co-published with the Academy for Educational Development. Education for Sustainability Book Series.

McKinsey (2009) 'Greenhouse gas abatement cost curves', *McKinsey & Company website*, [Online], www.mckinsey.com/clientservice/ccsi/Costcurves.asp,
[last accessed: 2nd December 2009]

Padgett, J Steinemann, A Clarke, J Vandenbergh, M (2008) 'A comparison of Carbon Calculators'. *Environmental Impact Assessment Review*, 28 pp 106 - 115

UK Government Pre-Budget Report, (2009). 'Supporting Low Carbon Growth' Chapter 7.

Ropke, I. (2009) 'Theories of Practice – New Inspiration for ecological economic studies on consumption', *Ecological Economics,* 68, pp 2490 – 2497.

Sanne, C. (2002) 'Willing Consumers – or locked in? Policies for a sustainable consumption',*Ecological Economics,* 42, pp 273 – 287.

Stockholm Environment Institute (2008) REAP v2
http://www.resource-accounting.org.uk/downloads
[last accessed: 22nd November 2009]

Valuation Office Agency,
http://www.voa.gov.uk/council_tax/index.htm
[last accessed: 18th November 2009]

Walter J., (2007) Torridge District Council, 'Knowing our Customers', Ward Profiles

Shakley S., Upham P., (2004) Winkleigh Parish Opinion Report on the proposed WINBEG Biomass Gasifier. Tyndall Centre (North), The University of ManchesterAppendices

9. Appendices

Appendix 1: Winkleigh CRed Questionnaire (Page 1)

CRed carbon reduction

local action for a global challenge

Winkleigh Village Parish Carbon Foot Print Assessment.

The Energy we use in our homes and in travel contributes to carbon emissions. These can be quite significant, and often there are small things, sometimes at little or no cost which can be done to save energy and reduce these emissions. It is not difficult for many households to save at least £100 a year on their energy bills by adopting small measures.

Our Research shows that even for households of same size and income electricity consumption alone can vary by as much as 6 times from one household to another.

Many Carbon Footprint assessments ask you to enter how much energy you have used, and this is usually difficult to do. Furthermore they do not allow you to pin point, except in broad terms where the quickest and cheapest savings are likely. This assessment examines general lifestyle and can help to identify where savings are possible.

Please fill in this questionnaire while you wait as it will speed up the assessment and allow as many people as possible to participate. If the computer is not available, please complete the form with your name and address and we shall endeavour to do the assessment for you and send you the results.

Devon

Other — please state:

Winkleigh

Other — please state:

brick solid | brick cavity | cob wall | stone/rubble infill | wall insulation

single gl. | double gl. | double gl. - low e | triple gl. | second. gl. | draft exclusion | no | yes

