WWF

for a living planet

Carbon Countdown for Homes

How to make Scotland's existing homes low carbon

Report prepared by CAG Consultants and Energy Action Scotland for WWF Scotland

For more information contact:
WWF Scotland
Little Dunkeld
Dunkeld
Perthshire PH8 0AD
t: 01350 728200
f: 01350 728201

Designed by Ian Kirkwood Design
www.ik-design.co.uk
Printed by Woods of Perth on recycled paper

Front cover photo: © iStock

wwfscotland.org.uk

Carbon Countdown for Homes

How to make Scotland's existing homes low carbon

© Aberdeen City Council

Report prepared by CAG Consultants and Energy Action Scotland for WWF Scotland

Project team

Trevor Houghton – Project Manager from CAG Consultants.
Liz Futcher, Scott Restrick and Melanie Sparrow from Energy Action Scotland.
Input on modelling from Ian Preston from the Centre for Sustainable Energy.
Expert advice from John Gilbert of John Gilbert Architects.

Acknowledgements

While the authors take full responsibility for the content of this report they would like to acknowledge the comment, advice and case study material they have received from:

Bob Barnham – Changeworks
George Baxter - Scottish and Southern Energy
Brenda Boardman - Environmental Change Institute
Chas Booth – Friends of the Earth Scotland
Andy Burns – eaga Home Services Division
David Cameron – Scottish Renewables
Stephen Cunningham – West Lothian Council
Robbie Findlay – eaga Scotland Ltd
Mark Henderson – Ecoliving
Colin Kerr – Ecoliving
Michael King – Associate CHPA
Janice Lyon – Aberdeen City Council
Andrew Marnie – South Ayrshire Council
Andrew Peacock – Heriot Watt University
Sue Roaf – Heriot Watt University
Paul Tuohy – University of Strathclyde
Elaine Waterson – Energy Saving Trust

Executive Summary

The purpose of this report

The purpose of this report is to make the case for a Scottish Government strategy to deliver low carbon homes, focusing on the existing housing stock, in line with the Scottish Government's 80% target for reduction in climate emissions by 2050. The overwhelming scientific consensus is that atmospheric greenhouse gas concentrations must be stabilised at a maximum of 450 parts per million (ppm)[1] of CO_2 equivalent to avoid irreversible and extremely damaging climate changes. This would require all developed countries to cut emissions by at least 80% from 1990 levels by 2050[2]. WWF's recent report *How Low – achieving optimal carbon savings from the UK's existing housing stock* (CSE, ACE, Moore 2008)[3] sets out the technical case for how an 80% reduction could be achieved in existing homes across the UK. This report looks at how to translate that information to a specific Scottish context and provide a route map to achieving an 80% carbon reduction by 2050 and an intermediate target of a 35% reduction by 2020. While the focus for the report is Scotland and Scottish powers, there is a clear need to support relevant reforms at a UK Government and EU level.

Why is existing housing so important?

To date, most of the policy initiatives on low and zero carbon housing have focused on new homes. Existing homes lack the same degree of policy ambition, despite the fact that over 85% of homes standing today will still be lived in by 2050. Improving residential energy efficiency is one of the most cost-effective ways of reducing carbon emissions. But urgent investment and action is required to seize this opportunity. This report examines how Scotland's existing homes can be transformed into low carbon homes and cut residential sector emissions by 80%.

The Starting Point (Chapter 1)

The Scottish Energy Study put forward estimates that the residential sector accounted for 34% of total energy demand and 33% of CO_2 emissions in Scotland in 2002, making it the biggest contributor to Scottish CO_2 emissions.The greater part of this residential energy use is in the form of space and water heating. As such cutting emissions from housing should have a central place in the Scottish Government's policies to attain its 80% emissions reduction target.

An integrated retrofit strategy

This report outlines an integrated strategy to retrofit Scotland's existing homes with measures that will generally raise their energy performance and progressively cut their emissions.

