



SevernWye
ENERGY AGENCY

Stroud District Council
40% House feasibility study

September 2007

Report

Contents

	<i>Page</i>
Executive Summary	
1. Background	3
2. Aims and objectives	5
3. Programme of work	6
4. Results	
4.1 Review of information about the Stroud housing stock	7
4.2 Selection of energy performance assessment methodology	13
4.3 Selection of baseline data and targets	14
4.4 Sample surveys of Stroud homes	15
4.5 Finance for measures	22
4.6 Review of local supply chain	32
4.7 Consumer survey	39
4.8 Review of procedures for selection of participants	43
5. Conclusions and recommendations for implementation	
5.1 Targets and achievability	44
5.2 Overview of delivery approach	46
5.3 Advice and behavioural change	47
5.4 Marketing and selection of participants	51
6. Outline plan for wider enhanced retrofit programme	
6.1 Overview	53
6.2 Marketing and advice	53
6.3 Installer network	54
7. Finance	56
Appendices	
Appendix 1: Baseline and targets – explanatory notes	
Appendix 2: Photographs of sample properties	
Appendix 3: Sample survey results	
Appendix 4: Ranking of energy saving measures	
Appendix 5: Consumer questionnaire	

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Executive Summary

In April 2006, Stroud District Council launched a new three year programme of work on climate change, including strategic development, support for business and further development of activities in the domestic sector. This study forms the first part of the third of these elements, and sets out proposals for implementation of the domestic sector aspects of the programme for the second and third phases, October 2007-March 2008 and April 2008 to March 2010 respectively.

The overall aim of this strand of work is to encourage and enable private homeowners in existing homes to reduce carbon emissions substantially, in line with the headline target of a 60% reduction in emissions on 1990 levels by 2050. This target was originally suggested by the Royal Commission on Environmental Pollution in their study 'Energy-the Changing Climate' in June 2000, and subsequently adopted in the 2003 and 2007 Energy White Papers.

This project was inspired by the "40% House" concept developed in the 2005 report by the Environmental Change Institute at the University of Oxford (www.40percent.org.uk), which reviewed the demand-side measures that would be required for the UK housing stock to achieve this target.

A critical factor in the perceived need for the project is the lack of market penetration of 'non standard' energy efficiency and micro-generation measures. National as well as local programmes support, in the main, the installation of the most cost-effective energy efficiency measures, where the capital costs are low enough and the returns in energy saving high enough to provide a relatively quick 'payback' on investment. However, the measures categorised as cost-effective in these terms are insufficient to reach the 60% target or to achieve affordable warmth in lower income homes. There is therefore a significant challenge ahead to move beyond this limited approach if the vision for a 40% house is to be achieved.

The Stroud 40% House Project focuses on retrofit, behavioural change and enabling mechanisms, whether and how it is possible to achieve the target in the *existing* housing stock, and the development of exemplars to test and inspire the wider spread of an enhanced level of retrofit in the District. The specific objectives of the feasibility study are to:

- Establish whether it is technically and economically feasible to establish such exemplars in Stroud
- Make recommendations for how it can be achieved

The study includes a review of information about the characteristics of the housing stock in the district, sample surveys of four different Stroud homes, a review of methodology for setting targets and monitoring the results, an assessment of costs and sources of finance for measures, an investigation of the local supply chain for sustainable energy measures and a consumer survey. Conclusions are presented in the form of recommendations for implementation.

The key principles guiding the recommendations were to ensure that the approach used is robust, pragmatic and workable. Target, baseline and monitoring data covering the same scope all need to be available for the approach used, so that the emissions reductions required and achieved under the project can be calculated. The recommendations are that:

- a) The same absolute target level is used for all participating households;
- b) The project covers all domestic energy use arising from heating and electricity use in the home;
- c) The emissions baseline for participating households is calculated from actual fuel use in the recent past, based on meter readings and bills available;
- d) Any monitoring of emissions levels and savings achieved is calculated from actual ongoing fuel use – either through the installation of smart meters, or by regular manual record keeping of fuel used during the course of the project;
- e) A target level of 2.8tCO₂ (0.8tC) per annum is used as the starting point and frame of reference for all houses, based on a 60% reduction from average domestic energy use emissions per (UK) household in 1990, but that:
- f) Given the ambitious nature of the target, the ultimate aim of the project should be to achieve this level on average across all the participating households, enabling any particularly hard-to-treat houses to be balanced by overachievements elsewhere.

The sample used for the surveys is only a small one and not statistically representative, so should be taken as an illustration only – however the results provide a useful insight into what it will be possible to achieve. They indicate that the recommended target is likely to be difficult but possible to achieve, with the addition of improvements in the efficiency of non-heating appliances and their use. An investment of the order of £26,000 per home for retrofit measures is indicated.

The measures required include those that are more practically and economically carried out in conjunction with other renovation work, such as internal wall and sloping ceiling insulation. The challenge is to ensure that home-owners are reached, encouraged and enabled at the right time to ensure that these measures are installed, and ongoing work with the supply chain is required to facilitate this within the wider market, along with a more direct awareness and marketing approach to achieve wider implementation of the full range of measures.

For the ‘40% House Exemplars’, a programme of work is recommended to include NHER surveys to model energy use and emissions and draw up an action plan, together with ongoing advice and support for the installation of measures, financial assistance, and a behavioural change programme.

1. Background

Climate change, energy efficiency and other environmental issues are high on the political and media agenda at present. More consumers are thinking about reducing energy consumption and moving towards sustainable energy, for both environmental and financial reasons, a phenomenon which is reflected in the increased demand for energy advice and related services.

Stroud District Council is an enlightened authority with a proven commitment both to sustainability and tackling fuel poverty, as illustrated by the recently published Environment Green Paper and their active role in the Gloucestershire Affordable Warmth Partnership, the Warm and Well programme and other relevant initiatives including:

- Gloucestershire Energy Efficiency Advice Centre
- WISE Homes: a scheme focussing on 'hard to treat' homes
- Manage Your Energy: staff behavioural change in local authority buildings
- Gloucestershire Renewable Energy Action Plan

Severn Wye Energy Agency (SWEA) is a non-profit company and registered charity promoting sustainable energy and affordable warmth locally and regionally. Established in Gloucestershire in 1999 under the EU SAVE programme, SWEA works with a wide range of partners across the sectors, but with a particular focus on the Gloucestershire local authorities.

In April 2006, Stroud District Council launched a new three year programme of work on climate change, including strategic development, support for business and further development of activities in the domestic sector. This study forms the first part of the third of these elements, and sets out proposals for implementation of the domestic sector aspects of the programme for the second and third phases, October 2007-March 2008 and April 2008 to March 2010 respectively.

The overall aim of this strand of work is to encourage and enable private homeowners in existing homes to reduce carbon emissions substantially, in line with the headline target of a 60% reduction in emissions on 1990 levels by 2050. This target was originally suggested by the Royal Commission on Environmental Pollution in their study 'Energy-the Changing Climate' in June 2000, and subsequently adopted in the 2003 and 2007 Energy White Papers.

This project was inspired by the "40% House" concept developed in the 2005 report by the Environmental Change Institute at the University of Oxford (www.40percent.org.uk), which reviewed the demand-side measures that would be required for the UK housing stock to achieve this target, including a quantification of the physical retrofit measures that would have to be applied. The study also reviewed demolition and new build rates, given that at current demolition rates two-thirds of the dwellings that will be standing in 2050 are already in existence. One of the policy options put forward in the conclusions is a significant increase in demolition rates of the most energy inefficient housing, although

the study does not go on to investigate the broader social or environmental impacts of this option.

The Stroud 40% House Project focuses on retrofit, behavioural change and enabling mechanisms, whether and how it is possible to achieve the target in the *existing* housing stock, and the development of exemplars to test and inspire the wider spread of an enhanced level of retrofit in the District. With the perspective of the policy and statistical background described above, it focuses in upon the practical details at local level.

A critical factor in the perceived need for the project is the lack of market penetration of 'non standard' energy efficiency and micro-generation measures. National as well as local programmes (Warm Front, Energy Efficiency Commitment, Warm and Well) support the installation of the most cost-effective energy efficiency measures, where the capital costs are low enough and the returns in energy saving high enough to provide a relatively quick 'payback' on investment.

Typical current practice is to assume a simple payback period (estimates for predicted annual fuel bill savings against cost of installation) of less than seven years as an indicator of 'cost-effectiveness' in owner-occupied housing, on the basis that the owner-occupiers own their homes for an average of seven years, and so will benefit directly from the full potential return on their investment, regardless of any potential impact of the improvements they have made on the price or saleability of their home.

However, the measures categorised as cost-effective in these terms are insufficient to reach the 60% target or to achieve affordable warmth in lower income homes. There is therefore a significant challenge ahead to move beyond this limited approach if the vision for a 40% house is to be achieved.

2. Aims and objectives

Against the background outlined above the domestic strand of the programme consists of two elements:

- a) Development of up to 20 exemplar '40% homes' that have reduced carbon emissions by 60% in line with the 2050 targets by providing help and support to those who have already invested in energy efficiency to enable them to move onto the next stage of becoming self-sufficient
- b) Enhance the mechanisms to raise the level of installations of low carbon retrofit building technologies across the board

This report is the outcome of the feasibility study for part (a) above, the conclusions for which form the proposals for implementation from October 2007 to March 2010. It aims to:

- Establish whether it is technically and economically feasible to establish such exemplars in Stroud
- Make recommendations for how it can be achieved

Should the proposals be accepted, work on the implementation of the programme will commence in October 2007. A progress report will be provided at the end of March 2008, which may recommend amendments to the programme for the next two years based on the experience of the initial phase and any external factors which may change during this period and are as yet unknown or unconfirmed (such as to government policy or grant programmes).

The Stroud 40% House project ('a' above) is intended to provide exemplars that will assist in the wider programme of enhancement (b) in Stroud, as well to be promoted to a wider audience. The research is relevant to both elements of the work and the conclusions to the study include outline recommendations for the latter, to be refined and adapted in the progress report at the end of the year.

In theory, theory and practice are the same, but in practice, they're not'

Santa Fe Institute 'Factor Four'

3. Programme of work

The feasibility study consisted of eight distinct but interlinked elements:

Element 1: Review of information about the Stroud housing stock

Element 2: Selection of energy performance assessment methodology

Element 3: Selection of baseline data and targets

Element 4: Sample surveys of four homes

Element 5: Review of finance for measures

Element 6: Review of local supply chain

Element 7: Consumer survey

Element 8: Review of requirements for selection of participants

4. Results

4.1 Review of information about the Stroud housing stock

A review was carried out of information about the energy performance of private sector housing in Stroud District, in order to establish a perspective on the task in hand, the range of housing types represented and the measures likely to be required.

The main sources of information are the Stroud District Council Private Sector House Condition Survey 2006 and the council-owned stock profile database (Probase). National statistics were also used for background data. The Stroud Private Sector House Condition Survey makes comparisons with the 2004 English House Condition Survey (EHCS).

UK household carbon emissions by end use: DTI Energy Consumption Tables, 2006	
Space Heating	53%
Hot water	21%
Consumer electronics	6%
Cold appliances	5%
Lighting	5%
Wet appliances	4%
Cooking	3%
Miscellaneous	3%

The table above shows that space heating continues to be the most significant component (more than half) of carbon emissions from home energy use, followed by water heating (at around a fifth). However it should be noted that lighting and electrical appliances if taken as a whole (excluding cooking, which can be based on other fuels) constitute another fifth.

This would indicate that while building thermal efficiency, heating and hot water appliance efficiency and controls are the most important issues to focus upon, full consideration should also be given to lighting and electrical appliance efficiency and use. Micro-generation (renewable energy sources used at household level) has a significant potential carbon reduction impact across all end uses.

The 1995 Home Energy Conservation Act set targets for a 30% improvement in the energy efficiency of housing between 1996 and 2011. The estimated reduction achieved in Stroud in the first ten years to 2006 is 17.15%, which leaves 12.85% to achieve in the remaining five years.

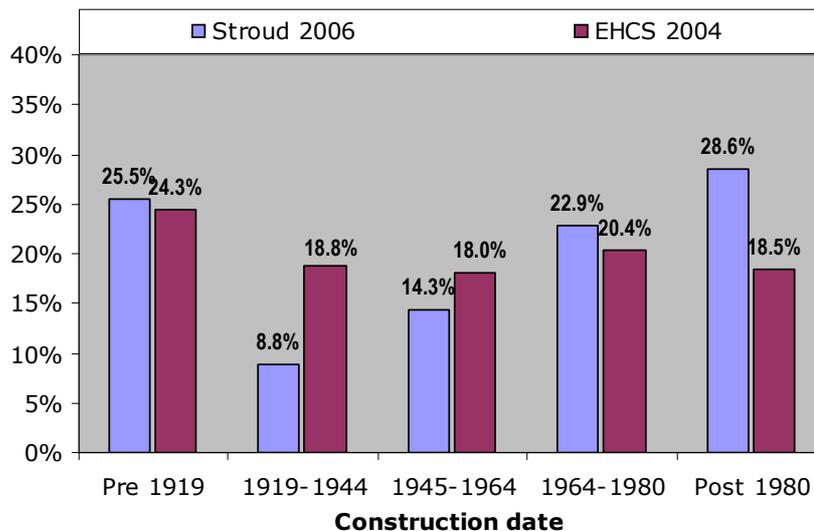
Statistics from the Stroud District Private Sector House Condition Survey 2006

The House Condition Survey (HCS) for 2006 identifies a total of 42,000 private sector homes in the District, of which 48.6% of homes (20,412 dwellings) were built before the 1965 Building Regulations. Private sector in this context includes owner-occupied, private rented and housing association homes.

Stroud homes by tenure – HCS 2006

Tenure	dwellings	%	EHCS 2004
Owner occupied	35,500	75%	71%
Privately rented	5,200	11%	10%
Housing Association	1,200	3%	8%
Local Authority	5,300	11%	11%
Total	47,200	100%	100%

Dwelling age profile England and Stroud – Stroud HCS 2006

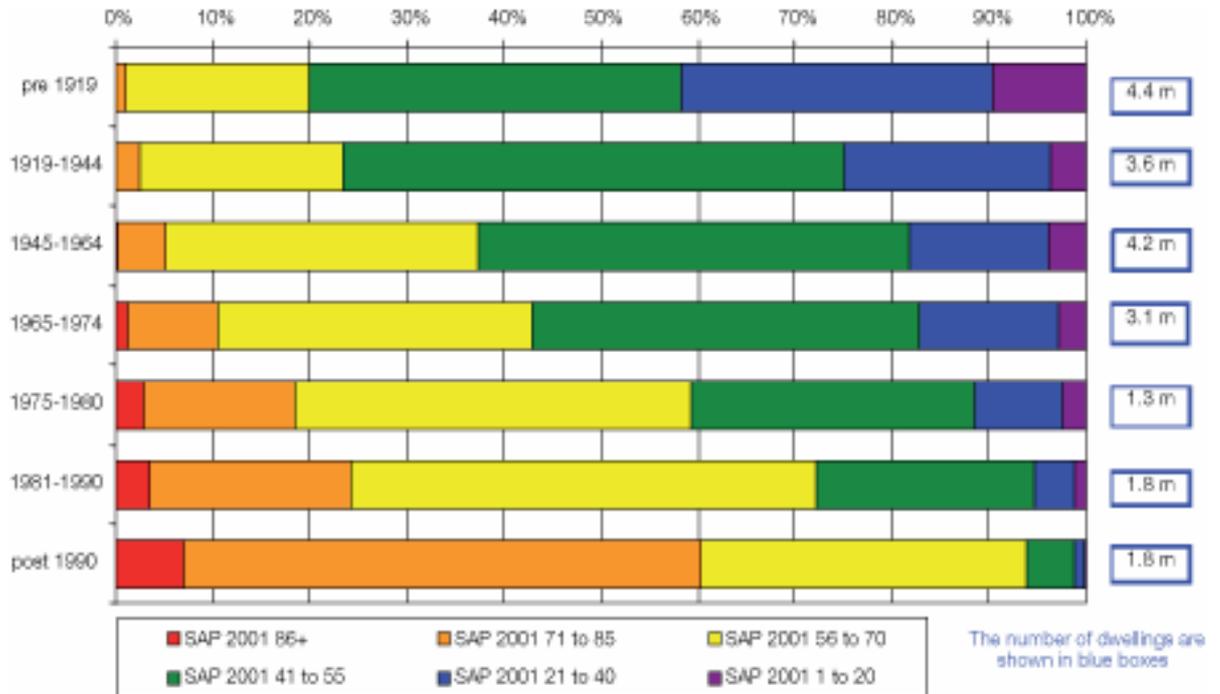


The energy efficiency of existing stock closely relate to age, with newer properties generally progressively more energy efficient, since the introduction of Building Regulations in 1965 and at stages with the periodic revisions of the relevant sections (mainly part L). The correlation between the age of a property and its energy efficiency is demonstrated in the graph below.

The owner-occupied stock has a similar age profile to the overall position, with 50.1% built post 1964, compared to 51.7% overall.

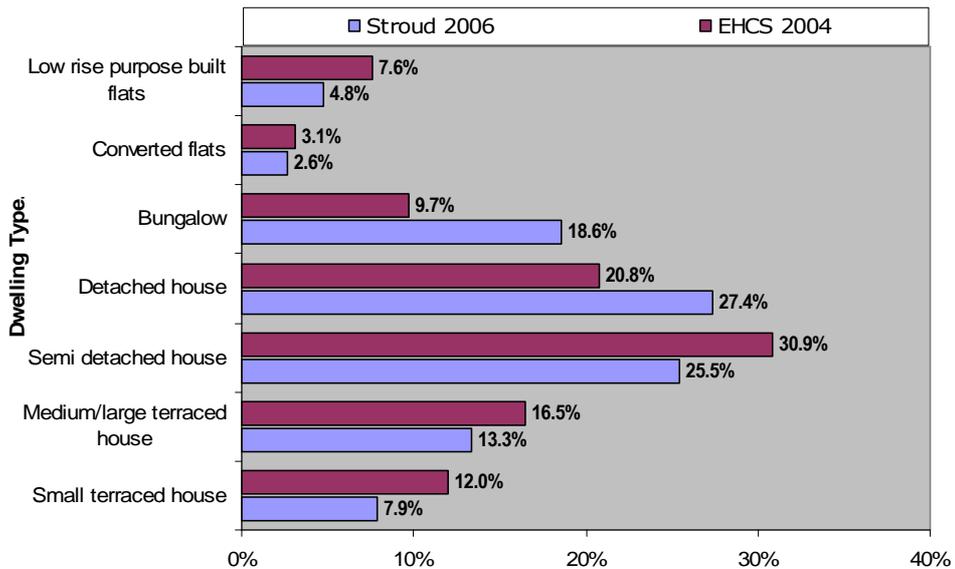
Just over 1,000 owner-occupied homes in Stroud are Grade II listed, all built before 1919.