thatch | slate/tile - no felt | slate/tile - w. felt | slate/tile - boarded

none | 25mm | 50mm | 100mm | 150mm | 200mm | 250mm | 300mm | unknown

gas cook | electric cook | gas+electric cook | aga cook | heat pump

bottled gas | electricity | oil | aga htg | aga water | aga fuel

non-condensing | condensing | combi | condensing combi

yes | no

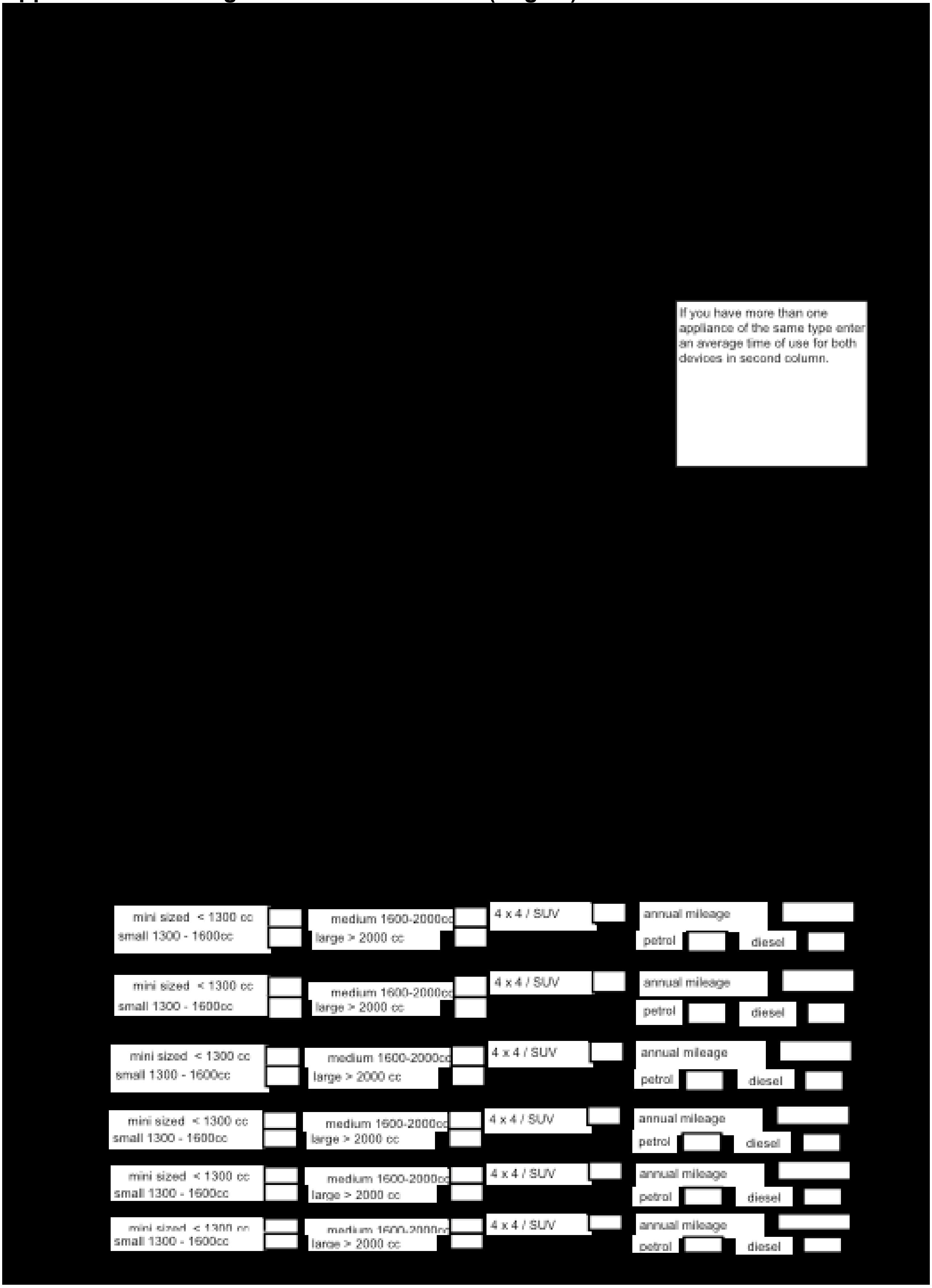
Appendix 1: Winkleigh CRed Questionnaire (Page 2)

The majority of machine which are older than 5 years are not likely to have a rating better than C.

Washing Machines tend to have a rating of A or B. Dryers and washer/ Dryers tend to be B or C, but those older than 5 years could have ratings of D or E

tungsten filament		Low energy		fluorescent tubes		halogen spots	
No	average hours per day	No.	average hours per day	No.	average hours per day	No.	average hours per day

Appendix 1: Winkleigh CRed Questionnaire (Page 3)



If you have more than one appliance of the same type enter an average time of use for both devices in second column.

mini sized < 1300 cc ☐ medium 1600-2000cc ☐ 4 x 4 / SUV ☐ annual mileage ☐
small 1300 - 1600cc ☐ large > 2000 cc ☐ petrol ☐ diesel ☐

mini sized < 1300 cc ☐ medium 1600-2000cc ☐ 4 x 4 / SUV ☐ annual mileage ☐
small 1300 - 1600cc ☐ large > 2000 cc ☐ petrol ☐ diesel ☐

mini sized < 1300 cc ☐ medium 1600-2000cc ☐ 4 x 4 / SUV ☐ annual mileage ☐
small 1300 - 1600cc ☐ large > 2000 cc ☐ petrol ☐ diesel ☐

mini sized < 1300 cc ☐ medium 1600-2000cc ☐ 4 x 4 / SUV ☐ annual mileage ☐
small 1300 - 1600cc ☐ large > 2000 cc ☐ petrol ☐ diesel ☐

mini sized < 1300 cc ☐ medium 1600-2000cc ☐ 4 x 4 / SUV ☐ annual mileage ☐
small 1300 - 1600cc ☐ large > 2000 cc ☐ petrol ☐ diesel ☐

mini sized < 1300 cc ☐ medium 1600-2000cc ☐ 4 x 4 / SUV ☐ annual mileage ☐
small 1300 - 1600cc ☐ large > 2000 cc ☐ petrol ☐ diesel ☐

Appendix 1: Winkleigh CRed Questionnaire (Page 4)

For train travel please enter total number of journeys times passengers for each route. Thus if two people travelled to London 5 times the numebr of journeys would be 10.