1. International symposium of the stabilistation of greenhouse gas concentrations, Hadley Centre, 2005
2. See, for example, Hohne, Phylipsen and Moltmann (2007)
3. http://www.wwf.org.uk/filelibrary/pdf/how_low_report.pdf

Measures to tackle Scotland's housing (Chapter 2)

The main focus is on physical measures to improve energy efficiency and to deploy microgeneration technologies. A very broad range of physical measures needs to be employed in the retrofit strategy in order to make the substantial improvements in the energy performance of the housing stock. This will include much wider use of external insulation and microgeneration technologies. Installation rates of all measures will need to be radically increased.

All homes can benefit from these physical measures, even so-called 'hard-to-treat' homes. Case studies are used to show some of the ways these homes can be improved.

Scotland has a high proportion of dwellings where Combined Heat and Power/District Heating could be used to provide low carbon energy supply. This is best integrated with heat requirements from non-domestic buildings.

How Low in Scotland (Chapter 3)

Targets and five scenarios for emission reductions in Scotland are set out based on the modelling undertaken for the whole of the UK in WWF's *How Low?* report as summarised below.

Modelling shows that a 31% reduction in residential emissions by 2020 is achievable even under conservative assumptions. Given the benefits of earlier action, it is proposed that Scotland should be aiming at a 35% emissions reduction target in the residential sector for 2020 to put it on a secure path to an 80% reduction by 2050.

The analysis shows that physical measures will need to be combined with consumer behaviour change and improved standards of domestic appliances. It also highlights that in order for an 80% reduction in emissions to be achieved by 2050 a number of other factors will need to be addressed:

- it will be necessary to implement a range of measures that go beyond those that are presently narrowly judged to be 'cost-effective' under current market conditions;
- a significant transformation of the market for a range of microgeneration technologies needs to be included in the actions up to 2020;
- a substantial decarbonisation of electricity supply is essential by 2050 if Scotland is to achieve the 80% target which links to the Scottish Government's targets for increasing the proportion of Scotland's electricity generated from renewable sources;

Base Year 1990	
Residential emissions	3.92 MtC
2020	**Level of emissions (MtC) after % reduction**
In line with the UK Energy Efficiency Action Plan[1]	2.70 MtC
% reduction	31%
Market potential (Scenario 1a)	3.01 MtC
% reduction	23%
Economic potential (Scenario 1b)	2.75 MtC
% reduction	30%
Shadow potential (Scenario 1c)	2.70 MtC
% reduction	31%
2050	
Scottish Government target (MtC)	0.78 MtC
% reduction	80%
Technical potential (Scenario 2a)	1.11 MtC
% reduction	72%
Theoretical potential (Scenario 2b)	0.65 MtC
% reduction	83%

1. DEFRA (2007) UK Energy Efficiency Action Plan

- the introduction of 'green gas'[1] into the gas supply to homes will also be necessary to achieve the 80% target.

Delivery mechanisms for an integrated strategy (Chapter 4)

While the main objective of the integrated retrofit strategy would be to cut carbon emissions, it is argued that it should also dovetail with other policy objectives through setting specific priorities. The priorities should include tackling fuel poverty, involving communities, and improving overall housing standards leading to health benefits. Taken together, this means that the priorities of a retrofit strategy should fit well with the Scottish Government's strategic objectives of 'greener, healthier, smarter, wealthier and fairer, safer and stronger'.

The main delivery mechanisms for the retrofit strategy should include:

- area-based 'Low Carbon Zones' where all substandard homes within the zone are systematically improved in order to achieve economies of scale;
- an enhanced Energy Performance Certificate requirement that specifies that basic energy efficiency standards have to be met before dwellings can be rented, sold or extended;
- introduction of 'balance trading' to ensure that new developments do not add to the carbon footprint of an area and to provide further investment in the existing housing stock;
- accelerating the introduction of CHP/District Heating to Scotland's existing homes through a package of support measures for local authorities;
- an enhanced role for the Energy Saving Trust (EST) in providing the 'single gateway' for support to householders on funding and installation of energy efficiency improvements;
- the rapid development of the EST's Home Energy Efficiency Database as the main tool for monitoring progress.