Profile of Energy Performance in Existing U.K. Dwelling Stock
 (extract from Review of Sustainability of Existing Buildings. DCLG, 2006)



The built form of the private sector stock for 1997 and 2006 is shown below. Detached and semi-detached homes predominate, whilst converted and purpose-built flats form only 3% of stock.

Built Form of Private Sector Stock 2006 – Stroud HCS 2006



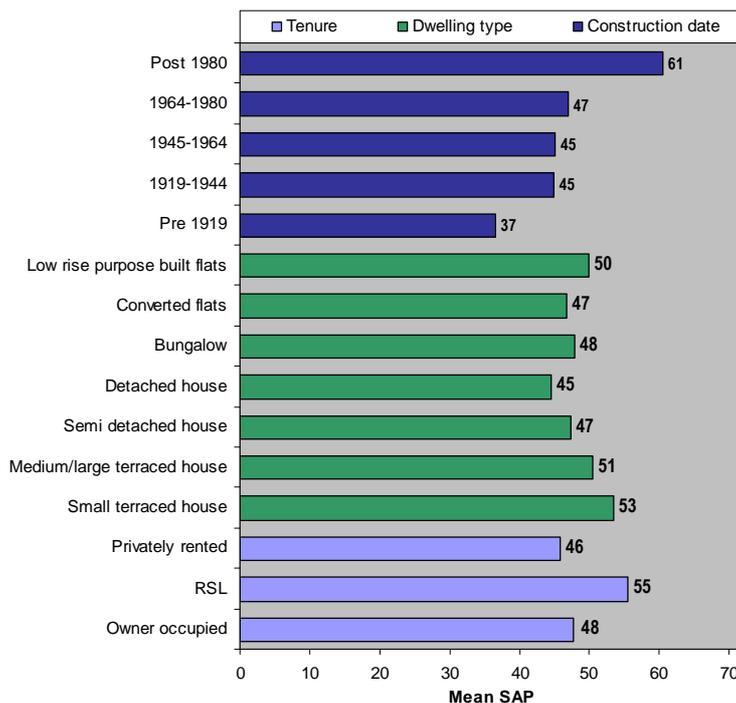
Energy efficiency of housing in Stroud

For this project, the main concern is the private sector housing stock, and once the local authority rented dwellings are excluded, there are only 14,740 records of private sector homes with energy rating results and CO₂ emission estimates available. The average results for these properties and some other key statistics are provided in the table below:

Average NHER	5.6
Average SAP	48
Average CO ₂ emissions	8.93 tonnes per year
Percentage of homes built before 1900	25.56%
Percentage of homes that are detached houses	47.39%
Percentage of homes with cavity wall construction	57.18%

The average SAP rating for private sector housing in Stroud is 48, which compares the national figure of just under 52.

SAP by general characteristics – Stroud HCS 2006



This table indicates that the homes with the lowest energy rating are:

- Properties built prior to 1964, especially those built prior to 1919
- Detached and semi-detached dwellings
- Privately-rented and owner-occupied

It is estimated that over 85% of properties in Stroud have mains gas.

Statistics obtained from NHER Probase database for Stroud District

Stroud District Council has an energy efficiency database (NHER Probase) which contains the addresses of 45,130 dwellings, which was the whole of the housing stock when the database was set up. The database includes some energy efficiency data on 24,955 dwellings, 19,980 of which are complete at “level 0” and thus have energy rating and CO₂ emission estimates available. The statistics below are based only on the private sector dwellings for which full energy data is available.

Age	Number	Percentage
Pre 1900	3,768	25.56%
1900-29	985	6.68%
1930-49	1,610	10.92%
1950-65	3,001	20.36%
1966-76	2,545	17.27%
1977-81	739	5.01%
1982-90	1,335	9.06%
1991-95	554	3.76%
Post 1995	203	1.38%
total	11,746	100%

Built form	Number	Percentage
Detached	6,986	47.39%
Semi-detached	4,909	33.30%
End terrace	1,088	7.38%
Mid terrace	1,363	9.25%
Mid terrace + passage	196	1.33%
Flat	185	1.26%
Maisonette	13	0.09%

Wall construction type	Number	Percentage
Solid brick	3,051	23.04%
Cavity	7,570	57.18%
Timber frame	110	0.83%
Stone	2,508	18.94%

This data confirms the pattern indicated in the HCS and indicates:

- A predominance of detached and semi detached homes (which will tend to have a higher than average heat loss through the walls)
- Around a third are pre 1930, almost all of which will be of solid wall construction
- Approximately another third were built in 1930-1965, many of which are likely to be of cavity wall construction

This indicates the importance of both cavity and solid wall insulation as a measure.

Conclusions of property assessment to inform selection of properties for project participation

As a result of the information about the Stroud housing stock above it is possible to indicate the ideal proportion of property types that should make up the 20 properties for inclusion in the project.

This recommendation has been made taking into consideration; the built form of private sector stock, the proportion of properties that are connected to the mains gas network and the date of construction. The table below shows the proposed number of properties for inclusion from the built form of the private sector stock.

Built Form	Percentage as a total of the Private Sector Stock	Suggested Number of Properties for Inclusion
Low rise purpose built flats	4.8%	1
Converted Flats	2.6%	1
Bungalow	18.6%	3
Detached house	27.4%	6
Semi detached house	25.5%	5
Medium/large terraced house	13.3%	2
Small terraced house	7.9%	2
Total	100%	20

It is estimated that at least 85% of properties in Stroud are on the mains gas network. As such it would be appropriate if 17 properties selected for this project were on the mains gas network and 3 properties were not. It is recommended that where possible the 3 properties are selected from the highest proportion of property types. This would result in 1 property being selected as not on the mains gas network from each of the following built forms:

- Detached house
- Semi detached house
- Bungalow

The review of information about the housing stock details the age of properties. It is important that the properties selected for inclusion in the project reflect the build dates of all houses in Stroud. Therefore the following should be taken into consideration:

Age of Properties	Percentage of Total Properties	Number for Inclusion in Project
Pre 1930	32.24%	7
1930-1965	31.28%	6
Post 1965	36.48%	7
Total	100%	20

4.2 Selection of energy performance assessment methodology

The options were reviewed for assessment methodology for the energy performance of the homes in the project. The requirements were for a methodology that would provide:

- Estimates of current energy consumption., fuel costs and CO₂ emissions, with the ability to back date to an agreed baseline
- Estimates of savings that could be achieved by installing a range of measures under standard occupancy conditions
- If possible the ability to fine-tune to actual consumption levels

Software in this field is currently in a state of flux due to the introduction of energy performance certification. For the feasibility study it was decided to collect the information required for full Standard Assessment Procedure (SAP) energy rating calculations using the NHER Plan Assessor computer program. Usually simplified data entry procedures (reduced data SAP or RDSAP) would be used for energy surveys of existing homes, but the current version of the software for this restricts the energy efficiency improvement options to a fixed list and does not give an estimate of the total CO₂ emissions for all energy use, which is what is required for this project.

The survey procedure requires full measurement of the properties, including the areas of each wall, floor and roof type, plus the areas of each window and door. Information was also collected on the heating and hot water systems and the numbers of low energy lights installed. Due to the difficulty in obtaining full details of the floor, wall and roof constructions, the U-values of these elements have been defaulted according to the age and type of construction in the same way as is defined for RDSAP. (Reduced Data SAP – Collected data set and inferences v4.1, published by FAERO on behalf of DEFRA, March 2007).

Initially an assessment of the current energy efficiency and CO₂ emissions was carried out based on the survey data, using the standard occupancy assumptions that are defined in SAP. The efficiency of electrical appliances is also based on standardised assumptions.

Actual fuel consumption data from fuel bills can be collected where this is available, and this would enable an assessment to be made as to whether the households in question have higher or lower consumption than average. This was not used in the current assessment however, due to temporary limitations in the flexibility of the software. It was, however, recognised at this stage that it may be desirable to include reductions in energy consumption due to higher than assumed efficiency appliances, or behavioural change (such as less use of appliances) and that (at least in some cases) a 60% reduction in emissions may not be feasible unless this is done.

In this case, monitoring of the targets would need to be based on actual fuel consumption data, with the NHER assessments used as an initial indicator to assist in identifying the *potential* impact of a range of measures under standard occupancy conditions.

4.3 Selection of baseline data and targets

During the feasibility study, we looked at various options for the methodology to establish the target and baseline emissions levels for the exemplar houses taking part in the 40% project.

The main issues under consideration included:

- a) The type of target to be used;
- b) The scope of emissions to be covered;
- c) The way in which the baseline should be calculated;
- d) How ongoing emissions levels and savings could be monitored; and
- e) The level at which the target should be set.

Appendix 1 provides a detailed discussion of the options considered and sets out our recommendations for the methodology to be used. In summary, we would recommend that:

- g) The same absolute target level is used for all participating households;
- h) The project covers all domestic energy use arising from heating and electricity use in the home;
- i) The emissions baseline for participating households is calculated from actual fuel use in the recent past, based on meter readings and bills available;
- j) Any monitoring of emissions levels and savings achieved is calculated from actual ongoing fuel use – either through the installation of smart meters, or by regular manual record keeping of fuel used during the course of the project;
- k) A target level of 2.8tCO₂ (0.8tC) per annum is used as the starting point and frame of reference for all houses, based on a 60% reduction from average domestic energy use emissions per household in 1990, but that:
- l) Given the ambitious nature of the target, the ultimate aim of the project should be to achieve this level on average across all the participating households, enabling any particularly hard-to-treat houses to be balanced by overachievements elsewhere.

The key principles guiding our recommendations were to ensure that the approach used is robust, pragmatic and workable, while having a common sense basis. In addition, target, baseline and monitoring data covering the same scope all need to be available for the approach used, so that the emissions reductions required and achieved under the project can be calculated.

4.4 Sample surveys of Stroud homes

Surveys were carried out of four homes in Stroud in order to explore the feasibility of possible targets for CO₂ emissions from the housing in the District. In particular the aim was to establish what measures would be required to achieve (a) a 60% reduction in CO₂ emissions compared to a baseline level in 1996, and (b) a “two tonne house” based on annual CO₂ emissions regardless of house type. The decision to use a 1990 baseline was arrived at after carrying out the surveys, and does not significantly alter the results for the purposes of the feasibility study.

Photographs of the properties surveyed are provided in Appendix 2

4.4.1 Methodology

The four homes were surveyed to collect the information required for full Standard Assessment Procedure (SAP) energy rating calculations using the NHER Plan Assessor computer program, as detailed above.

In each case, a baseline energy consumption for 1996 was estimated by removing those improvement measures assumed to have been installed since then. This includes the removal of extensions to the property where these have been carried out since 1996. The addition of a new build extension to a property will generally improve the energy rating (and the emissions per m² of floor area), but may increase the total CO₂ emissions in tonnes per year.

4.4.2 Sample property survey results

Tables of results are presented for each of the four properties below in Appendix 3. These include the SAP and NHER energy ratings, total CO₂ emissions in tonnes per year and the percentage reduction in this compared to the baseline. The CO₂ emissions based on the SAP, (for energy consumption for space heating, hot water and internal lighting only) have also been included as it may be easier to achieve a 60% reduction on this basis.

Sample property1: Rodborough Hill

Description of property and main energy features:

This is a four bedroom, two storey double fronted detached house built in 1905. On three sides the external walls are of cavity brick construction (which is unusual for the age of the property) but one side wall is solid brick. The cavity walls have been insulated, and the pitched roof has 100mm of loft insulation throughout, with an additional 150mm over about half its area. Most of the windows are traditional single-glazed timber sash windows.

There is a small extension at the rear of the property providing a dining area for the kitchen on the ground floor and an en-suite bathroom to one bedroom on the first floor. This extension was built in 2005 and has double glazed windows and is assumed to have good levels of insulation to meet the 2002 Building Regulations standards.

Heating is by radiators served by a condensing (mains) gas boiler with a programmer, room thermostat and thermostatic radiator valves (TRVs). There is also a live fuel effect gas fire in the living room. Hot water is from a hot water cylinder served by the boiler, with 25mm spray foam insulation and a cylinder thermostat.

Improvement measures assumed to have been installed since 1996:

The improvement measures since 1996 have been assumed to be cavity wall insulation, loft top up from 100mm to 175mm (average), new gas fire in living room (assumed open solid fuel fire previously) and new condensing boiler and TRVs (assumed 65% efficient boiler previously). The extension was not built in 1996 so the property has an increased floor area that will reduce the CO₂ savings from the improvements (estimated as 37.5%) but will have contributed to the significantly improved SAP energy rating (from 33 to 63) since 1996.

Further potential improvement measures and their effect on CO₂ emissions:

The most significant further energy efficiency improvement for this property would be (internal or external) insulation to the side wall that is of solid brick construction. Further top-up to the loft insulation, more low energy lights and additional hot water cylinder insulation would also lead to further minor improvements.

However, to achieve a 60% reduction in CO₂ emissions compared to a 1996 baseline would also require the installation of both solar hot water and solar PV systems, with all appliances raised to A rated or better, and avoiding use of the secondary gas fire in the living room (which is much less efficient than use of the boiler to heat this room). Due to the size of this property, it would not be possible to achieve much less than 6 tonnes of CO₂ emissions per year from this property under 'standard occupancy conditions' unless the rest of the electricity used could also be obtained from a local renewable energy source.

Sample property 2: Castlemead

Description of property and main energy features:

This property is a five bedroom, two storey detached house built in the 1970s of cavity brick wall construction with some decorative timber panelling at first floor level and stone by the main entrance. It is built into a steep hillside, with the lower floor significantly smaller than the upper, and an integral garage on the lower level. The cavity walls are insulated, and the pitched roof has approximately 100mm of insulation between the joists. All of the windows are uPVC double-glazed. There is a large conservatory at the rear of the property but this is thermally separated from the living room so has not been taken as part of the dwelling for the energy consumption estimates. (If this conservatory is heated the energy consumption and CO₂ emissions are likely to be significantly higher than is estimated in the results indicated).

Heating is by radiators served by a condensing (mains) gas boiler with a programmer, room thermostat and TRVs. There is also a glass-fronted wood burning stove in the living room. Hot water is from a hot water cylinder served by the boiler, with 25mm spray foam insulation and a cylinder thermostat.

Despite having better energy efficiency overall than the other three examples, this house is prone to condensation dampness, especially on the window frames of the north facing bedrooms at the front. This is likely to be primarily due to lack of ventilation, and the installation of mechanical extract fans to the kitchen and bathroom is recommended, although these would slightly reduce the energy efficiency of the property (and slightly increase the CO₂ emissions).

Improvement measures assumed to have been installed since 1996:

The improvement measures since 1996 have been assumed to be cavity wall insulation, a new condensing boiler and TRVs (assumed 65% efficient boiler previously), CFLs (5 rooms) and double glazing. The conservatory has not been included in the assessment as it is thermally separated, so assumed to be unheated. The CO₂ savings from these improvements is estimated as 33.6%.

Further potential improvement measures and their effect on CO₂ emissions:

Further top-up to the loft insulation, more low energy lights and additional hot water cylinder insulation would also lead to further minor improvements in the energy efficiency of this property. Insulation to the exposed floor over the garage would be beneficial and relatively straightforward to install – this might also help to reduce the risk of condensation problems in the property.

With the installation of both solar hot water and PV, plus all appliances to be A rated or better a saving of 57-63% is achievable, reducing the CO₂ emissions to about 4 to 4.5 tonnes. To reduce emissions further would require a behavioural change shift away from ‘standard occupancy conditions’. One example could be a greater proportion of heat provided by the secondary source than assumed – as the secondary heating is a wood burning stove which has low CO₂ emissions.

Sample property 3: Moors Terrace

Description of property and main energy features:

This is a three bedroom, two storey, mid terrace house built of local stone. The original house is thought to have been built pre-1900 but it now includes a relatively large modern extension (built in 1996) that added a kitchen on the ground floor and third bedroom on the first. This extension has significantly improved the energy efficiency of the property, especially since the adjacent property was extended as part of the same project, giving both houses a more efficient ratio of area of heat loss elements to the floor area.

The original stone walls have not been insulated, but the extension is assumed to have relatively good levels of insulation to meet the 1995 Building Regulations standards. The pitched roof has 150mm of loft insulation throughout, with an additional 50mm of timber added to the joists to enable this to be boarded over without compressing it. The windows in the original part of the house are traditional single-glazed timber casement windows but those in the extension are double glazed.

Heating is by radiators served by a pre-1998 balanced flue (mains) gas boiler with a programmer, room thermostat and TRVs (kitchen and main bedroom only). There is also a wood-burning stove in the living room. Hot water is from a hot water cylinder served by the boiler, with a 25mm insulation jacket and a cylinder thermostat.

Improvement measures assumed to have been installed since 1996:

The improvement measures since 1996 have been assumed to be loft top up from 100mm to 150mm, under floor insulation to the solid ground floor, and CFLs in two rooms. The baseline has been taken as before the extension was built. The property therefore has an increased floor area that has effectively cancelled out the CO₂ savings from the improvements (estimated as only 0.2% net) but will have contributed to the significantly improved SAP energy rating (from 49 to 63) since 1996.

Further potential improvement measures and their effect on CO₂ emissions:

The most significant further energy efficiency improvement for this property would be replacing the boiler with a new 'A' rated condensing gas boiler. Insulation to the stone walls of the original house, further top-up to the loft insulation, secondary glazing to the single glazed windows, more low energy lights and additional hot water cylinder insulation would also lead to further improvements.

However, a 60% reduction in CO₂ emissions compared to a 1996 baseline would not quite be achieved even with the installation of both solar hot water and solar PV systems, plus all appliances that are A rated or better. As this property is slightly smaller than average, it might be possible however to achieve CO₂ emissions of about 2.33 tonnes per year from this property under 'standard occupancy conditions'. As in the previous example, the secondary heating is a wood burning stove which has very low CO₂ emissions, so greater use of this than assumed as standard might lead to further reductions in CO₂ emissions.

Sample property 4: Bisley Road

Description of property and main energy features:

This property is a large four bedroom, detached house built of local stone. It is built into the hillside so the lowest floor is below street level and is significantly smaller than the upper floor. There is also a 'room in the roof' so there are effectively four storeys overall. The house is assumed to have been built pre-1900, and it includes a rear 'extension' that is of similar age which gives the property a (thermally inefficient) 'L' shape. The original stone walls have not been insulated, and there is no accessible loft space so this has also been assumed to be un-insulated. Most of the windows are traditional single-glazed timber sash windows but a few at the rear are double glazed.