Appendix 2: Energy Clinic Flyer

Appendix 3: Winkleigh Energy Clinic Feedback Questionnaire (Page 1)

I want to lower my carbon emissions	

Flyer	

Email	

Appendix 3: Winkleigh Energy Clinic Feedback Questionnaire (Page 2)

Appendix 4: Case Study - Reepham Insulation Project (RIP CO2)

Reepham is a village in Norfolk where an active community "Green Team" has been championing a variety of green initiatives. Reepham Insulation Project (RIP CO2) started following a CRed Community Carbon Audit showing that only 8% of homes in the village were properly insulated to recommended government standards.

Project Objective
To increase the uptake of loft insulation by the Reephamcommunity

Key barriers to action identified

- Plenty of information was being disseminated by the council promoting grant funding available and the benefits of home insulation, but the uptake was slow.
- Engagement programme with local residents helped explain low uptake – it showed that trust issues were important and that residents were not responding to a council call for action. Messages from trusted community members seen to be more effective.
- Grant funding for loft installation required a complex and time consuming application process involving some duplication

The Programme
Recognising grant funding was available,Reepham Green Team approached a local insulation installer and secured a 10% discount for the community in return for promoting their services. The company agreed to help residents with the application process and identify whether they would be required to pay, and if so how much.

The Promotion
The programme was promoted through two morning events so as to engage as broad a cross section of the community as possible: a Wednesday – to target the unemployed, and elderly and; a Saturday – to target the employed (high and low income professionals) and younger families. The key message was to promote the financial savings from the project and to access money available from 'your' taxes to fund the insulation, with a secondary message of carbon emission savings.

The eventswere promoted through a local free newspaper (Reepham Post) with a dropout leaflet. Additional leaflets and posters were strategically place around commercial outlets, including local shops, amenities, council offices. Markeing by word of mouth was an important driver with the Green Team attending key community group meetings, including; young mothers club, elderly meetings in the church, Scouts club and schools. People were asked to become ambassadors for the project and talk about it among friends, family and work colleagues. The support of the Rotary Club was also enlisted as they are an extremely trusted and well known group.

During the morning events, six Rotarians, utilising their trusted position in the community, encouraged residents to sign up as interested in the scheme (nothing was committed at this point). Broadlands District Council's "Energy Bus", a 27 foot purpose built information bus for shows and events, running on biodiesel, was in the market square during both days. The installation company were also on hand to answer technical questions and be introduced as the approved installation company.

The main objective of the events was to obtain *names and contact numbers* of residents with an interest in insulating their home with the support of grant funding. In total 200 names were collected and passed to the installation company for follow-up and to commercialise these leads.

Costs and Funding
The District Council agreed to support the initiative with £350 for marketing and promotions. The Green Team provided a feedback report to the council to improve their chance of securing future support. Design and print cost £300 (posters and flyers), The Newspaper drop out leaflets cost £40.

Results

6 months after the events, 25% (50) of the leads had been commercialised. The remainder had been left with a quote and had yet to take up the offer

Learning's and Recommendations

- Identifying the barriers to action very important so the Green Team could focus their efforts; for example cutting out unnecessary form filling.
- Time and effort from the community acting as volunteers was essential; very much a bottom up strategy approach. Utilising trusted intermediary relationships within the community was key to drive awareness.
- Keep it simple! – an initial idea of bulk buying of insulation was discounted as it would have over complicated the process.
- Plan for good promotion - without awareness the project had little chance of succeeding. To ensure support by community groups, ensure brands/names are promoted 'in support' of the project.
- You need a champion! - Ensuring there was a key person to champion the project and be the driving force to keep traction was crucial. Identifying these key stakeholders early is essential.
- In hindsight, the Green Team could have asked for a commission from the installers for every converted lead, of perhaps 10%. This would help fund the work of the Green Team. Alternatively, it could finance a member of staff to work part-time to work on low carbon projects like these.

Appendix 5: Suggested Implementation Plan for WHIP CO2

Stage	Objective	Timeline
1	Communicate Carbon Audit Results	January 2010
2	Identify & establish contact with Partner Organisations (Cosy Devon, Torridge DC, Parish Council, Accredited businesses)	February 2010
3	Community Engagement, Public Relations, Utilising established Intermediaries	February 2010
4	Community Event – sign up to bulk buy	March 2010
5	Installation of works	Summer 2010
6	6 month follow-up – sign up laggards	Autumn 2010

- ✓ Stage 1 – Communicate the results of the carbon audit, highlighting an urgent need for change. While the motion of the carbon Footprinting exercise is still fresh in the community, this feedback should be actioned early in January 2010.
- ✓ Stage 2 – Early in February 2010, identify *local* partnership organisations who will offer a financial discount for community residents for home insulation projects. Additionally,make contact with Torridge District Council ('Cosy Devon') for advice and support on large volumes of grant funding applications.

  i.) Loft space insulators (Cosy Devon – see figure 30 below)

  ii.) Cavity wall insulators

  (Cavity Wall insulators should be registered with the 'Cavity Insulation Guarantee Agency' to ensure credibility of the work)

Stage 3 – Public Relations

i.) Trusted intermediaries to publicise the deal and a subsequent community event.