Funding and Capacity (Chapter 5)

There is no official source of information on Scotland's current expenditure on energy efficiency and microgeneration technologies in existing homes, a situation that needs to be rectified. It is likely that at least a doubling of current investment is needed in carbon reduction measures in existing homes in order to put Scotland on track to deliver an 80% reduction in emissions by 2050

© Changeworks

in the residential sector with further investment needed to decarbonise energy supply.

Data from the Scottish House Condition Survey 2002 show that householder expenditure on home improvements is substantial. Since this survey, high fuel price rises are providing a very strong incentive for owner-occupiers to invest in energy efficiency. With some additional incentives, householders could provide the largest part of the additional investment required. It is proposed that energy suppliers should provide additional investment through feed-in tariffs.

It should also be recognised that the broader benefits to Scotland's economy (in terms of Gross Value Added, savings on fuel bills, the value of carbon savings and jobs created) provide justification for the Scottish Government and local authorities directing more investment to deliver better energy performance standards in existing housing.

A fully-developed retrofit strategy will need to give detailed attention to the issues of capacity and skills. An initial examination of these issues suggests that provided there are unambiguous policy signals from the Scottish Government, in tandem with good management of programmes (to avoid stop-go), the insulation industry should be able to respond to the increased level of installations required for the strategy. However, there are real concerns about the numbers of skilled central heating and renewable energy engineers being trained and re-trained. Attention is also needed to ensure there are sufficient numbers of experienced and knowledgeable building control officers and local authority planners to ensure there are not bottlenecks in obtaining permissions for improvements.

Policy to promote an integrated retrofit strategy (Chapter 6)

The integrated strategy outlined in this report would represent a very significant investment in Scotland's

1. 'Green gas' primarily methane derived from the treatment of waste, anaerobic digestion of agricultural organic matter and landfill gas would be injected into the natural gas grid network.

housing with a big impact on the lives of most Scots as well as being the most significant part of Scotland's carbon reduction policy. As such, it is appropriate that it should be led from the Scottish Government at cabinet level working in close cooperation with local authorities (leading on 'opt-out' area-based schemes) and the Energy Saving Trust (leading on 'opt-in' programmes for home-owners and private landlords).

Monitoring of the impact of the strategy would primarily be carried out through the Home Energy Efficiency Database. Installers should be able to provide input through the relevant bodies – i.e. CERT Strategy Group / Fuel Poverty Forum.

It is recommended that the Scottish Government:

- establishes progressive targets for reduction of emissions from existing housing up to 2050 from a 1990 baseline to sit alongside the proposed 2016 zero carbon target for all new housing. There should be interim targets with a target to reduce residential emissions by 35% by 2020;
- retain the Home Energy Conservation Act with a clear focus on carbon emission reduction and eliminating fuel poverty, it should be properly resourced, and more rigorous reporting systems established. These systems should be linked to the development of the HEED database;
- should work with local authorities to reduce residential carbon emissions in the context of the Single Outcome Agreement and the Scottish Climate Change Declaration. In the longer term, in consultation with the Convention of Scottish Local Authorities (COSLA), a specific indicator on the energy performance of the housing stock and associated carbon emissions, linked to progressive national targets for residential emissions should be established;

- implements the Sullivan Report proposal that primary legislation is sought to allow Scottish Ministers the opportunity to extend the provision and type of Energy Performance Certificates;
- requires any domestic property owner to meet a minimum energy efficiency performance standard on the Energy Performance Certificate scale before they can sell, rent or extend a home[2]. This measure needs to be backed by a comprehensive support package of advice, low-interest loans with grants for low-income home owners.

The Scottish Government needs to put in place readily available financial support for home owners and landlords to improve the housing. Changes should include:

- simplifying the current grants regimes for energy efficiency measures and microgeneration technologies with a single application for home owners seeking financial support (for grants, loans or rebates) for improvements to their homes;
- establishing a substantial revolving loan fund;
- encouraging financial institution to widen the availability of 'green mortgages';
- enabling council tax rebates as a reward for householders who improve their homes;
- heavily promoting the Landlord Energy Saving Allowance.