Heating is by radiators served by a (mains) gas fired Rayburn 'Royal' kitchen range with a programmer and TRVs. This type of boiler is very inefficient (assumed to be 46%). There is also a wood-burning stove in the living room and an open fireplace in the dining room. Hot water is from a spray foam insulated hot water cylinder served by the boiler, with a 25mm insulation jacket over it and a cylinder thermostat.

Improvement measures assumed to have been installed since 1996:

The improvement measures since 1996 have been assumed to be wood-burning stove as secondary heating, hot water cylinder jacket, TRVs, five double glazed windows and CFLs (5 rooms). These have not significantly improved the SAP energy rating (from 1 to 10) since 1996 but have led to an assumed reduction in CO₂ emissions of 20.34%, primarily due to the assumed use of wood in the living room stove.

Further potential improvement measures and their effect on CO₂ emissions:

The most significant further energy efficiency improvement for this property would be replacing the kitchen range with a new 'A' rated condensing gas boiler. This measure alone would achieve a 60% reduction in the CO₂ emissions compared to the assumed 1996 baseline. Insulation to the stone walls, insulation to the lofts and sloping ceilings, secondary glazing to the single glazed windows, more low energy lights and additional hot water cylinder insulation would also lead to further improvements. As this property is significantly larger than average, CO₂ emissions of less than about 5 tonnes per year would, however, be difficult to achieve under standard occupancy conditions.

4.4.3 Conclusions and recommendations for sample properties

Although the sample was small and not representative of all types of home in Stroud, the results give useful indications for what is achievable and at what would need to be done to reach the project targets.

Summary of results for sample properties - SAP

	Baseline (1996)	Current	All measures
Rodborough Hill	33	63	73
Castlemead	47	67	78
Moors Terrace	49	63	83
Bisley Road	1	10	74

Summary of results for sample properties - NHER

	Baseline (1996)	Current	All measures
Rodborough Hill	3.9	7.2	8.8
Castlemead	5.5	8.2	9.5
Moors Terrace	4.3	7.0	10.2
Bisley Road	1.3	1.8	9.1

Summary of results for sample properties – kWh/year

	Baseline (1996)	Current	All measures	All measures plus 40% lower than average use
Rodborough Hill	62,338	40,781	33,447	31,919
Castlemead	38,531	23,974	19,223	17,696
Moors Terrace	25,780	23,752	12,640	11,390
Bisley Road	125,204	114,398	26,697	24,808

Summary of results for sample properties – CO₂ emissions (tonnes per year)

	Baseline (1996)	Current	All measures		All measures plus 40% lower than average use	
			t/a	% reduction	t/a	% reduction
Rodborough Hill	15.13	9.45	7.09	53	6.15	59
Castlemead	8.18	5.43	4.15	49	3.4	58
Moors Terrace	5.36	5.28	2.96	45	2.33	57
Bisley Road	28.12	22.40	5.83	79	4.87	83
average	14.2	10.64	5.01	57	4.18	64

The achievement of a 60% reduction in emissions in the homes surveyed is a tough target except for Bisley Road which has a very poor energy rating at present. It may be achieved on average with the addition of the reduction in appliance consumption.

The other three properties surveyed had SAP energy ratings that are reasonably close to the likely average in 1996 so the analysis of percentage savings (excluding the effect of any extensions) should be fairly typical.

The target of 2.8 tCO₂ per annum is achievable in one of the homes surveyed. However the other three homes surveyed are all larger detached properties, which will tend to be the most difficult in terms of the absolute target for emissions. Detached houses are 27.4% of the private sector stock, and are therefore over-represented in the small sample used for the study.

All four homes in this survey were on the mains gas network so alternative technologies such as ground source heat pumps and biomass boiler based systems have not been considered for these examples. These technologies may be appropriate for other homes in the District however.

As there is a strong correlation between the ability to reach an absolute target of emissions and the house size, an additional indicator that would help to illustrate this is to consider CO₂ emissions per square metre of floor area per year:

Summary of results for sample properties - kgCO₂/m² per year

	Baseline (1996)	Current	All measures	All measures plus 40% lower than average use
Rodborough Hill	99.5	53.8	40.4	35.0
Castlemead	68.5	45.5	34.8	28.5
Moors Terrace	93.4	59.1	33.1	26.1
Bisley Road	177.6	141.5	36.8	30.8

A new home built to the latest Building Regulations (Part L1A 2006) would be likely to have total CO₂ emissions of less than 40 kgCO₂/m² per year.

4.5 Review of finance for measures

4.5.1 Capital costs of measures

The figures below are very approximate and based on broad experience. Individual quotations would be needed to reflect particular circumstances, and a number of factors may influence the cost including changes in the prices of materials, the impact upon the market of significant changes in government grant schemes, and practical opportunities to combine different works at the same time.

Approximate capital costs of improvement measures

Measure	Capital Cost	Comments
Hot water cylinder insulation to 80mm	£20	DIY
CFLs to 100%	£50	DIY
Loft insulation top-up	£200-£300	May be cheaper if DIY May be significantly more if additional ventilation to loft space needed or access difficult
Insulation to sloping ceilings	Total:£1,500-£2,000 Marginal:£800-1,000	Marginal cost if re-plastering or reproofing.
Cavity wall insulation	£300-£500	Depends on property size
External insulation to solid walls	£4,000-£9,000	Depends on property size
Internal insulation to solid walls	Total: £3,000- 8,000 Marginal:£2,000-5,000	Depends on details and size. Marginal if re-plastering anyway
Insulation to exposed floors	£30-£100 per m ²	Depends on access and presence of services
Draught sealing to external doors and windows	£100-£200	May be cheaper if DIY
Secondary glazing or replacement double glazed windows	£2,500-£5,000	Depends on number/size/type of windows
Improved heating controls (room thermostats, TRVs, etc)	£500	Less if done at same time as other work on the heating system
Replacement 'A' rated condensing boiler	£1,000-£2,500	Bottom end of the range if boiler can be located in the same place as previously
Solar hot water system (4m ²)	£2,000-£5,000	Depends on size and ease of access. Many companies are quoting much higher prices.
Solar photovoltaic system (1kWp)	£6,000-£10,000	Depends on size and ease of access
Ground source heat pump	£8,000-£10,000	Depends on size and ease of access
Biomass boiler system	£4,000-£6,000	Also requires secure dry space for fuel store

4.5.2 Existing sources of finance

Summary of current funding for sustainable energy retrofit measures.

Measures	Eligibility	£
Warm Front		
Loft insulation, cavity wall insulation, draught-proofing, hot water tank jacket, insulated hot water tank, cfls, central heating, night storage heaters, solid fuel room heaters	In receipt of listed benefits, <i>and</i> either over 60 or with children under 16	Maximum of £2,700 or £4,000 if oil central heating.
Gloucestershire Energy Efficiency Grants (GEEG)		
Loft insulation, cavity wall insulation, draught-proofing, hot water tank jacket, replacement gas boiler, heating controls	Over 60 with savings less than £16,000 and income below agreed maximum; All over 70s (insulation only); On benefit, between 16 and 60.	Maximum of £2,500
WISE Homes		
Sloping ceiling insulation Flat roof insulation Internal or external wall insulation Floor insulation Upgrade heating Wood pellet heating Solar hot water Ground source heat pump Micro wind or hydro Eco loft insulation	Open to all Flexible grant for 60+ on low income (as GEEG)	Insulation: Up to £1,000 per measure to max of £2,000 Wood chip/pellet boiler: £1,000 Solar h/w, heat pump, wood pellet room heater, micro-wind or hydro: £500 Up to £6,000, based on full assessment of need
Low Carbon Buildings Programme		
Solar PV Solar thermal hot water Ground source heat pump Wood pellet stoves/room heater Wood fuelled boiler Small hydro Wind turbine	No restriction	Lower of £2,000 per kW to max £2,500 or 50% Lower of £400 or 30% Lower of £1,200 or 30% Lower of £600 or 20% Lower of £1,500 or 30% Lower of £1,000 per kW to max £2,500 or 30% Lower of £1,000 per kW to max £2,500 or 30%
Energy Efficiency Commitment (EEC)		
(Mainly) loft insulation, cavity wall insulation, draught-proofing, cfls, replacement gas boilers. Ground source heat pump Solar thermal		Varies with supplier, higher levels of funding for 'priority group' £1,500 (n-power) £75 (Scottish Power)

It should be noted that all these programmes are subject to change, and in particular:

- Warm Front is government funded and revised periodically
- GEEG is a Gloucestershire wide scheme devised for the Warm and Well programme, and uses local authority private sector funding to fill the 'eligibility gap' between Warm Front and the truly 'able to pay'. In Stroud the funding comes from the District Council. Eligibility criteria are reviewed regularly by the local authority steering group.
- WISE is a Stroud District programme and funded directly by the District Council
- Low Carbon Buildings Programme budgets may run out before the end of the 2007-8 financial year and no further funding has been announced.
- Some fuel suppliers give relatively small amounts of funding towards renewables at present under EEC but this cannot be added to the LCBP. Examples are around £75 towards solar thermal from Scottish Power, and £1,500 towards ground source heat pumps from n-power.

Potential for future funding under CERT

EEC finishes in March 2008 and will be replaced by a similar programme Carbon Emissions Reduction Target (CERT), to run from 2008-2011. Levels of funding under CERT will not start to be confirmed until January 2008 at the earliest, but some indications are given in the consultation documents and 'illustrative mix' of measures (these are still under discussion with suppliers).

CERT allows for support for micro-generation and non-standard insulation measures, but the support likely to be available is uneven across the technologies with solar thermal, solar PV and micro-wind likely to receive little benefit from the scheme as currently proposed.

Measures within the CERT obligation will be selected on the basis of best value for lifetime carbon saving. A total of 5% of the CERT carbon saving target for priority groups (low income households in receipt of certain eligible benefits) can be transferred to non-priority groups (where measures are cheaper to deliver) in exchange for the priority groups having certain additional "fuel poverty" measures installed. The cost of the additional measures would be roughly equivalent to the savings from the 5% switch to the non-priority group.

The priority group areas where these additional measures are installed should be off the gas network and in the private sector. It is proposed that a utility company can choose from the following 3 measures based on the CERT lifetime carbon saving criteria, justified by the figures in the table below.

- Solid wall insulation
- Ground source heat pumps
- Biomass boilers

Example of CERT cost and carbon savings for off-gas priority group private homes

Technology	Existing heating fuel (CH = central heating)	Average full capital cost of additional measure	Cost saving to householder £/year	Carbon saving KgC per year
Solar thermal	Oil CH	3000	51	146
Solar thermal	Electric storage	3000	74	102
Solid wall insulation	Oil CH	3180	305	607
Solid wall insulation	Electric storage	3180	539	1,069
Biomass boiler	Oil CH	5000	188	912
Biomass boiler	Electric storage	6900	565	1,612
Heat pump	Oil CH	9500	142	407
Heat pump	Electric storage	9500	478	1,083

4.5.3 Financing the measures for the sample homes

As an illustration a very approximate costing and breakdown of grants available has been carried out for each sample home. In these properties neither GEEG nor Warm Front were applicable to the households in question.

Rodborough Hill

Cost	Measures	EEC	WISE	LCBP
£20	Hot water cylinder insulation to 80mm			
£50	CFLs to 100%			
£300	Loft to 300mm (U=0.2)			
£5,000	Insulation to solid wall at side (internal, total cost)		£1,000	
£4,000	Secondary glazing and draught sealing			
£3,500	Solar hot water system (4m ²)	(£75)	£500	£400
£10,000	Solar PV(1kWp)			£2,000
£22,870			£1,500	£2,400

Total costs minus grants: £18,970

Castlemead

Cost	Measures	EEC	WISE	LCBP
£20	Hot water cylinder insulation to 80mm			
£50	CFLs to 100%			
£300	Loft to 300mm (U=0.2)			
£2,000	Insulation to floor over garage		£1,000	
£3,500	Solar hot water system (4m ²)	(£75)	£500	£400
£16,000	Solar PV (2kWp)			£2,500
£21,870			£1,500	£2,900

Total costs minus grant availability: £17,470

Moors Terrace

Cost	Measures	EEC	WISE	LCBP
£20	Hot water cylinder insulation to 80mm			
£50	CFLs to 100%			
£250	Loft to 300mm (U=0.2)			
£2,500	New A rated condensing boiler and TRVs			
£4,000	Secondary glazing			
£4,000	Insulation to solid stone walls (internal)		£1,000	
£4,000	Solar hot water system (4m ²)	(£75)	£500	£400
£10,000	Solar PV (1kWp)			£2,000
£24,820			£1,500	£2,400

Total costs minus grant availability: £20,920

Bisley Road

Cost	Measures	EEC	WISE	LCBP
£20	Hot water cylinder insulation to 80mm			
£50	CFLs to 100%			
£300	Loft to 300mm (U=0.2)			
£2,500	New 'A' rated condensing boiler and TRVs to all radiators, with temperature and two zone time control			
£5,000	Secondary glazing to single glazed windows			
£4,000	Insulation to sloping ceilings, stud wall to room in the roof and roof to bay		£1,000	
£8,000	Insulation to solid stone walls (internal)		£1,000	
£4,000	Solar hot water system (4m ²)	(£75)	£500	£400
£10,000	Solar PV system (1kWp)			£2,000
£33,870			£2,500	£2,400

Total costs minus grant availability: £28,970

The sample is small and the results are illustrative only and may not be representative of Stroud housing in general – however it is a useful starting point for assessing the potential costs and requirements for additional finance.

Approximate estimated costs of all measures to achieve target savings

Cost of measures (£)	Total	WISE	LCBP	Remaining
Rodborough Hill	22,870	1,500	2,400	18,970
Castlemead	21,870	1,500	2,900	17,470
Moors Terrace	24,820	1,500	2,400	20,920
Bisley Road	33,870	2,500	2,400	28,470
Average	25,857	1,750	2,525	21,457

Based on this small sample, a broad estimate of the capital cost of measures to reduce the carbon emissions of an existing home to in the region of 40% of 1996 levels is around £25,000, of which around 10% is currently covered by government grants. In Stroud the additional WISE grant already offers a further 7-10%, but the remaining major portion would currently have to be provided by the householder.

This information should be set against the estimated fuel costs and savings associated with these measures to save energy and carbon emissions. These are summarised below for the four homes surveyed in the study.

Summary of results for sample properties – fuel costs £/year

	Baseline (1996)	Current	All measures	Annual savings against baseline	All measures plus 40% lower than average use
Rodborough Hill	2,103	1,579	1,360	743	1,125
Castlemead	1,404	1,032	863	541	682
Moors Terrace	931	962	655	276	510
Bisley Road	3,664	3,283	1,116	2,548	902

A review of the simple payback on fuel bill savings indicates clearly that this would not be a good argument in favour of installation of the measures recommended.

Estimate of fuel bill savings and simple payback for all measures

	Fuel bill saving	Cost of all measures	Simple payback time (years)	Cost after grants	Payback to householder with grants
Rodborough Hill	743	22,870	31	18,970	26
Castlemead	541	21,870	40	17,470	32
Moors Terrace	276	24,870	90	20,920	76
Bisley Road	2,548	33,870	13	28,470	11

This calculation does not however take into account future fuel cost rises or reduction in the costs of measures.

It also does not take into account the fact that where internal solid wall insulation is preferable to external (this is likely to be common in Stroud for aesthetic reasons, as many properties are stone or older brick, with a characteristic appearance) this is highly unlikely to be carried out as a one-off measure as implied in the approximate costs given above. Instead it may be installed when major refurbishment is needed, including re-plastering, with several implications for the purposes of this project:

- This may happen at some point in the next 30 years
- It offers a rare opportunity for insulation which must not be missed
- The costs of the insulation itself will be reduced as they will be marginal to the costs of the other works being carried out
- The disruption to the household is also ‘marginal’ with regard to the other works being carried out

4.5.2 Options for additional finance

Some households may be able and willing to finance carbon reduction measures themselves, to a greater or lesser extent. There are a number of factors influencing this, including:

- household income and expenditure
- savings
- access to loans
- attitude to borrowing
- age and other personal circumstances
- length of time they expect to stay in the property in question
- condition of property and timing of other renovation, repair or improvements

Approach	Opportunities/benefits	Risks/disbenefits	Examples
Managed programme of LA grant-aided work	Price reduction and control Hand holding to completion encourages good conversion rates Codes of conduct for operatives Ability to integrate with quality advice Ability to add measures/messages Ability to set and adapt eligibility criteria with changing conditions Facilitates ongoing monitoring and improvement through communication with installers	Relatively resource intensive to manage Time and delay to run tenders Tends to favour larger companies Lowest price tenders may not result in good activity levels Requirement for quality control with associated costs and liability	Warm & Well, Gloucestershire, South Glos., Somerset Simply Solar, Kirklees Greenkey, Glos Solarplan, Northamptonshire
LA grants or as addition to existing schemes	Installer selection done for you Quality control (may be) done for you Achieves more significant price reduction for consumer	Dependent on continuation of scheme over which no control May not have notice of scheme ending Possible lack of installer price control	CO2i (Powys) Oxford Solar Initiative
Cash-backs	Simple to administrate and market Flexible 'piggy-backing' on other schemes Ability to integrate with quality advice Paperwork requirements on householder only, not installers Client contact facilitates monitoring	Lack of quality control unless 'piggy-back' on other schemes	Think BIG (South West) Solar for London

<p>Vouchers for energy efficiency products as incentive to install other measures</p>	<p>Simple to administrate Achieves secondary measure and potential savings Simple marketing theme Flexible ‘piggy-backing’ on other schemes Can be easily amended/adapted over time Ability to integrate with quality advice Paperwork requirements on householder, not installers – facilitates customer monitoring</p>	<p>Consumers limited to certain items/suppliers which may not be relevant for them at the time Does not reduce cost of measures for client</p>	
<p>Low or zero interest loans</p>	<p>Assists households without access to capital Revolving loans recycle capital outlay (can be based on equity release on sale) Encourages long term view Most useful for lower income homes for medium cost , cost-effective measures (such as heating improvements)</p>	<p>Planning and administration can be costly and/or time-consuming especially if done ‘from scratch’. Increases credit burden on households if used for measures with longer payback than loan repayments. Take-up not generally high</p>	<p>Take the Lead, Herefordshire and West Midlands</p>

Given the scale of work that is needed in this programme, involving significant and sometimes expensive measures in (initially) relatively few homes, and the changing market at present, the simpler approaches with maximum flexibility and minimum complexity in management appear the most appropriate. These are the cash-back and voucher approaches.