(E.g. Rotarians, Parish Councillors, The Winkleigh Society and Distinctly Winkleigh publication)

Stage 4 – Community Event (1)

i.) An event spread over 2 mornings and/or evenings

(1 week day and 1 weekend day) to promote home insulation as a cost effective solution to rising living costs. The event is for face to face engagement where projects can be explained. The partner organisations will be present as well.

ii.) Names and contact details obtained and passed to partner organisations for follow up.

Stage 5 – Installation of works. Summer 2010 presents the ideal climatic conditions for construction work of this type to be carried out.

Stage 6 – Community event (2) to follow-up and feedback the success of event 1. Typical financial and carbon emission savings headline the event with a view to signing up the laggards who delayed initial sign up. Autumn 2010 still present good climatic conditions for this type of work.

This model is an effective way to ensure the best financial deals for community residents, and to ensure substantial interest in the uptake.

As mentioned, Cosy Devon has been identified as the recommended grant body for Winkleigh. *Figure 30* below highlights the different criteria for residents.

Cosy Devon Grading	**Eligibility and Pricing**
Priority	Age 70+FREE cavity wall and loft insulation
Cosy Devon +2	Age 65 to 70 or <£18,000 hhld income/year. FREE cavity wall and loft insulation
Cosy Devon +1	Age 60 to 64. £24 cavity wall insulation. If existing loft insulation is 60 – 100mm is FREE. If existing loft insulation is 0 – 60mm cost is £14
Able to pay (SUBJECT TO SURVEY**)	£150 cavity wall insulation. If existing loft insulation is 60 – 100mm is £200. If existing loft insulation is 0 – 60mm cost is £170

Figure 30

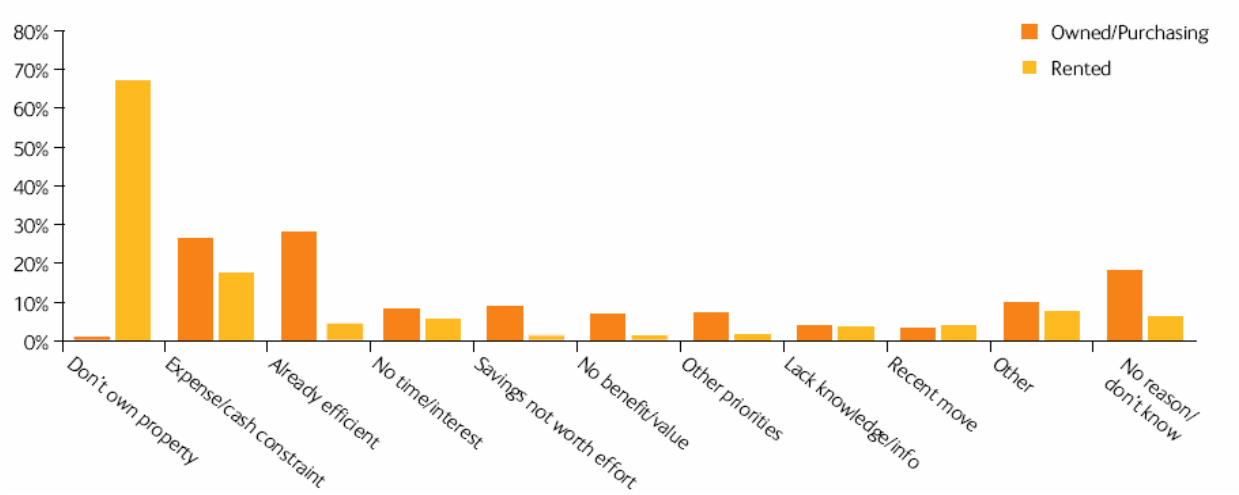
Source: Energy Savings Trust South West office

* loft insulation installed to a thickness of 270mm approx

**additional charges per square metre may be charged depending on quantity requirements

According to a research paper "Powergen Energy Efficiency Monitor, *Energy efficiency in UK households* " (2004) carried out by the Centre for Competition Policy (CCP) and UEA, a major reason for not acting on energy efficiency measures in the home is <u>not</u> owning one's property as seen in *Figure 31* below. Therefore, this community engagement must include and incentivise Winkleigh landlords.

Figure 31



Source: Powergen Energy Monitor (2004)

Quick Wins
Through Cosy Devon grant schemes, household who are on less that £18,000 per year, are eligible for FREE cavity wall and loft insulation.

Figure 32, Winkleigh Household Income

Number of households with an income of less than £15,000	% of households with an income of less than £15,000	Number of households with an income of less than £20,000	% of households with an income of less than
6,799	23.80%	10,907	38.20%
198	**20.90%**	**325**	**34.30%**

(Source: Torridge District Council, 'Knowing our customers')

Comments

- ✓ There is an estimated 198 households in Winkleigh on an income of less than £15,000 and would therefore qualify for the FREE cavity wall and loft insulation grants with Cosy Devon.
- ✓ There is scope for more than 198 considering 325 earn less than £20,000, with the cap on FREE insulation at £18,000.

The tables below are the Family Health Service Authority (FHSA) 2007 population estimates in different age ranges. Those who are aged 65+ are eligible for FREE cavity wall and loft insulation through the Cosy Devon grant schemes.

AGE	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49
NO.	84	88	89	110	82	62	81	122	132	139
%	4.08%	2.27%	4.81%	5.34%	3.98%	3.01%	3.93%	5.93%	6.41%	6.75%

AGE	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95+
NO.	150	183	210	170	142	90	65	28	17	5
%	7.29%	8.89%	10.20%	8.26%	6.90%	4.37%	3.16%	1.36%	0.83%	0.24%

(Source: Torridge District Council, 'Knowing our customers')

Comments:

- 25% of residents are in the age bracket of 65+
  Totaling 517 residents
  Assuming 2 persons per house hold = 258 homes to insulate
  (Naturally some homes will already have insulation in their homes.)

Social Issues is Winkleigh

According to the Department for Work and Pensions the percentage claim rate (August 2005) for:

- ✓ Disability Living Allowance (DLA)
- ✓ Incapacity Benefit and Severe Disablement Allowance (IB & SDA)
- ✓ Income Support (IS)
- ✓ Job Seekers Allowance (JSA
- ✓ Pensions Credits (PC):

	DLA	IB & SDA	IS	JSA	PC
Torridge	4.20%	6.60%	4.60%	1.90%	18.50%
Devon	4.40%	6.80%	5.20%	1.60%	18.50%
WINKLEIGH	**2.50%**	**5.00%**	**3.00%**	**1.20%**	**13.20%**

Comments

- Total benefit claims = 25% (24.9%)
- Further investigation is required to ascertain if any of these claims overlap
- Further investigation is required to ascertain the proportion of claimants who live on their own. It cannot be concluded that almost 25% of residents in Winkleigh are on a type of benefit and therefore entitled to FREE insulation measures.

Financial Incentives for the Winkleigh Green Team

Cosy Devon is offering financial incentives to voluntary organisations and community groups only (Cosy Devon Website 2009), to refer people onto the scheme. This presents an opportunity for WGT to become self funding, enabling community projects to realise their true potential from the get go.

We therefore believe that there is scope to implement substantial insulation projects with Winkleigh through the grant schemes. The main priority of the Winkleigh Green Team is to identify the residents who are eligible for the grant scheme.

Appendx 6: Accompanying letter to indiviudal carbon footprints who attended the Winkleigh Energy Clinic

University of East Anglia
Norwich Business School
Norwich
Norfolk
NR4 7TJ

Mr/Ms XXXX
XXXXXX
XXXXXX
XXXXXX
XXXXXX

Friday, 11th December 2009

Dear Mr/Ms XXXXX,

Please find enclosed the results of your carbon footprint from the survey taken at the Winkleigh Energy Clinic, which took place on the 31st October 2009 in the Community Village Hall, Winkleigh, Devon.

You maybe interested to know that average carbon footprint for housing and transport related emissions in Winkleigh Parish is **13.07 tonnes of CO2.**

To find out more information on ways to cut you household energy bills and carbon emissions, we strongly advise you visit the Energy Saving Trust website: www.energysavingtrust.org.uk or call FREE on 0800 512 012.

We would like to thank you for supporting the Energy Clinic and hope that you are enjoying some of the money saving tips we all discussed on the night.

We hope that you will continue to support environmentally friendly community events and projects in Winkleigh, and help to motivate friends, family and neighbours to do the same.

We wish you and your family a very Merry Christmas, and a *'low carbon'* New Year!

Best Wishes

Alastair, Jim and James

Enc.