4.6 Review of local supply chain

The local 'supply chain' for home owners carrying out work on their homes was reviewed with two scenarios in mind:

- Home owners carrying out renovation work to their homes, providing an opportunity to incorporate sustainable energy improvements
- Home owners specifically seeking retrofit of energy improvements

The supply chain has several potential functions in this context:

- As a route to market, with potential for engagement in scheme marketing
- As a channel for information about technical options, advice and financial assistance
- As the suppliers and installers of relevant products and equipment

Home-owners will come into contact with various providers of goods and services at different stages in the process of having work done on their homes, and there may be many opportunities to influence them to include carbon reduction measures at relevant stages. This is particularly important as some major carbon saving measures, such as internal solid wall insulation, will only be practical at specific times in the history of the care of an individual property – such as when a thorough renovation is needed, including re-plastering.

With this in mind the following categories of key actors within the supply chain were researched:

- Installers of heating and insulation
- Installers of micro-generation
- Builders
- Building Merchants
- DIY Stores
- Development Control
- Building Inspectors

4.6.1 Insulation and heating installers

A telephone survey was carried out of insulation and heating installers to assess how they might be drawn into the 40% house and enhanced retrofit activity. They were asked a standard list of questions regarding sustainable energy measures. The list of installers was drawn from several sources including:

- NIA installer list
- Yell installer list – insulation
- Yell – Builders
- Care and repair - central heating list
- Care and repair – insulation installers

In order to ensure that as many as possible would be prepared to answer questions, the lead statement was kept as short as possible and adapted for different character response types.

One hundred calls were made, and the results were categorised as follows:

Successful contact, information logged.	25
Attempted contact, but unsuccessful	45
Business not related to the enquiry or response very negative	25
Business does not exist	5

Regarding non-standard energy efficiency measures, responses were largely negative. Those who responded positively were mostly unsuitable due to reasons varying from ‘retiring soon’ to ‘too far away’ and ‘long waiting list already’.

The most positive response came from Domestic & General Insulation, who are able to provide the most comprehensive list of measures, with the ability to install in Stroud. This is unsurprising however, as this company has already established a strong working relationship and track record with both SWEA and local authorities in Gloucestershire, and is the main contractor delivering in quantity on the successful Warm and Well programme.

Of the twenty five successful calls, five expressed an interest in exploring further the possibility of working within an installer network in the Stroud area. Three of the five ‘currently’ only install standard measures, although are receptive to the idea of exploring further areas which could potentially become profitable. Only two installers currently undertake work to install non-standard measures. Both installers are small businesses expressing reserved interest in the possibility of extended energy efficiency work in Stroud. One of the installers is a builder, and the other is keenly involved within the renewable industry.

The general conclusion is there is not a demand for additional work in providing non-standard insulation and heating measures amongst the easily identifiable potential providers. This may mean that it is difficult to find providers for these measures in practice, or simply that these measures are integrated within general building or heating provision.

4.6.2 Installers of micro-generation

The current situation was reviewed as regards activity by micro-generation installers in Gloucestershire, as the market is in a state of transition at present.

Micro-generation or building integrated renewable energy includes solar water heating, solar photovoltaic electricity (PV), small scale wind turbines, micro hydro, ground source heat pumps, automated wood pellet room heaters and wood fuelled boiler systems. Only approved products installed by accredited installers qualify for grant assistance under the DBERR Low Carbon Buildings Programme.

A major barrier to installation of renewable energy technologies in the domestic sector is the selection of a suitably qualified and accredited installer. A recent mail shot to Gloucestershire householders from one of the non-accredited solar thermal installation companies using high pressure sales techniques with associated high prices claimed their company has 40% of the UK solar water heating market.

A basic accreditation scheme was established under the DTI Clear Skies Householder Renewable Energy Grants Scheme which ran from April 2004 to April 2007. The accreditation was free to installers and only required the installer to have completed two installations of the renewable energy technology for which were applying for accreditation. These installations were then inspected. There was no requirement that the installer should have previous training either in renewable energy installation or in plumbing, heating or electrical installation over and above statutory requirements, which were minimal in the plumbing and heating sector at the time the Clear Skies accreditation scheme was introduced.

This resulted in a large number of accredited installers of various levels of skill and experience, many of whom promoted themselves through the Clear Skies website contact list as working in several different regions of the UK. Therefore if a householder searches the current Low Carbon Buildings Programme website for an installer to provide for a quotation for a solar water heating installation in south-west England they will be provided with a list of 137 accredited solar installers, some as far away as Cambridgeshire and northern Scotland.

The DBERR (Department for Business, Enterprise and Regulatory Reform), recently awarded a contract to the Building Research Establishment (BRE) to introduce a more robust Microgeneration Accreditation Scheme with clear installation standards for each renewable energy technology and a requirement that all installers join the Renewable Energy Association's REAL Assurance Scheme, a consumer code for companies installing renewable heating, hot water and electricity systems to domestic customers.

Under the Microgeneration Accreditation Scheme, an assessment is undertaken at the company's office(s) and of at least one installation on site to ensure that policies and procedures meet the requirements of the scheme and that the work that has been undertaken is consistent with the system design. The BRE who manage the scheme have produced Microgeneration Standard Guidance Sheets for each technology which will be used as a benchmark when inspecting installations that have received public financial support.

In future the Low Carbon Buildings Programme grants will only be available to applicants using both products and installers certified under the Microgeneration Certification Scheme. However the future of grants under the Low Carbon Buildings Programme is in doubt after the current budget allocated has been used up.

The Microgeneration scheme management costs are expected to be covered by installer accreditation fees of £1,800 per installer/ company which may be seen as a barrier by small companies. In addition renewable energy installation companies will be required to join the Renewable Energy Association's REAL code of customer care including quality assurance and a complaints procedure, at a cost of £200/ year.

SWEA is the delivery partner for the renewable energy targets under the Gloucestershire Local Area Agreement 2007-10, and is currently developing and marketing a renewable energy advice service to increase the uptake of installations. In order to build stronger links with installers who currently work or have expressed interest in working in Gloucestershire, SWEA has initiated development of a Gloucestershire Sustainable Energy Installer Network. This may also be extended to South Gloucestershire. The network will form a useful resource for activity within Stroud specifically.

Development work on the network has been carried out with the Stroud requirements in mind, as follows.

Using contact details from the LCBP approved installer list for the south-west and data from the Renewable Energy Office for the SW (RegenSW) 32 renewable energy installation companies were contacted by e mail. They were sent a basic questionnaire and an invitation to attend a discussion evening and focus group in Nailsworth. It is intended to keep an open membership for all LCBP accredited installers who meet the membership criteria, and it is anticipated that the network will expand as it becomes established.

32 LCBP accredited companies were contacted
 15 companies have expressed an interest in joining the installer network to date
 9 installers attended the focus group meeting

The companies that responded provided the following data about the technologies they install and the total numbers of installations in Gloucestershire over the last 3 years undertaken by the companies who responded.

Technology	Number of companies	Installations in Gloucestershire Sept 2004 – Sept 2007
Solar thermal	6	115
Solar PV	3	23
Micro wind	1	1
Micro hydro	0	0
Biomass	1	1
Ground source heat pumps	3	7
Total installations		147

Note: some companies offer more than one technology

This will not represent all installations, as other companies including those using high pressure sales techniques (and therefore not LCBP accredited) have also been active in the county.

Feedback from installer focus group

Installers were asked about barriers to increasing the number of household renewable energy installations, using as a score of 1 – 5, with 1 indicating a minor barrier and 5 the most significant. 7 completed questionnaires were returned, with the following results:

Barriers for home owners	Average score
Too expensive/ too long a payback period	3.3
Not convinced of reliability or performance	2.3
Can't find a suitable installer	2.1
Requirement for planning permission	2.9
Too much information on renewable energy products and options making choice difficult	2.3

Barriers for installers	Average score
Changing the rules for government grant schemes and installer accreditation	4.1
Cost of accreditation and training	3.3
Lack of government long term support for householder renewable energy	3.3
Requirement for planning permission	2.7
A small % of enquiries leading to quotes and installations due to lack of customer knowledge as to what they want and too many casual enquiries	3.4

Within the discussion, participants were asked the following questions about marketing, incentives and barriers:

Question:

What is the target group for domestic private sector renewable energy installations?

Response from one installer:

We have installed 60 solar thermal installations over the last 3 years in Gloucestershire. Only 5 customers were under 50 and most were moderately well off with capital to invest.

Question:

If a local authority wished to provide financial support for local domestic renewable energy systems, how would they best use £20,000 or £50,000, for example grants or incentives (such as vouchers for A-rated appliances).

Response:

The overwhelming majority response was to keep grants or incentives simple. Vouchers for new appliances were not supported as some people considering

renewable energy installations may already have relatively new appliances. Installers wanted minimum involvement in grant schemes - for example the grant should be paid directly to the householder on completion of the installation as a cash-back on production of a receipted invoice with simple claim form.

Grants should be divided equally across all technologies if there is a fixed grant and fixed target number of installations, on a first come first served basis with no monthly or annual cap. Stop/ start grants are to be avoided. A grant of £350 was regarded as too low and £500 about right on top of existing LCBP grants or future government financial incentives.

Question: Can you give any advice on a marketing strategy?

Responses:

- People are not sure how to value a renewable energy installation. For example a foreign holiday or new kitchen may be more expensive than a renewable energy installation and have no economic payback.
- Marketing should flag up potential increased capital value of a property with a low maintenance renewable energy system installed, especially once energy performance certificates for properties become more commonplace.
- Renewable energy on new build is cheaper than a retrofit on existing properties
- It would be beneficial if marketing material carried local authority endorsement.
- Installers are having to spend time on basic renewable energy information and education with some initial enquiries (such as the difference between solar thermal and solar PV). It would help if advice centres fulfilled this role.
- Get a brief description of the products offered by installers so that if a customer has a preference they can be directed to the most appropriate installer.
- SWEA could put a Sustainable Energy Installer section on their website with information and links to grants.

Question: What are the other barriers to domestic renewable energy?

Response:

Planning can be an additional cost and delay. The installers present suggested SWEA should seek some generic advice from planners and circulate this to the installer group, for example through a newsletter or electronic e-zine. It was suggested that a planner could address a future meeting of the installer group

All the installers attending the meeting indicated they would be interested in quoting for work as part of the Stroud 40% house and enhanced retrofit programmes.

4.6.3 Builders' merchants, DIY stores, estate agents, development control

A series of brief, structured, on-site interviews were carried out to assess the present supply chain situation and identify opportunities for further investigation. All sites were visited unannounced to gain a "real world" impression of what products and services are currently available, and to gauge the attitudes of those involved directly with providing these services.

These interviews do not represent an exhaustive, comprehensive review of all providers in the district, but provide a sample of these organisations, and the attitudes of those involved in delivering relevant services to the general public.

Businesses were visited in Minchinhampton, Nailsworth, Painswick, Stonehouse, and Stroud. Interviews were conducted in two DIY stores, three builders merchants, and ten building societies. Two architects requested written questionnaires to be sent by email, of which one has been returned to date.

Summary of results:

Local DIY stores sell a limited range of products (principally loft insulation), offer printed and verbal advice on how to use them, and recommend that customers with more demanding enquiries visit a local builders' merchant. Demand is usually seasonal, and they would welcome additional information and/or training for themselves and customers.

Local builders' merchants carry a wider range of insulation products, including loft, floor, and wall insulation, some kept in stock, some to order. Whilst most tradespeople know what they want, information literature is normally available, either in-house or from manufacturers, and more complex enquiries can usually be answered by counter staff making use of product specifications, and telephone and fax help lines. Counter staff find that making the effort to provide good service is worthwhile as it usually results in obtaining customer orders.

Local estate agents feel that energy efficiency has nothing to do with their function of selling homes, and although Energy Performance Certificates are in their infancy, energy performance is not currently an important consideration for homebuyers. Some were happy to distribute energy efficiency literature to homebuyers, and one mentioned that they have a separate developer's office that might have more interest in the Enhanced Retrofit Programme.

At SDC, the service received from the planning department was admirable, but as pointed out by the planning officer, their focus is not on energy efficiency. Building Control do not provide "drop in" technical advice, only help with administrative matters, as the technical officers are frequently out on site visits. Residents are welcome to make appointments to resolve technical questions.

Both planning and Building Control Officers suggest residents consult local architects if they have specific technical queries.

4.7 Consumer survey

A simple survey was carried out of consumer attitudes in Stroud to improving the energy efficiency of their homes and installing micro-generation. This took two forms, a focus group discussion and a questionnaire survey.

4.7.1 Focus group results, Stroud

Q1: If your home was surveyed for energy efficiency, how do you think it would perform?

- Badly because it is a listed building. We had to take out our double glazing because someone reported us. We would like solar hot water but cannot get planning permission. There is no loft and solid walls.
- My house is a very well insulated colander! It is a Cotswold stone property and has been renovated as eco friendly as possible but Cotswold stone is very difficult to draught proof. I do have solar hot water though.
- Not great, I have solid walls. I do have my loft insulated though... but only about 4 inches.
- Excellently. I have solar hot water which has cut my heating bills by 50%, the cavity walls are filled and the loft insulation is beyond building regulation standards. I also have all low energy lighting bar two bulbs which don't get used a lot.
- Its not as bad as it was. It is a top floor flat and we are getting the cavity walls filled soon. Had the loft insulation topped up to 300mm recently which I have found not only keeps the heat in during winter but also keeps me cool in the summer. I didn't know it worked both ways!

Q2: Are there energy efficiency measures you know of that you do not have in your home?

- All participants responded yes.
Why don't you have them?
- Money, knowledge, availability, suitability

Q3: If a report on your home was worse than you expected, how would that make you feel?

- Fed up. We try to be green but the type of house we have makes it difficult
- I wouldn't expect it to be good as my building is listed so there is little I can do.
- It wouldn't make any difference to most people.

Q4: Would a poor rating motivate you to invest in sustainable energy measures?

- If it was possible
- If it was cost effective
- If it increased the value of my property

Q5: Within the next 3 years would you consider investing in any of the following?

- *Solar hot water?* 3 already had it, two are definitely planning to install, two would like to but are not sure it would be suitable for their properties.
- *Cavity wall insulation?* All have it except one who is getting it installed soon.
- *Loft insulation?* Most have got enough, some need a top up. The problem of where to put all the stuff from the loft is delaying their actions.
- *Solid wall insulation?* 5 of the participants had solid walls. The general feeling was that solid wall insulation would be too much hassle. In Cotswold cottages the rooms are often very small already so installing SWI would lose too much space.
- *Biomass?* Only if the current heating system was broken. Might be more interesting for people off the gas network.

- *100% energy efficient lighting?* One already had 100%. Others had mostly CFL's but a few fittings didn't take them. Nobody would consider changing the light fitting for one that only took energy saving light bulbs.
- *All A rated appliances?* All participants agreed that if they were changing an appliance they would definitely look for A rated (or A++) although design and dimensions are still important.

Q6: How much would you consider to be a reasonable amount to spend on sustainable energy measures for your house?

- *Up to £3000?* Everyone considered this reasonable.
- *Up to £5000?* Three people considered this reasonable.
- *Up to £10000?* Two people considered this reasonable.
- In a few years time the measures will pay for themselves in the value of your property.
- But does it increase the asset value of your home proportionally to the investment? People would assume a £10K conservatory would add £15K to the value of the property, but would an £8K PV system add more than £8K to the value of the house??
- But we are talking about future asset value... it might not pay for itself immediately like a conservatory, but as the price of fuel rises these technologies will be more valuable.
- Also the process of installing sustainable energy technologies could be combined with the introduction of other modern design features.

So is the look of the property more important than the sustainability?

- Appearance, look and style all go hand in hand with sustainable and environmentally friendly features.

Q7: If the energy performance of your home was visible to your neighbours and to passers by would you be more inclined to spend money on improving it?

- No! Would not make any difference.

4.7.2 Questionnaire survey

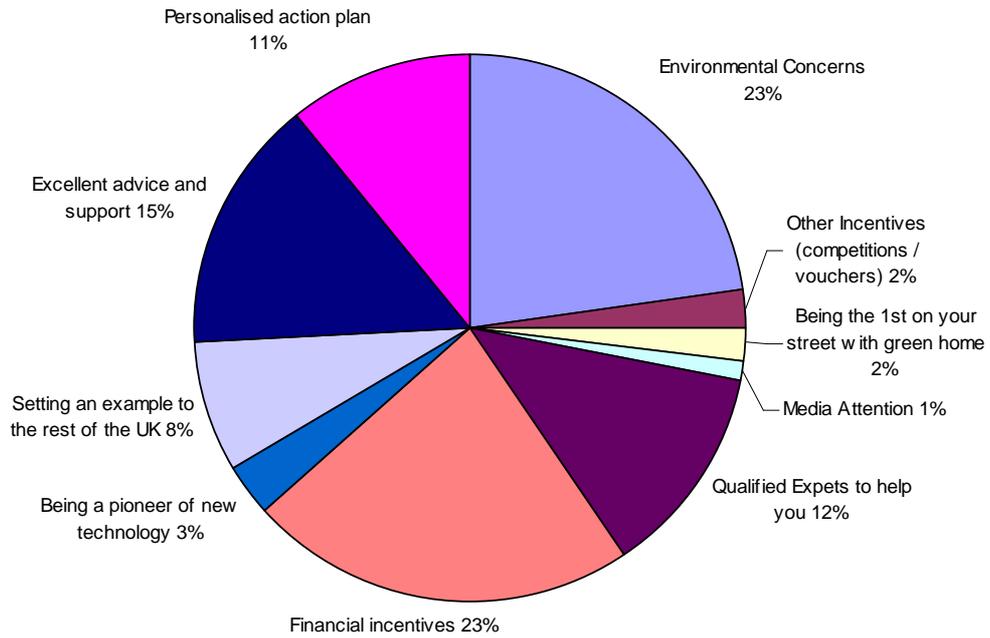
There were 53 respondents to the questionnaire survey with the results indicated in the charts below.

The most important drivers for change (23% of respondents) were environmental concerns and financial incentives, with expert support, advice and personalized action plans as the next most important categories.

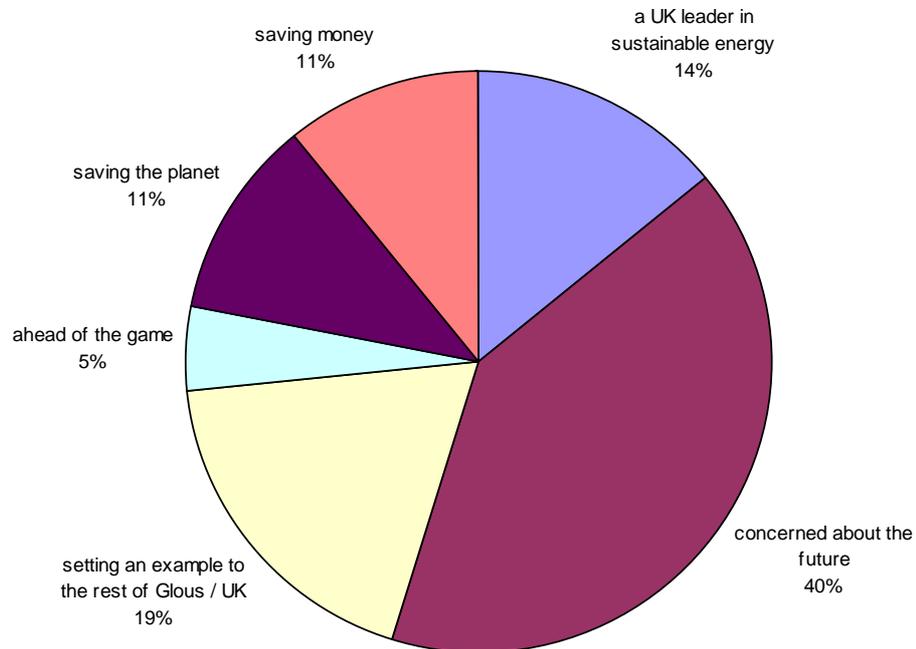
Press articles, e-mail contact, presentations to community groups and flyers through the door were the most popular medium for communication.

Preferred incentives were money-off (26%), followed by a rail-card for a year, vouchers for Farmers' Markets or shares in a wind farm (12%), and vouchers for energy saving appliances (11%).

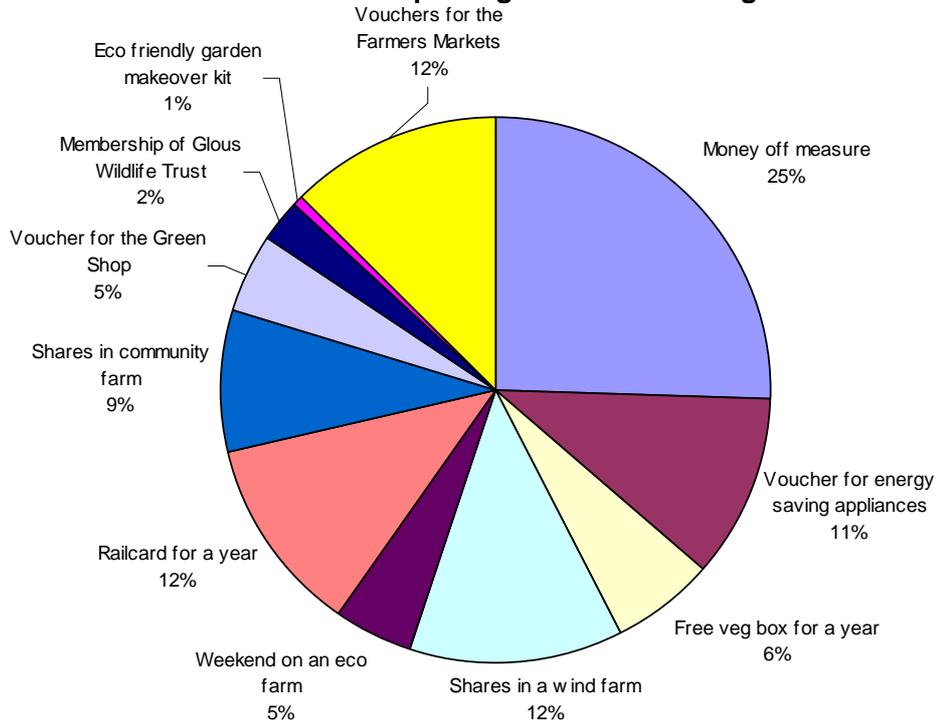
Q1: What would encourage you to make changes?



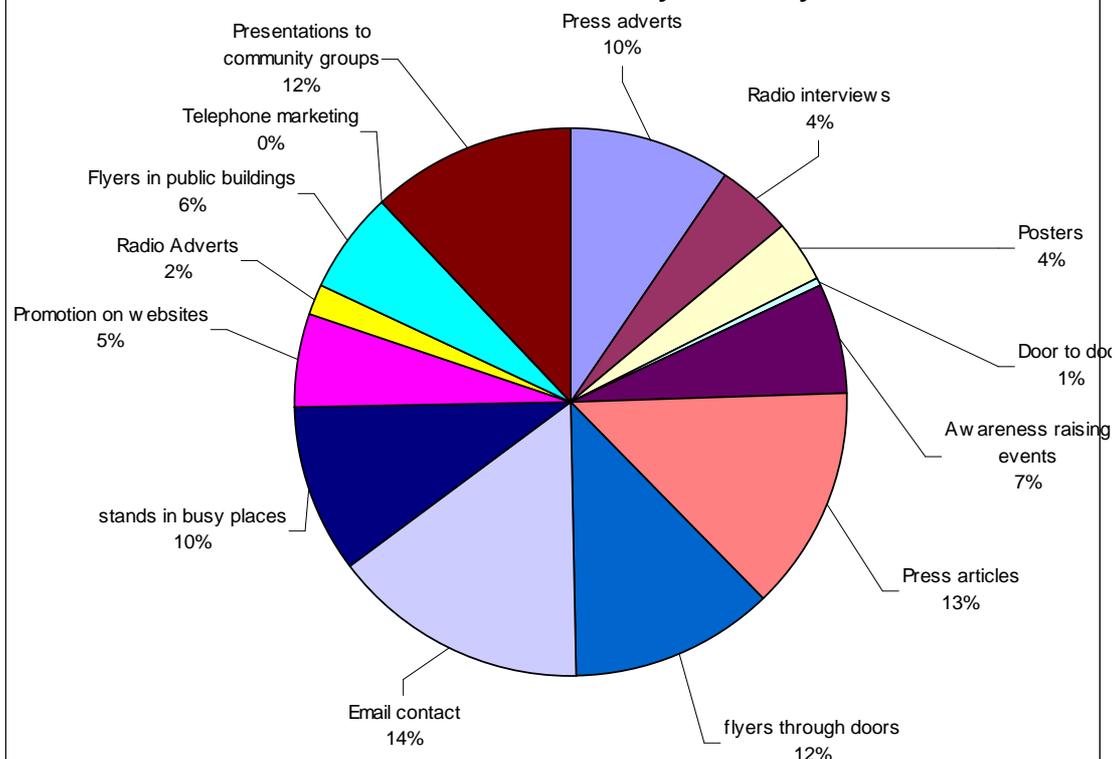
Q2: What is the message? Stroud District is...



Q3: Which incentive package would encourage action?



Q4: What would be the best way to reach you?



4.8 Review of procedures for selecting participants

Target activity levels agreed at the start of the programme were:

Stage 1: 200 residents of Stroud engaged in the programme

Stage 2: 40 home surveys

Stage 3: 20 homes/households selected for development as 40% house exemplars

This requires three stages of engagement and selection. The intention is that the 40 will be drawn from the 200, and the 20 from the 40.

The following issues were identified to take into consideration, and the applicability to each stage indicated below.

Issue	Requirement	Stage	Action
Equal access	All residents should have the opportunity to take part	1	Ensure range of alternative marketing and contact options, including local media
Local relevance	Range of housing types and sizes reflected	2 3	Use outline list of house types as guidance for selection
	Geographical range within district represented	2 3	Note wards and whether urban or rural in selection
Relevance to maximum spread of households	Households in exemplar case studies cover a variety of types: size, age, income level, gender mix, composition, ethnicity.	3	Ask relevant questions in selection procedures
Householder motivation to invest	Households not eligible for maximum grant aid under Warm Front and WISE will need to be willing to invest own funds as part of ultimate package	3	Ask relevant questions in selection procedures
Householder capacity to invest	In order to achieve range of results, at least some of the exemplars must have sufficient funds to complete the majority of the work identified.	3	Ask relevant questions in selection procedures
Household willingness to engage in behavioural change programmes	Commitment to cooperate in multi stage programme over 2 -3 years.	3	Ask relevant questions in selection procedures
Household willingness to participate in publicity of exemplars	Households to participate in providing information about themselves and their experience of the programme to be part of the final exemplar descriptions to be disseminated.	3	Ask relevant questions in selection procedures

5. Conclusions and recommendations for implementation

5.1 Targets and achievability

The same absolute target level of 2.8tCO₂ (0.8tC) per annum will be used for all participating households, bearing in mind that this target is based upon:

- achieving this as an average across the housing stock
- a 60% reduction against a 1990 baseline to be achieved by 2050

Action plans will be developed for each of the Stroud 40% House exemplars to achieve these targets, using NHER surveys to model current consumption under standard occupancy conditions, and the impact of selected measures.

It is not expected, however, that every home will actually achieve the target within the 2.5 year programme, because:

- Some key measures (such as internal solid wall, sloping ceiling, flat roof or under floor insulation) are most practically and economically carried out in conjunction with other works at the time when these are necessary, rather than as one-off measures, and this may not occur within the programme (although there is a reasonable chance that it will occur before 2050).
- Some measures may be too expensive for the home-owners in question at present, even if partial grants are available. This is likely to apply to measures such as PV or heat pumps. As fuel prices rise in future years, and with a possible reduction in installation costs these measures may become more viable.
- Any particularly hard-to-treat houses may be balanced by overachievements elsewhere.
- It will be easier to achieve the target in smaller homes, so within a range of house types higher emissions in larger homes may be balanced to some extent by lower emissions in smaller ones.

The project will nevertheless provide an informative and inspiring example, and it is anticipated that significant carbon savings can be achieved through the programme.

The project covers all domestic energy use arising from heating and electricity use in the home, and the emissions baseline for participating households will be calculated from actual fuel use in the recent past, based on meter readings and bills available.

The monitoring of emissions levels and savings achieved will be calculated from actual ongoing fuel use – either through the installation of smart meters, or by regular manual record keeping of fuel used during the course of the project. This will also form part of the behavioural change programme, which is described in section 5.3.

Why is behavioural change important?

- Capital installations and behavioural change go hand in hand when it comes to the effective reduction of domestic emissions. The sample surveys illustrated that both are needed in order to achieve the magnitude of emissions reductions required, and the introduction of one often helps to prompt take-up of the

other. Indeed, the original 40% house report¹ states that motivating energy conscious behaviour is a key element for transforming the housing stock.

- If people can be inspired to change their behaviour, significant emissions savings can be achieved at little or no cost. Almost half of the UK's CO₂ emissions actually come from the things we do as we go about our daily lives. Things like leaving lights on unnecessarily, having the heating on when there's nobody home, or overfilling the kettle all waste energy, cost money, and result in needless CO₂ emissions.
- There are many simple things that can be done through behavioural change that won't cost anything. The London Committee on Climate Change considered that a 20% reduction in emissions could be achieved should "two-thirds of Londoners do things that cost them nothing and in actual fact put more money back in their pockets"². With an appropriate behavioural change programme in place, a similar magnitude of savings should be achievable in the exemplar Stroud households, complimenting the reductions from any capital installations, and making the ambitious 40% house target easier to reach.
- An added bonus of inspiring people to become more energy conscious at home is that this often ends up permeating to other aspects of their lives as well. Once people have successfully reduced their core home energy use, they often start to examine ways in which they can reduce their impact more widely, such as how they travel, what they buy, what they recycle and so on. Enthusing and enabling participants to make a difference in this way, can therefore have an ongoing impact far beyond the reaches of the project, contributing to the long term societal shift needed to move to a low carbon economy.

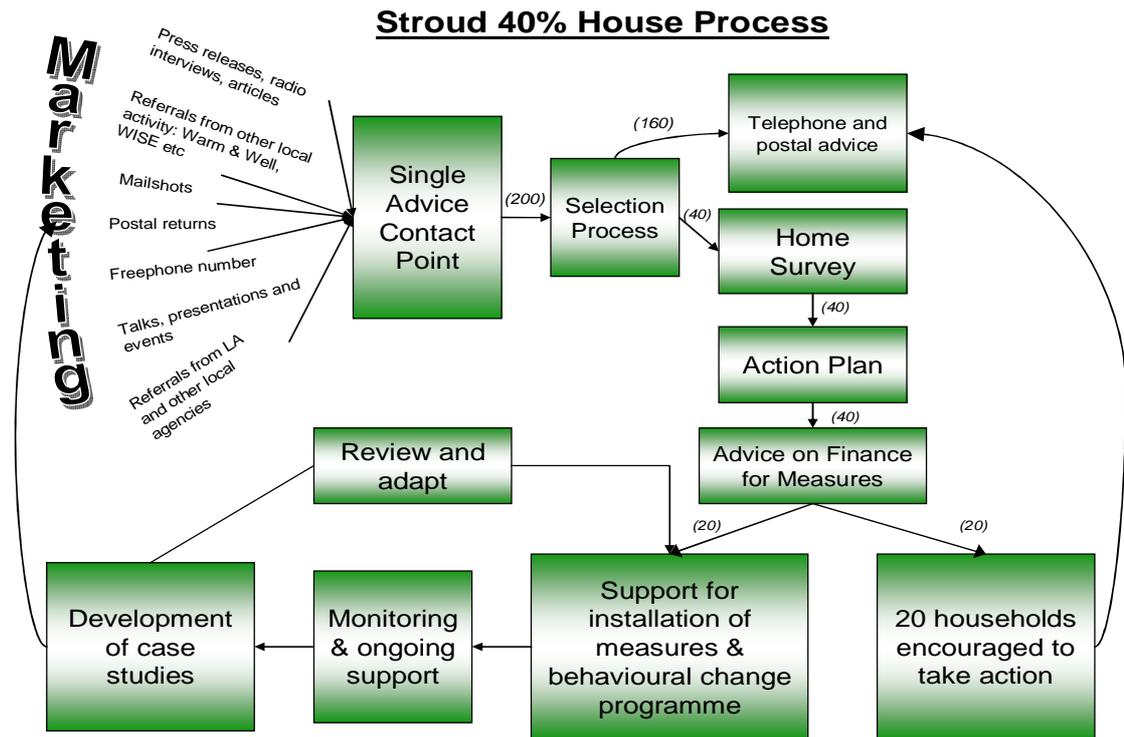
¹ "40 Percent House", Environmental Change Institute, 2005. Report can be accessed at: <http://www.eci.ox.ac.uk/research/energy/downloads/40house/40house.pdf>

² "Joint Committee on the Draft Climate Change Bill – First Report", House of Lords & House of Commons, 2007. Report can be accessed at: <http://www.publications.parliament.uk/pa/jt200607/jtselect/jtclimate/170/17011.htm>

5.2 Overview of delivery approach

The Stroud 40 % House programme of work will consist of the following elements:

Task	Timing
Development of branding and marketing materials	September - October 2007
Agree application procedures for participation in scheme and any grants etc.	October 2007
Marketing of opportunity to join the programme (target 200 households reached)	October - December 2007
Establishment of Gloucestershire Sustainable Energy Installers Network	September – November 2007
Selection of 40 homes/households as potential participants	October - December 2007
NHER surveys of 40 homes, and provision of action plans	November - January 2008
Selection of 20 households to participate as exemplars, and signing of agreement with households	November - February 2008
Commencement of behavioural change programme for 20 exemplars	March 2008
Report on first phase of programme	March 2008
Support for installation of measures in 20 exemplar homes	November 2007 – December 2009
Behavioural change programme for 20 exemplars	March 2008 – December 2009
Production of Stroud 40% House case studies in printed and pdf format, summarising the experience of the project	January –March 2010
Interim evaluation and report	March 2009
Final evaluation and report	March 2010



5.3 Advice and behavioural change

SWEA will provide dedicated advice staff for the programme, so that the participating households will have contact with known individuals over an extended period of time.

All households entering the programme will be asked if they would like to join the exemplars in depth programme. 40 homes will be selected and these will have an NHER survey. The survey will be carried out by one of the dedicated advisers, and the results analysed, and used to produce an action plan for the household.

The action plan will set out the measures required to achieve the target, the sources of finance available, and the additional target to be achieved through behavioural change and improved appliance efficiency.

Those households not included in the 40 will be given verbal advice and a written (Home Energy Check) report provided through the EST Advice programme. The latter is the Gloucestershire EEAC until March 2008, after which it may be provided through a South West regional EST Advice Centre.

From the 40 homes surveyed, 20 will be selected to be developed as the Stroud 40% House exemplars, and an in depth advice programme will commence, consisting of support and advice on installing the relevant measures, and a behavioural change programme, described below.

The behavioural change programme

The suggested programme set out below is based on the principle of creating a virtuous circle for behavioural change by:

- Motivating participating households so that they want to reduce their energy use
- Providing them with appropriate information, so that it is easy for them to take action
- Monitoring energy use on a regular basis, so that households can clearly see what they have achieved, providing them with fresh motivation to continue.

Stage 1: Engaging and motivating households

- Time would be taken to engage households in the behavioural change aspects of the project, both during the selection process and during an initial energy adviser home visit. For example, in addition to discussing the impacts of energy use, participants could also be shown a powerful short film³ encouraging people to realise the impacts they have in their every day actions and decision-making.
- The key aim would be to inspire and enthuse participants to want to do something about their energy use, and to make it clear that participation in the programme will provide them with support and advice that will help them to do this.
- All stages of the behavioural change programme would be carried out in keeping with the principles recommended in Futerra's '*The Rules of the Game*' designed to help change attitudes towards climate change, as well as its sister publication '*New Rules, New Game*' which focuses on behaviour change communications⁴.

Stage 2: Making it easy to act

- Once households have been motivated to take action, it is important to make it as easy as possible for them to do so. Key to this is ensuring that they have a clear idea of what they can do and what impact it should have.
- We would propose that this is best covered during a comprehensive initial energy adviser visit to each participating household. Such a visit could cover a large number of different objectives and activities, including:
 - Discussing the impacts of energy use and inspiring households to want to act (see section above).
 - Discussing current energy use patterns with the participants and how they think these could be most easily reduced.
 - A walk-round of the house using a hand-held smart meter to show the electricity used by various appliances when in use / left on standby, so that the biggest electricity guzzlers for that particular house can be identified.

³ E.g. Futerra's "One Minute Film" available on http://www.futerra.co.uk/auto.php?inc=case&site_cat=5&site_sub=13&case=0 or one of the short films on the Climate Challenge website (<http://www.climatechallenge.gov.uk/multimedia/film.html>)

⁴ Available on <http://www.futerra.co.uk/downloads/NewRules:NewGame.pdf>

- Helping participating households to set their central heating / hot water controls so that they are optimum for their needs whilst cutting out any waste.
- Providing information on (and demonstrating samples of) the variety of energy saving bulbs available and discussing which ones would be most appropriate throughout the house and where they can be obtained from.
- Helping participants to install free “local cooling” software on their computers, and to set up efficient power saving settings that are appropriate for their needs⁵, if desired.
- Identifying any appliances likely to be bought or replaced in the next few years, so that the energy adviser can discuss and provide follow-up information on the benefits of choosing an energy efficient model.
- Providing each participating household with a freebie “goody bag” of items designed to help them get off to a good start - with the dual purpose of helping to bond participants to the programme, as well as helping them to see early reductions in their monitored emissions, which should in turn inspire further action. These could contain items such as energy saving bulbs, a ‘powerdown’ plug, a timer switch, an eco kettle, “climate change” light switch surrounds, “shut me off” stickers, thermometer cards, and tailored “hints and tips” cards that use illuminating statistics to illustrate the potential magnitude of savings available for different types of energy use.
- Use of the practical “hints and tips” cards provided in the goody bag to talk through how energy could be saved in each area – the cards provided could be tailored to the household’s circumstances (e.g. to reflect the type of hot water and central heating systems in place).
- Discussing where the freebie items could most usefully be used (and helping to install them, if desired).
- Showing householders the ongoing monitoring that needs to be undertaken, and providing them with the appropriate templates; and
- Agreeing an action plan of the behavioural changes that they are planning to make as a result of the visit (including any changes already made while the energy adviser is there) – this will provide a written reminder to participants after the energy adviser has gone, and should help to cement their commitment to the project.

Stage 3: Ongoing monitoring and support

- Baseline and target emissions levels for each household will have been calculated at the start of the project. During the initial energy adviser home visit, households will also be provided with a monitoring template for each fuel being monitored.
- The templates would also include a space for households to raise any queries or share key achievements, if they wish. These templates could then be submitted either electronically, or in hard copy, on a regular basis.
- Households will be asked to participate in monthly reporting of energy used, by fuel. This could either be done by the use of smart meters, or simply

⁵ For details, see <http://www.localcooling.com/>. All participating households could also be registered as a ‘40% house’ team, helping to provide useful data on computer related savings achieved during the project.

through manual meter readings. At the end of each reporting period we would circulate a group email, reporting on overall project savings achieved and sharing key achievements to date. As well as providing a means to share best practice, this should also keep the project fresh in participants' minds and help the households to feel part of a larger group making significant achievements.

- We would also look to produce summary reports for each household, that could be sent to them electronically (or hard copy) at various points throughout the project – for example quarterly.

These would include a visual record of their overall baseline emissions, target emissions and monitored emissions to date. This should help to keep the project at the forefront of the participants' minds.

Stage 4: Evaluation and feedback

- During the project, participants would have the chance to raise any energy-related queries they might have during their monthly reporting process. They would also have ongoing access to phone support from energy advisers, as required.
- There would also be scope for a possible final home visit by energy advisers, if desired. This would be to discuss participants' experience during the programme, (what they've achieved, what they've found hard, any lessons learned and feedback on the programme as a whole), as well as to take any final meter readings, and retrieve any loan items. The initial action plan agreed with the household could be used as the basis of this discussion.
- Once people have successfully reduced their core home energy use, they are often inspired to examine ways in which they can reduce their impact more widely. This final visit would therefore also offer an opportunity to provide the participants with another lot of practical "hints and tips" cards providing illuminating statistics about wider domestic energy savings – for example relating to travel, purchases, recycling, water use etc. Enabling participants to widen their awareness in this way can therefore help to have an ongoing impact beyond the reaches of the project itself.

Summary of intended activities

In summary, the proposed behavioural change programme would include:

- a discussion on the impacts of energy use during the selection process when undertaking home energy surveys;
- an initial home visit to each participating household to kick-start the behavioural programme (up to half a day for each visit should be allowed, including travel);
- the production of tailored 'hints and tips' cards that can be used to reflect each household's heating and hot water systems;
- the co-ordination of a free energy saving 'goody bag' for each participant;
- co-ordination of the monthly monitoring, group feedback email and tailored summary progress reports;
- ongoing phone support and advice, as needed; and
- a possible final home visit at the end of the project to get feedback and final meter readings – though this could be done electronically if needed.

5.4 Marketing and selection of participants

The aims of the marketing for this programme are to:

- Engage the interest of 200 Stroud households in participating in or following the programme
- Provide fair and open access to all Stroud residents to apply to participate in the programme
- Identify 40 suitable households for inclusion, willing and able to engage in the full programme
- Select 20 households for the exemplar programme representing a range of household and building types, so that the resulting case studies give as wide a range of possibilities and experience as possible.
- Disseminate the programme to a wider audience in Stroud and beyond

Message

The message is to inspire Stroud residents to want to take action to reduce carbon emissions. Features are:

- Living in an environment friendly community
- Future-proofing: a home for 2050
- Low carbon homes achieving modern comfort in older and traditional homes
- Showing ways to making homes environmentally friendly without destroying the built heritage
- Low carbon living does not mean low quality of life
- Action by individuals to tackle climate change
- Pride in Stroud as a forward-thinking place (this is action supported by all in the wider community working together: the Council elected members and all departments including development control, local environmental NGOs, community groups, private industry).

Materials

- Project introductory leaflet/flyer
- Press releases
- Fact-sheets on hard to treat/non-standard measures
- 'Goody bags' containing energy saving products for participating households
- Quarterly e-bulletin for participating households
- Project website (linked to or part of SWEA or SDC website)
- Project mobile stands
- Stroud 40% House case studies (to be produced at the end of the project)

Activities

- Articles in local press, and on local radio
- Talks to community groups
- Analysis of Warm and Well and WISE databases to identify potential candidates and make direct contact
- Referral from Council and Care and Repair
- Advice column in local paper
- Presence in shopping areas, builders merchants, DIY and hardware stores

Selection criteria

Essential

- Owner-occupier living in Stroud District
- Willing in principle to carry out sustainable energy improvements to their home (bearing in mind affordability and other practical considerations)
- Willing to participate in 2 year behavioural change programme, including potential installation of an Ecometer
- Willing to be featured in a written case study

Desirable

- Willing to participate in further publicity around the project
- Range of building types represented
- Range of household types represented

6. Outline recommendations for wider enhanced retrofit programme

6.1 Overview

Task	Timing
Development of finance and incentives	April 2008
Development of marketing materials	April - May 2008
Further development and support for Gloucestershire Sustainable Energy Installers Network	June 2008 – December 2010
Marketing, advice and incentives	June 2008 – December 2010
Evaluation and report	January – March 2010

6.2 Marketing and advice

The core approach will be the same as for the 40% House exemplars, and the message, materials and activities for that part of the programme will also be applicable to the wider enhanced retrofit objectives. Additional elements will be:

Activities

- Placing materials at the various contact points with householders planning to and actually carrying out repairs, renovation and improvements, including builders' merchants, DIY and hardware stores, planning and building control
- Liaison with estate agents and building societies to negotiate appropriate materials to place with them

Incentives

A number of ideas were developed for incentives and may be tried at different stages of the project, as alternatives to direct grant-aid. These may be used within competitions or in the form of a 'reward' for installing measures.

A number of options were suggested in the consumer survey and the top five preferred:

- Money off measures
- Vouchers towards purchase of the most efficient electrical appliances
- Shares in a windfarm
- Vouchers for a the farmers' market
- A railcard for a year
- Shares in a Community Farm
- Voucher for the Green Shop
- Lifetime membership of Gloucestershire Wildlife Trust
- A years' supply of organic veg-box
- A weekend on an eco-farm
- An eco-friendly garden make-over (rainwater collection butt, composting bin)

6.3 Installer network

SWEA proposes to establish a local installer network for micro-generation installers in Gloucestershire and South Gloucestershire, which will support achievement of Local Area Agreement targets from 2007-10 in both areas. This network will include the Stroud area, and the climate change programme provides the opportunity to focus particularly on raising the level of activity in Stroud.

The network will be established as a Gloucestershire Sustainable Energy Installers Network, to consolidate a more holistic approach to encouraging home owners to consider all aspects of energy use in the home. However, the feasibility study indicated that it will be more difficult to engage the interest of insulation and heating installers, and problems of under-supply may emerge. The work to develop the network will therefore be in two strands, outlined below.

It is important to note that the market is developing and changing and that the approach will need to be reviewed regularly and adaptations made in response to experience of the market and changes in external factors such as government funding regimes.

The aims of the Installer Network are to:

- Increase consumer confidence and the number of installations of sustainable energy measures by providing supporting independent advice and information.
- Raise consumer awareness of the relevant quality and code of conduct schemes, and the assurances that these provide.
- Improve conversion rates and reduce wasted time for installers by providing a pre-quotation advice and information service, including identification of suitable technologies, siting and planning issues.
- Provide referrals to installers, supported by local authority endorsed marketing, awareness and advice programmes.
- Provide access to lists of accredited installers to home-owners.
- Give home-owners a general awareness of prices in the current market, to avoid extreme levels of over-pricing.
- Raise awareness amongst installers of providers of complementary goods and services within the broader carbon reduction/sustainable energy field of activity.
- Support smaller local installers to enter the market by providing information and referrals.
- Enable monitoring of installation numbers at District and County level.
- Overcome barriers by facilitating dialogue between installers and the local authority.

It is costly and time-consuming to establish technical and legal monitoring procedures, and not cost-effective to carry this out at local level. The network will therefore refer to national schemes wherever possible. These are currently in a state of flux, but likely to include:

- The Low Carbon Buildings Programme (may finish in the next few months)
- The Microgeneration Certification scheme (to be launched in late 2007)
- The Renewable Energy Assurance Listed (REAL) Consumer Code
- EEC/CERT installers

Specific provision by SWEA at local level will include:

- Advice and information to home-owners
- Lists of installers available locally for different products, to home-owners
- Information to installers, through meetings and/or e-zine
- Customer satisfaction monitoring by:
 - Postal survey to all customers who have had installations
 - Visit to random sample of 10% of installations
- Facilitated meeting for installers with relevant local authority and other bodies (such as planning, building control, grant scheme managers) to discuss and resolve issues.

Specific requirements for installers will include:

- Provision of regular data on technologies installed in Gloucestershire properties, with addresses.
- Agreement to participation in a common complaints procedure.
- Evidence of public liability insurance
- Minimum 12 months guarantee on labour and materials.

The basis of this type of network is that all contractual arrangements for installations including price and quality of workmanship remain a direct contract between the householders and their selected installer. SWEA will take up any complaints with the installer through the agreed complaints procedure but neither SWEA nor the local authorities that may support the network will be liable in any circumstances for the quality of workmanship or materials or 3rd party damages.

7. Finance

In addition to funding for the people time required to manage the project and provide the advice, marketing and technical support, Stroud District Council have indicated that they are able to provide some capital funding for measures. As part of the feasibility study SWEA have been asked to develop proposals for this.

This funding is for both the 40% House and the Enhanced Retrofit programme.

Finance available:

2007-8: Funding for SWEA staff time for marketing, advice and project management is already agreed. In addition there may be up to £40,000 available for measures.

2008-9 and 2009-10: Total funding £150,000 per annum. An estimated £86,000 per annum is required for staffing and the production of marketing materials, leaving approximately £64,000 per annum for retrofit measures to homes.

Funding available for measures is estimated therefore at:

2007-8	2008-9	2009-10
£40,000	£64,000	£64,000

With uncertainty about both government grants and future prices, it is difficult to devise a definitive grants structure for this project, and it is recommended that it is reviewed during the course of the project. An outline proposal is set out below as a starting point.

The sample survey indicates that the full costs of implementing all measures in the exemplar homes may be around £26,000. For 20 homes this would be £520,000. If all the capital available were to be dedicated to supporting the 20 homes, it may be possible to offer grants of up to 32%. However, this includes measures such as solid wall insulation, which are relatively unlikely to be taken up within the duration of the project, and this approach would leave no support for other homes in the district.

During the course of the feasibility study a local supplier has begun to market an electronic monitoring device for fuel and water consumption, the 'Ecometer'. They have fitted this at Stroud District Council offices and in a new housing development in Oxfordshire, and are open to trialling the device in a domestic retrofit situation. It can be linked to a visual display in the home and/or to a web based data manager. Sensors can be easily fitted where a pulsed output meter exists (such as in modern gas and electricity meters), and pulsed meters can be retrofitted to water, oil, LPG or mains gas supplies as required. This would enable all except solid fuels to be monitored (as well as water), and would be very useful within the behavioural change programme.

Costs for the Ecometer are based on an estimated average, due to the variation in requirements that will present in different homes in practice.

EEC suppliers may be able to supply the items for the 'goody bags' at no or low cost, such as powerdown plugs and eco-kettles.

We recommend that an outline for the capital spend is decided at the outset, but that this is reviewed at the end of each financial year, in order to be able to respond to:

- changes in external circumstances such as government grants
- lessons learnt and consumer and installer feedback during each stage of the project

We also recommend that no assurances are given about level of spend or grants available in each subsequent year, both to avoid false expectations and to encourage consumers to act now.

In order to avoid confusion with the WISE grants, we propose that:

- The 20 exemplar homes do not have access to WISE homes grants in addition to the proposals below.
- An exception may be made for those exemplar homes in which the households are eligible for the higher level of support under WISE – in which case the two grants may be used additionally.
- The WISE grants are promoted within the enhanced retrofit programme

With these provisos in mind, the outline proposal for financial support for measures is as follows:

Target group	2007-8	2008-10
20 exemplar households	<p>20 x £600 (estimated) Ecometers, 100% funded = £12,000</p> <p>Upgrade to 100% low energy lighting, including the more specialised products. Estimate £100 per home x 20 = £2,000</p> <p>£26,000 for measures, additional to LCBP while it lasts. For example: 7 x £3,000 for PV = £21,000 8 x £600 for solar hot water = £4,800</p>	60% grant up to a maximum of £6,000 per home for works identified in action plan. 20 x £6,000 = £120,000
Other households	Promote WISE grants	Promote WISE grants, with £8,000 of additional incentives as 'reward' for installing major measures, in form of vouchers for 'next' measure or 'green lifestyle' items identified in consumer survey.
Total budget	£20,000	128,000

Appendix 1: Baseline and target methodology – explanatory notes

Introduction

1. This appendix sets out recommendations for the methodology to be used to establish both the target level, and the current baseline level, of emissions for the exemplar houses taking part in the 40% house project. A summary of the recommended approach is set out below, followed by a more detailed discussion of the options considered.

Summary of recommendations

2. In summary, we would recommend that:
 - the same absolute target level is used across all participating households;
 - the project covers all domestic energy use arising from electricity, heating and hot water use in the home;
 - the emissions baseline for participating households is calculated from actual fuel use in the recent past, based on meter readings and bills available;
 - any monitoring of emissions levels and savings achieved is calculated from actual ongoing fuel use – either through the installation of smart meters, or by regular manual record keeping of fuel used during the course of the project;
 - a target level of 2.8tCO₂ (0.8tC) per annum is used as the starting point and frame of reference for all houses, based on a 60% reduction from average domestic energy use emissions per household in 1990; but that
 - given the ambitious nature of the target, the ultimate aim of the project should be to achieve this level on average across all the participating households, enabling any particularly hard-to-treat houses to be balanced by overachievements elsewhere.
3. The key principles underlying the recommended methodology are that:
 - the target, baseline and monitoring data all need to cover the same scope, so that they can be directly compared to establish the emissions reduction required and achieved; and
 - the approach used needs to be robust, pragmatic and workable, as well as having a common sense basis.

Consideration of type of target to be used

4. We considered four key types of target that could potentially be used by households participating in the project. These were to have:
 - a. **the same absolute target for all houses**, regardless of current emissions or circumstance e.g. XtCO₂ per year per participating household;
 - b. **the same relative target for all houses**, linked to their emissions baseline e.g. for all participating households to reduce their emissions by X% from current levels;
 - c. **different absolute targets for each house**, based on individual circumstances e.g. XtCO₂ per year for a large household living in an old four-bedroom detached house with electric space and water heating, but YtCO₂ per year for a small household living in a new one-bedroom flat with access to communal combined heat and power heating; and

- d. ***different relative targets for each house***, based on individual circumstances e.g. an X% reduction from current emissions for a household living in a detached house without cavity wall insulation and currently using coal-fired heating, but a Y% reduction for a one person household living in a new house meeting all current building regulations.
5. We would recommend that the same target is used for each household. While at first glance it might appear fairer to try and tailor targets to individual circumstances, there are several key disadvantages to doing so. The problem is that there are so many different potential drivers of emissions from domestic energy use (e.g. size of dwelling, type of dwelling, number of occupants, main fuel source etc) that it is simply not pragmatic to come up with fair individual targets that take them all into account.
6. Even just trying to take one or two key variables into account would complicate the target-setting process hugely, while at the same time making the vision of the project a lot less transparent for marketing and replication purposes. In addition, the available data upon which targets can be set (discussed later in the appendix) does not go into sufficient detail to enable us to set tailored targets consistent with the long term national emissions reductions required.
7. We would also recommend that absolute, rather than relative, targets are used for each household, though there are pros and cons to each approach and one could make a justifiable case for either.
8. Under an absolute target, the underlying principle is that participating households try to converge on the same “quota” of emissions per household, regardless of circumstance. Therefore those with high current emissions levels would need to take more action than those with low current emissions levels. Under a relative target, each household would be working towards the same proportionate reduction from their baseline level (e.g. Y% of current emissions), so that those with high emissions at present would continue to have higher emissions levels in future than those with low current emissions.
9. Which of these options is preferable depends, in part, on whether a household’s current or historic emissions levels are believed to be an accurate reflection of their potential future emissions levels. If current emissions levels were thought to be a good indicator of “necessary” emissions for a household (e.g. a household’s current emissions are high because they cannot easily be reduced), then one could argue that the relative target approach makes sense. On the other hand, if a house has low current emissions because it has already utilised many of the emissions-reducing measures available to it, then it would seem inappropriate to require that it reduces its emissions by a further X%, when these emissions reductions could be achieved much more easily in houses which have yet to undertake any energy saving measures.
10. Given that participating households and houses are likely to be at different points along the energy saving road, the most pragmatic and cost effective approach would seem to be to base the target on absolute emissions levels. While this may mean that some hard to treat houses could fail to reach the target, or reach it only

at high cost, the overall emissions saved per pound invested during the project should be significantly higher than under relative targets, where the money invested would be skewed towards higher cost measures to secure further reductions in those households which already have relatively low emissions.

11. Therefore, on balance, we would recommend that the same absolute target level is used for all participating households.

Scope of emissions to be covered by the project

12. We considered a number of different options for coverage of the project, including:
 - a. emissions covered by the Energy Performance Certificates' (EPC) environmental impact rating – this focuses on lighting, heating and hot water only;
 - b. emissions covered by all domestic electricity, heating and hot water use;
 - c. total household emissions, including use of transport and energy embodied in purchases/disposals etc.
13. We would recommend that the project covers all domestic electricity, heating and hot water use, but excludes wider emissions such as transport and embodied emissions (option b, above). This is for two main reasons.
14. Firstly, it is vital that target, baseline and monitoring data are all easily available for the scope used in the project. Otherwise it is not possible to establish the emissions reduction required to reach the target, or to establish if the target has been achieved. Secondly, providing that the data is available, the broader the scope of the emissions covered, the larger the number of emission reduction opportunities available.
15. When it comes to setting a target, the majority of national data on domestic emissions focuses on the emissions covered by electricity, heating and hot water use. This scope also makes it relatively easy to calculate a consistent baseline and undertake ongoing monitoring at the individual household level - it simply requires the household to record electricity and gas meter readings (or the volume of fuel purchased where fuels other than gas or electricity are used). Encouraging the households to take routine meter readings in this way helps to provide an ongoing feedback mechanism, enabling them to regularly see the impact that their energy saving actions have had to date.
16. Some further disaggregation of national data is available, which would enable a target to be set on the basis of lighting, heating and hot water only, if so wished. However, such an approach would make it more difficult to undertake an accurate baseline and monitoring of emissions at the individual household level, since most meters do not distinguish between lighting and other electricity use. While both baseline and final emissions could be calculated by an EPC environmental impact rating at the start and end of the project, these are only broad brush estimates based on generalised assumptions, and take no account of actual behaviour. This approach would therefore increase the complexity of implementing the project, while at the same time reducing its accuracy and excluding any incentives for potentially significant behavioural change.

17. The third option, of using a wider emissions base that includes transport and embodied emissions, clearly helps to maximise emissions reduction opportunities. However, it would also make the project unfeasibly complicated. Robust national data is not available for this wider scope of emissions, making the setting of a consistent and sensible target level very difficult. Similarly, the complexity and time involved in monitoring (or estimating) these wider emissions on an ongoing basis at a household level would far outweigh any benefits gained by the broader scope. The administrative requirements of such a system would be likely to engulf participating households and detract from the overall vision and message of the project.
18. Therefore, we would recommend that the project covers all domestic electricity, heating and hot water use, but excludes wider emissions such as transport and embodied emissions.

Measurement of baseline

19. As discussed in the previous section, one of the reasons we would recommend that the project covers all domestic electricity, heating and hot water use, is that this makes it relatively easy to calculate a consistent baseline, based on actual fuel use. This section looks at how such a baseline could be measured in reality.
20. Taking electricity use as an example, the electricity component of the baseline would need to reflect the household's average annual emissions from electricity. It should be relatively simple for the household to take a current reading from the electricity meter, together with the date that the reading was taken. It should also be possible to have access to all previous actual meter readings (not estimates) and dates over the course of the last year or two – either by reading directly from past electricity bills or, if the householder no longer has these, by phoning the electricity supply company¹. Obtaining at least a full year's worth of data is preferable, to help remove any seasonal bias.
21. Armed with this information, average daily electricity use between each of the readings can be calculated, and a weighted average over the appropriate period can be used to calculate annual electricity use over the past year. Defra's standard emissions factors for electricity (as used in the Climate Change Agreements and Emissions Trading Scheme) can then be applied to get to a figure for annual emissions. The same process can be undertaken for gas use, using gas meter readings and Defra's standard emissions factors.
22. If the household uses oil, or another fuel, a similar process can be followed. However, since meter readings are unlikely to be available for these other fuels, the quantities used will need to be calculated from either the householder's receipts of fuel bought, or by phoning the fuel supply company to find out the dates and quantities purchased over the last year or so. Emissions can then be calculated as before, applying the relevant emissions factor. Depending on the

¹ If for some reason this information is not available, the electricity use could still be estimated based on current payment levels and tariffs.

units in which the fuel is measured, it is possible that this will need to be converted to a kwh unit before the emissions factor is applied – again using Defra’s standard conversion factors, as appropriate.

23. Once the household’s target and baseline have been established, this then enables us to calculate the emission reduction required to meet the target, and to identify the options available to the household to help them achieve this.

Ongoing monitoring

24. As discussed in the section on the scope of emissions to be covered, one of the reasons we would recommend that the project covers all domestic electricity, heating and hot water use, is that this makes it relatively easy to monitor emissions at householder level on an ongoing basis. This section looks briefly at how such monitoring could be undertaken in reality.
25. One possibility is that participating households could have smart meters installed that facilitate the regular reviewing and recording of energy use, making it very easy to monitor progress of the project. This would have the added benefit of maximising the motivational impact of the programme on behaviour change, as it would be very easy for householders to regularly see the impact that their energy saving actions had had to date. However, these smart meters can be somewhat expensive, and would tend to cover only electricity and gas, so would not necessarily be appropriate for everyone.
26. If smart meters were not used, then ongoing monitoring at the household level could still be relatively easily achieved by the regular reporting of meter readings (e.g. once a month) and application of standard emission factors. For other fuels, which are not metered, monitoring would have to be through ongoing monitoring of fuel purchases and/or use, whichever is more appropriate in the circumstances.
27. An additional factor worth considering when it comes to calculating emissions levels is the issue of how renewable energy should be treated. Standard emissions factors used by the Government (e.g. under the Climate Change Agreements, Emissions Trading Scheme, or for international reporting purposes) assume a zero emissions factor for renewable energy – whether that energy is generated locally or purchased from the grid. In order to retain consistency with these national and international approaches, one option may be that any renewable elements of the householders energy use should also have a zero emissions factor. This would certainly incentivise households to switch to renewable energy, and could provide a valuable means of helping them to meet their target (particularly in hard to treat houses).
28. On the other hand, the existence of the Renewables Obligation means that the supply of renewable electricity, at present, outstrips demand. Until demand for renewable electricity catches up with supply, switching to renewable electricity purchased from the grid doesn’t actually reduce overall emissions – it simply allocates some of the surplus supply to that particular consumer. This is different from the installation of local renewable energy (e.g. solar hot water panels or wood-fired community heating) which does actually reduce overall emissions. We do therefore want to encourage households to reduce their electricity use, even

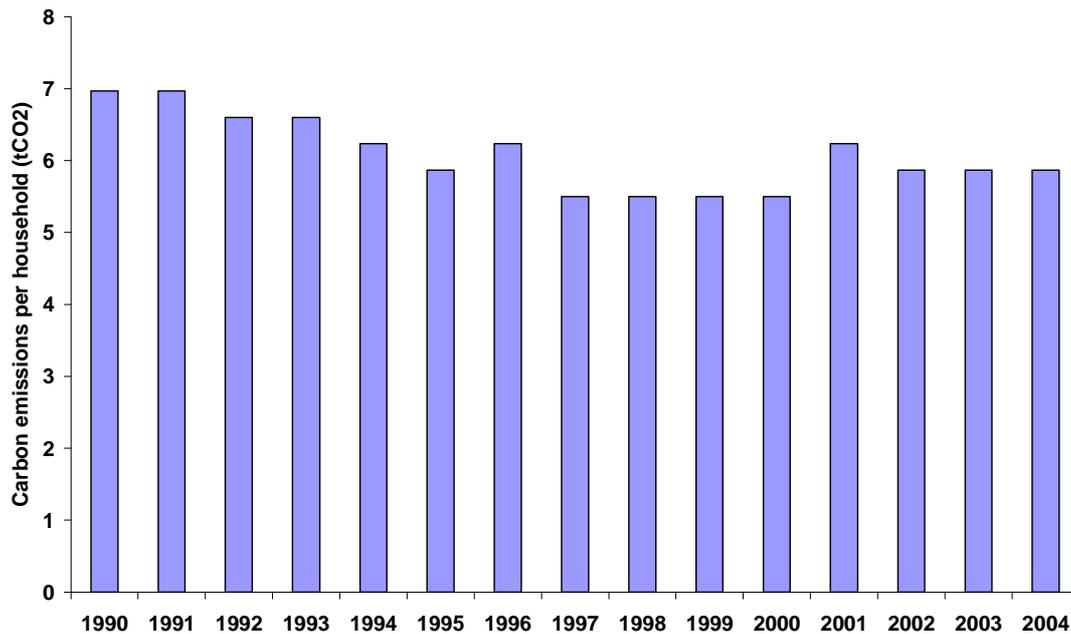
when they are purchasing renewable electricity. On this basis, one could argue that only the installation of local renewable energy should be counted as zero carbon, and that green electricity purchased from the grid should continue to use the standard electricity grid emissions factor.

29. One possibility to get round this could be to use two monitoring indicators in cases where the household switches to purchasing renewable electricity from the grid. One indicator could show total emissions assuming fossil-fuel sourced electricity use, while the other shows emission levels assuming zero-carbon electricity. This dual indicator should incentivise households to switch to renewable energy (which is valuable for boosting demand levels) and help them towards their target, while at the same time ensuring that they are able to see the beneficial impact of reducing their own electricity use in terms of overall emissions levels.

Base year and percentage reduction to be used for calculating target level

30. We considered a number of different options for both base year and percentage reduction to be used when calculating the target level. The target level used needs to be underpinned by the wider climate change context, while at the same time being ambitious, and yet feasible, for participating households.
31. In terms of the wider climate change context, then in the UK, the generally accepted long term emissions reduction target is a 60% reduction from 1990 emissions levels by 2050. This is the target used in the current draft climate change bill and most recent Energy White Paper. From an international perspective, 1990 is also the base year used for the emissions reduction targets under the Kyoto Protocol.
32. On the basis of all sectors doing their bit to meet this wider UK target, it would therefore be consistent for participating households to use a target that reflected a 60% reduction in average domestic emissions from 1990 levels. Clearly we would be looking to achieve this much earlier than the UK's 2050 target, but it would be a useful benchmark to show how such significant reductions could be achieved in this sector, if necessary.
33. While 1990 would seem to be the most sensible base year to use, to reflect this wider context, alternative base years could be used, if desired. The Royal Commission on Environmental Pollution (RCEP) published a report in 2000 recommending a 60% reduction from "current levels" by 2050. Their data at the time was based on 1997 emissions levels (the most recent year for which estimates were available), so the report could be used as a basis for justifying either a 1997 or current year baseline, if an alternative was desired.
34. Figure 1, overleaf, shows average household emissions from electricity, heating and hot water use from 1990 until 2004 (the most recent data available).

Figure 1: Carbon emissions due to domestic energy consumption (tCO₂ per household)



Source: BRE Domestic Energy Fact File, Table 78, 2006

35. It can be seen from Figure 1 that average household emissions have decreased slightly over time. A 60% reduction from 1990 emissions levels would therefore result in a target of 2.8tCO₂ (0.8tC) per annum for each participating household, while a 60% reduction from 2004 emissions levels would result in a slightly more stringent target of 2.4tCO₂ (0.6tC) per annum.
36. The target level used needs to be ambitious, but still feasible. The four initial sample surveys undertaken, which estimated emissions levels based on energy performance certificate assumptions, suggest that reductions of the order of 60% could be difficult to achieve in some circumstances. It is worth noting that these estimates of emissions baseline and reduction potential are based on installed measures only, and hence exclude any scope for reduction through behavioural change. When installed measures are combined with a behavioural change programme, it is likely that such reductions should be achievable in the majority of cases.
37. However, it should be noted that a target reflecting 60% reductions from average levels would be very ambitious. It would need significant behavioural input and buy-in from the participating households, and for some houses, achieving such a target simply may not be feasible. With this in mind, we would recommend that a 1990 base year for the target is preferable to any more recent base years, since it not only links better with the wider context, but it also enables a slightly less stringent target level to be adopted.
38. Even allowing for this, there are likely to be some houses where a 2.8tCO₂ target (60% reduction from 1990 levels) is not achievable. In such circumstances, if these houses were not filtered out during the selection stage, it may be sensible to use the 2.8tCO₂ target as a starting point for all houses, but to accept that the ultimate aim of the project is to achieve this level on average over the project as a

whole. This would allow any additional emissions from particularly hard-to-treat houses to be balanced by overachievements elsewhere.

39. Overall therefore, we would recommend that a target level of 2.8tCO₂ (0.8tC) per annum is used as the starting point and frame of reference for all houses, based on a 60% reduction from average domestic energy use emissions per household in 1990. However, given that this is a very ambitious target and that it might not be achievable for some houses, we would propose that the ultimate aim of the project is to achieve this level on average across all the participating households, so that any particularly hard to treat houses can be balanced by overachievements elsewhere.

Appendix 2 – Photos of the properties surveyed.

<p>Rodborough Hill</p>	
	
<p>Front and side elevations</p>	<p>Rear elevation showing modern extension</p>
	
<p>Rear elevation to original house</p>	<p>Condensing boiler</p>

Castlemead Road - Detached house with timber cladding at front and built into hillside at rear



Front elevation



Side elevation



Rear elevation



Boiler flue and condensate drain

Moors Terrace - Mid terrace house with stone walls and extension



Front elevation



Rear elevation



Side elevation of extension

Bisley Road - Detached 4 storey house, stone walls, dormer in roof



Front and side elevations



Rear elevation showing extension



Side elevation

Appendix 3: Summary of results for sample homes

Rodborough Hill	Total floor area = 175.5m ² (152.0m ² before extension)		Total CO ₂ – all energy use		CO ₂ for heating, hot water and lighting only (as SAP)	
	SAP	NHER	Tonnes/year	% reduction	Tonnes/year	% reduction
Estimated baseline (1996)	33	3.9	15.13		13.41	
Current (2007)	63	7.2	9.45	37.5%	7.14	46.8%
Hot water cylinder insulation to 80mm	63	7.2	9.42		7.10	
CFLs to 100%	64	7.3	9.36		7.00	
Loft to 300mm (U=0.2)	64	7.3	9.27		6.93	
External insulation to solid wall at side	68	7.9	8.38		6.15	
Secondary glazing to single glazed windows and draught sealing to doors	70	8.4	7.68		5.77	
Solar hot water system (4m ²)	71	8.5	7.42		5.50	
Solar photovoltaic system (1kWp)	73	8.8	7.09	53.1%	5.07	62.2%
40% lower than average use of lighting, cooking, appliances and hot water			6.15	59.4%	-	-

Notes:

- Measures are assessed cumulatively in the order reported in the above table
- Improvement measures since 1996 assumed to be cavity wall insulation, loft top up from 100mm to 175mm (average), new gas fire in living room (assumed open solid fuel fire previously) and new condensing boiler and TRVs (assumed 65% efficient boiler previously).
- Estimated baseline assumes extension not built then (thus property has increased floor area that will reduce the energy savings from the improvements)
- South facing slope of roof has limited area (so a larger area of solar panels may be needed to achieve the savings indicated above if they have to be mounted E-W)
- 40% lower than average use of lighting, cooking, appliances and hot water can be achieved with all appliances ‘A’ rated and switching off when not needed.

Castlemead	Total floor area = 119.4m ²		Total CO ₂ – all energy use		CO ₂ for heating, hot water and lighting only (as SAP)	
	SAP	NHER	Total CO ₂	% reduction	CO ₂ (SAP)	% reduction
Estimated baseline (1996)	47	5.5	8.18		6.92	
Current (2007)	67	8.2	5.43	33.6%	4.02	41.9%
Hot water cylinder insulation to 80mm	68	8.2	5.38		3.97	
CFLs to 100%	69	8.3	5.31		3.87	
Loft to 300mm (U=0.2)	71	8.5	5.13		3.69	
Insulation to exposed floor over garage (U = 0.3)	71	8.6	5.02		3.57	
Solar hot water system (4m ²)	73	8.9	4.78		3.33	
Solar photovoltaic system (1kWp)	75	9.2	4.46	45.5%	2.92	57.8%
Solar photovoltaic system (2kWp)	78	9.5	4.15	49.2%	2.51	63.7%
40% lower than average use of lighting, cooking, appliances and hot water			3.40	58.4%	-	-

Notes:

- Measures are assessed cumulatively in the order reported in the above table
- Improvement measures since 1996 assumed to be cavity wall insulation, new condensing boiler and TRVs (assumed 65% efficient boiler previously), CFLs (5 rooms) and double glazing.
- Conservatory is thermally separated so it is assumed that this is not heated to any significant extent.
- Pitched roof slope to rear faces southwest so it should be straightforward to install solar energy systems to this property
- 40% lower than average use of lighting, cooking, appliances and hot water can be achieved with all appliances 'A' rated and switching off when not needed

Moors Terrace	Total floor area = 89.4m ² (57.4m ² before extension)		Total CO ₂ – all energy use		CO ₂ for heating, hot water and lighting only (as SAP)	
	SAP	NHER	Total CO ₂	% reduction	CO ₂ (SAP)	% reduction
Estimated baseline (1996)	49	4.3	5.36		4.19	
Current (2007)	63	7.0	5.28	0.2%	3.95	0.1%
Hot water cylinder insulation to 80mm	64	7.1	5.14		3.81	
CFLs to 100%	66	7.3	5.07		3.73	
Loft to 300mm (U=0.2)	66	7.4	5.03		3.69	
New 'A' rated condensing boiler and TRVs to all radiators	74	8.6	4.03	24.8%	2.68	36.0%
Secondary glazing to single glazed windows	74	8.7	3.97		2.63	
Insulation to solid stone walls (internal)	78	9.4	3.51		2.23	
Solar hot water system (4m ²)	80	9.7	3.29		2.01	
Solar photovoltaic system (1kWp)	83	10.2	2.96	44.8%	1.58	62.3%
40% lower than average use of lighting, cooking, appliances and hot water			2.33	56.5%	-	-

Notes:

- Measures are assessed cumulatively in the order reported in the above table
- Improvement measures since 1996 assumed to be loft top up from 100mm to 150mm, under floor insulation to solid ground floor, and CFLs (2 rooms).
- Estimated baseline assumes extension not built then (thus property has increased floor area that will reduce the energy savings from the improvements) but overall this has significantly improved the energy efficiency of the property.
- South facing slope of roof has limited area due to extension (so a larger area of solar panels may be needed to achieve the savings indicated above if they have to be mounted E-W)
- 40% lower than average use of lighting, cooking, appliances and hot water can be achieved with all appliances 'A' rated and switching off when not needed.

Bisley Road	Total floor area = 158.3m ²		Total CO ₂ – all energy use		CO ₂ for heating, hot water and lighting only (as SAP)	
	SAP	NHER	Total CO ₂	% reduction	CO ₂ (SAP)	% reduction
Estimated baseline (1996)	1	1.3	28.12		27.30	
Current (2007)	10	1.8	22.40	20.34%	19.92	27.03%
Hot water cylinder insulation to 80mm	10	1.8	22.34		19.85	
CFLs to 100%	11	1.9	22.30		19.77	
Loft (main and extension) to 300mm (U=0.2)	13	2.0	21.29		18.91	
New 'A' rated condensing boiler, TRVs to all radiators, temperature and time control to two zones	49	5.6	10.36	63.15%	8.03	70.59%
Secondary glazing to single glazed windows	50	5.7	10.06		7.83	
Insulation to solid stone walls (internal)	66	8.1	7.07		5.25	
Insulation to sloping ceilings, stud wall to room in the roof and roof to bay	70	8.6	6.43		4.61	
Solar hot water system (4m ²)	72	8.8	6.16		4.35	
Solar photovoltaic system (1kWp)	74	9.1	5.83	79.27%	3.91	85.68%
40% lower than average use of lighting, cooking, appliances and hot water			4.87	82.68%		-

Notes:

- Measures are assessed cumulatively in the order reported in the above table
- Improvement measures since 1996 assumed to be wood-burning stove as secondary heating, hot water cylinder jacket, TRVs, five double glazed windows and CFLs (5 rooms).
- Loft difficult to access so insulation more expensive than standard, may only be cost effective when major roof work needed.
- South facing slope of roof has limited area due to extension (so larger area of solar panels may be needed to achieve the savings indicated above if they have to be mounted E-W)
- 40% lower than average use of lighting, cooking, appliances and hot water can be achieved with all appliances 'A' rated and switching off when not needed.



BNDH06: Ranking of energy saving measures in the home

Version 5.2

This Briefing Note and referenced information is a public consultation document and will be used to inform Government decisions. The information and analysis form part of the Evidence Base created by Defra's Market Transformation Programme.

1 Summary

This short Briefing Note ranks the most common measures for heating, insulation, and appliances, and presents the results in simple graphical form.

2 Introduction

It is important to be aware of relative values when comparing energy saving measures that may be competing for limited funds. This overview of costs and benefits in terms of energy and carbon emissions provides useful supporting information. Extensive work on the costs and benefits of energy saving measures in the home was carried out for DEFFRA in 2001, and the figures in this Note are a much simplified presentation of the results. Please see BRE Report BR435¹ for a full explanation of the measures explored and assumptions made.

Figure 1 shows the potential for annual savings in delivered energy, assuming that the measure is applied to all suitable housing to which it has not already been applied in full. Allowance has also been made, where relevant, for housing to which it has been partly applied and there is scope for upgrading.

Figure 2 takes into account the cost of such measures, amortised over their lifetime, to give the unit cost of energy saved.

Figures 3 and 4 show the corresponding position for savings in carbon emissions instead of energy and, where this arises from reduced electricity consumption, the marginal electricity emission factor predicted for year 2010 has been used (0.0286 kgC/MJ). In each case, the different measures have been placed in order of reducing benefit.

¹ BRE Report (BR 435) : *Carbon emission reductions from energy efficiency improvements to the UK housing stock* by L D Shorrock, J Henderson, J I Utley and G A Walters, BRE Housing Centre, 2001



Figure 1

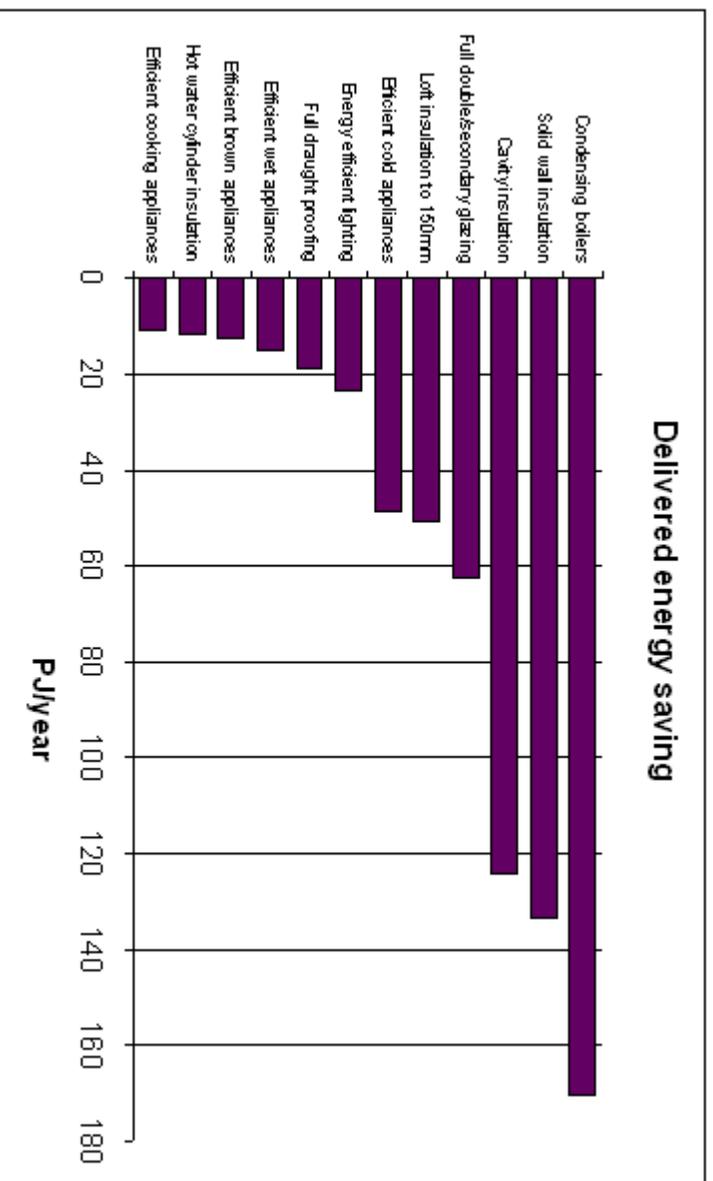


Figure 2

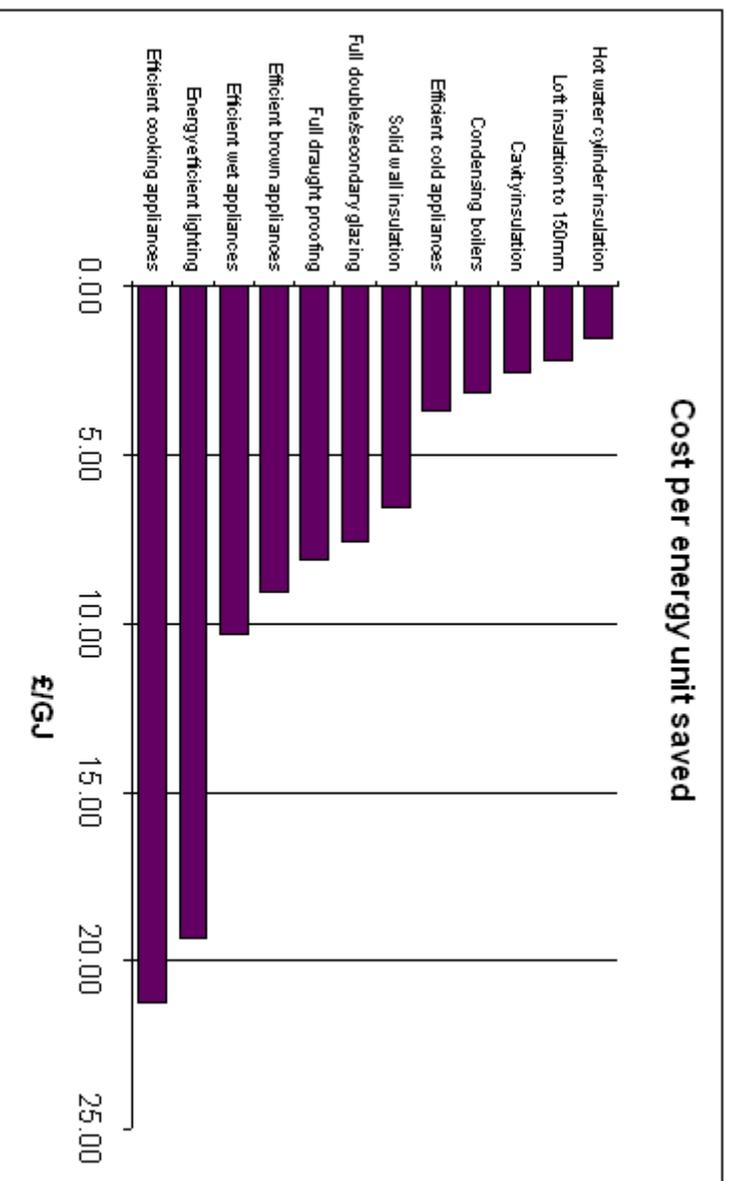




Figure 3

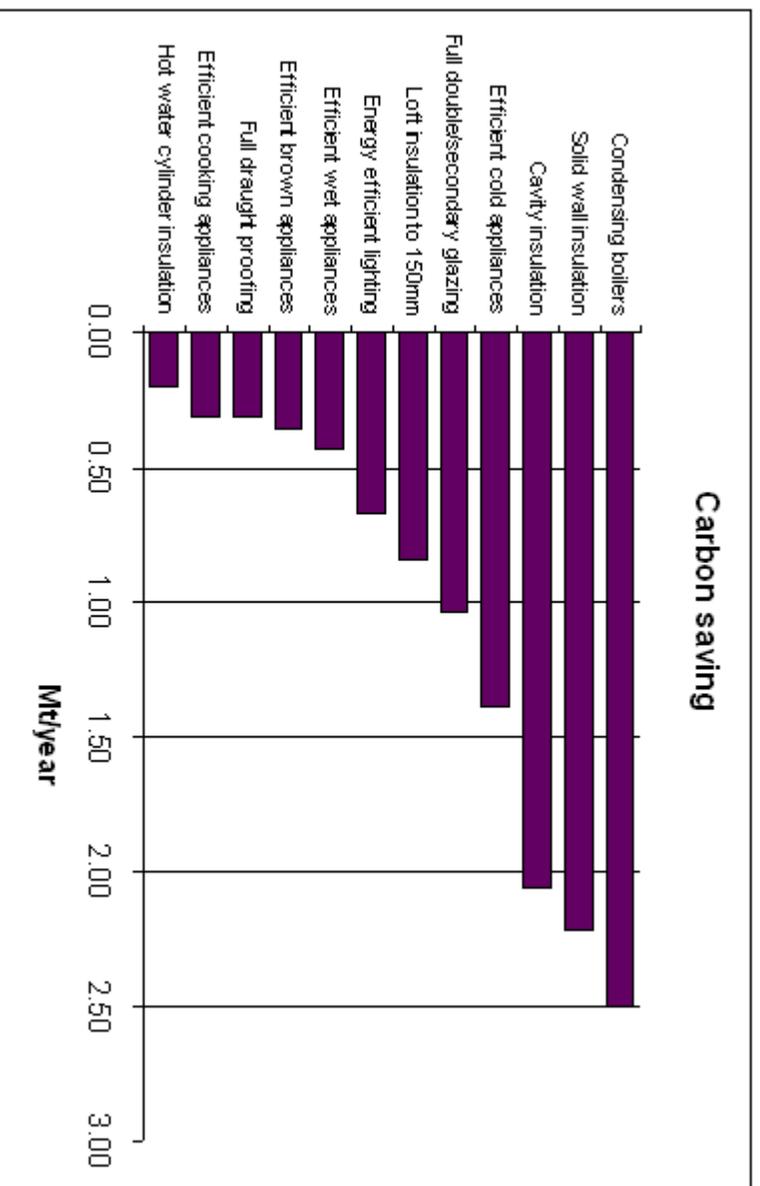
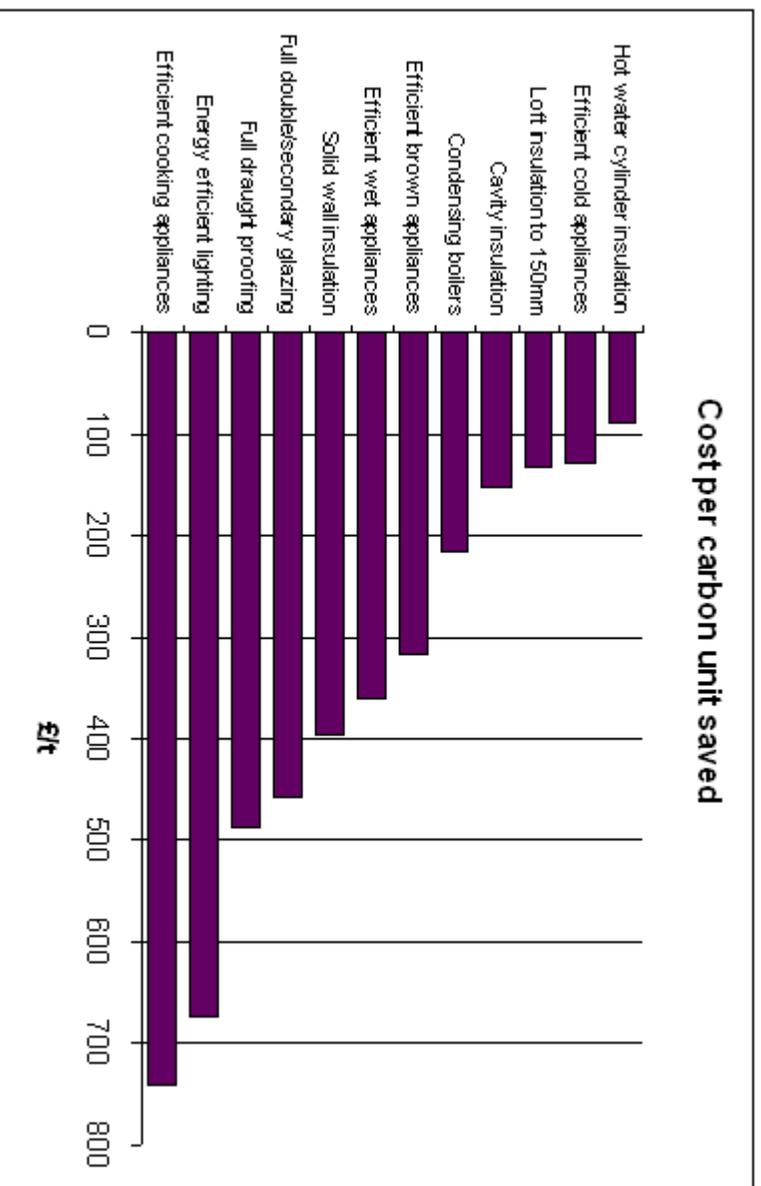


Figure 4





Related MTP information

None

Changes from version 5.1

- Minor text and format changes

Consultation and further information

Stakeholders are encouraged to review this document and provide suggestions that may improve the quality of information provided, email info@mtprog.com quoting the document reference, or call the MTP enquiry line on +44 (0) 845 600 8951.

For further information on related issues visit www.mtprog.com



SWEA - Consumer Survey

Severn Wye Energy Agency is involved in an ambitious sustainable energy initiative, and is looking for opinions of local residents to assist with the development of this project.

The project is looking for residents in the Stroud district to take sustainable energy beyond the standard loft and cavity wall insulation. We will be asking homeowners to invest their own money in green technologies which may have very long payback periods or may indeed never pay for themselves through financial savings. We will also be asking homeowners to make behavioural changes which they may view as inconvenient or intrusive.

We need to identify ways to promote this project which will appeal to and motivate the people of Stroud to get involved and to take action. We would appreciate your honest answers to the questions below. If you have any queries please contact Ian on 01594 544186 or email ian@swea.co.uk.

Q1 : What would encourage you to make changes to your home and behaviour?

- | | |
|---|--|
| <input type="checkbox"/> Environmental concerns | <input type="checkbox"/> Financial incentives |
| <input type="checkbox"/> Other incentives (competitions, vouchers) | <input type="checkbox"/> Being a pioneer of new technology |
| <input type="checkbox"/> Being the first on your street with a green home | <input type="checkbox"/> Setting an example to the rest of Stroud / UK |
| <input type="checkbox"/> Media attention (Interviews / photos etc.) | <input type="checkbox"/> Excellent advice and support |
| <input type="checkbox"/> Qualified experts to help you | <input type="checkbox"/> A personalised action plan for your home. |
| <input type="checkbox"/> Other (please specify below) | |

Q2. With your responses to the previous question in mind, what do you think the main message of the project should be? Stroud District is..... *(Please choose ONE)*

- ...the UK leader in sustainable energy / environmental technologies
- ...concerned about the future and is acting to make it better
- ... setting an example to the rest of Gloucestershire / the UK / Europe
- ... ahead of the game
- ... saving the planet
- ... saving money

Please enter your own suggestions below:



- Q3. Which of the incentive packages below would encourage you to invest money into a sustainable energy measure?
(choose up to THREE)
- | | |
|---|---|
| <input type="checkbox"/> Money off the measure | <input type="checkbox"/> Shares in community farm |
| <input type="checkbox"/> Voucher for energy saving appliances | <input type="checkbox"/> Voucher for the Green Shop |
| <input type="checkbox"/> Free veg box for a year | <input type="checkbox"/> Membership to Gloucestershire Wildlife Trust |
| <input type="checkbox"/> Shares in a wind farm | <input type="checkbox"/> an eco friendly garden makeover kit |
| <input type="checkbox"/> a weekend away on an ecofarm | <input type="checkbox"/> Vouchers to spend at the Farmers Market |
| <input type="checkbox"/> A railcard for a year | <input type="checkbox"/> Other (please suggest below) |

Q4. If we wanted to let you know about this project, how would be the best way to reach you?
(Please choose up to FOUR options)

- | | | |
|---|--|--|
| <input type="checkbox"/> Press advertisements | <input type="checkbox"/> Press articles | <input type="checkbox"/> Radio advertisements |
| <input type="checkbox"/> Radio interviews | <input type="checkbox"/> Flyers / leaflets through doors | <input type="checkbox"/> Flyers / leaflets in public buildings |
| <input type="checkbox"/> Posters | <input type="checkbox"/> Email contact | <input type="checkbox"/> Telephone marketing |
| <input type="checkbox"/> Door to door marketing | <input type="checkbox"/> Stands in shopping centre / at Farmers Market / outside Supermarket | <input type="checkbox"/> Presentations to community groups |
| <input type="checkbox"/> Awareness raising event(s) | <input type="checkbox"/> Promotion on websites | <input type="checkbox"/> Other (please specify below) |

And where would we do that?

(Please suggest places, publications, radio shows or stations, places for posters, community groups, clubs or societies we could present to, buildings where we should advertise, etc.)

Thank you for taking part in this survey and for taking the time to share your thoughts with us.
If you would like to provide us with your name and contact details we may keep you informed of this project and other work that SWEA is involved with but will NOT pass this information on to any other organisation.

Name	Telephone
Address	Postcode
Email	Please tick this box if you DO NOT wish to be contacted by SWEA in the future. <input type="checkbox"/>

Please return by post to Severn Wye Energy Agency, FREEPOST SWC4126, Mitcheldean, GL17 0ZZ