There are also policy changes that are required at the UK and EU level to give the necessary impetus to a retrofit strategy in Scotland. These include:

- establishing a financial support mechanism (feed-in tariff or heat obligation) for low and zero carbon heat supply and a feed-in tariff for electricity generation from microgeneration technologies;
- pressing for a zero VAT rate on all insulation products;
- the rapid roll out of smart metering with real-time consumer displays;
- removing the VAT anomaly that makes it more attractive to demolish homes rather than refurbish them;
- the rapid raising of mandatory domestic appliance standards through the Framework Directive for the Eco-design of Energy Using Products.

2. Extensions to properties would be under the governance of the Building (Scotland) Act 2003 and covered by the Building Standard – so in the future there will need to be a linkage between the energy performance required by the Building Standards and SQHS.

Contents

Chapter 1
The Starting Point

In this chapter, the residential sector emissions baseline for a Scottish retrofit strategy is discussed in the context of:

- current targets;
- the current condition of the housing stock;
- the existing programmes that have been established to address fuel poverty, improve energy efficiency and cut CO_2 emissions.

This provides the starting point for the strategy.

Targets, targets, targets

The following existing EU, UK and Scottish Government targets are relevant to a Scottish retrofit strategy:

- EU target to have 20% of its total energy met by renewable sources – the UK share of this target is 15%.
- Kyoto Protocol - the UK's obligation is to reduce GHG emissions by 12.5% by 2008-2012 compared with 1990 levels (UK Government).
- UK Government's domestic commitment to reduce CO_2 emissions by 20% below 1990 levels by 2010, with a longer-term goal to reduce CO_2 emissions by 60% by around 2050 (UK Government).
- Scottish Climate Change Programme - target to reduce Scotland's carbon emissions by 2.7 MtC by 2010 (Scottish Government)
- Scottish Climate Change Bill – target to reduce Scotland's carbon emissions by 80% from a 1990 baseline (Scottish Government).
- The UK Energy Efficiency Action Plan identifies measures to reduce emissions from the UK housing stock by 13.MtC[1] (equivalent to a 31% cut) by 2020 (UK Government).
- Renewable electricity target – for 50% of electricity generation to be met from renewable sources in Scotland by 2020 (Scottish Government).
- Fuel Poverty - target to end fuel poverty in Scotland by 2016 as far as is reasonably practicable (Scottish Government).
- The Scottish Housing Quality Standard (SHQS) which includes a commitment to ensure all social rented houses (608,000 homes) have effective insulation and a full, efficient central heating system by 2015 (Scottish Government).

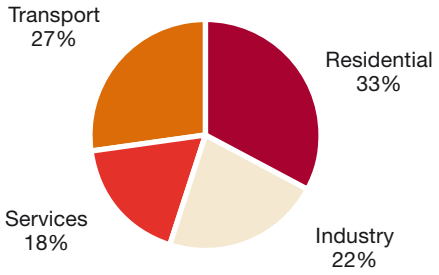
© Energy Agency

What are now needed are specific targets for the reduction of emissions from the existing housing stock to drive the funding and delivery of reductions in the residential sector in order to help meet the targets listed above.

The contribution of the residential sector to total emissions

The Scottish Energy Study put forward estimates based on energy sales that the residential sector accounted for 34% of total energy demand and 33% of CO_2 emissions in Scotland in 2002[2]. As such, the use of energy in the residential sector is shown as the biggest cause of emissions in Scotland, amounting to 3.88 MtC of emissions.

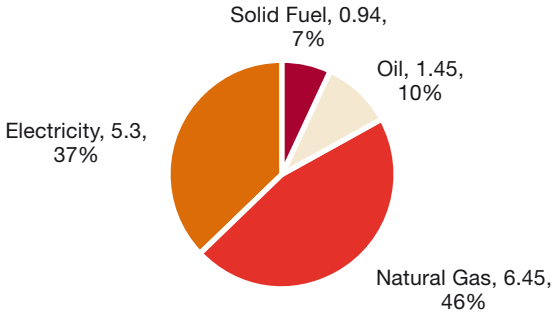
Figure 1.1
CO_2 Emissions by Sector in Scotland 2002 (%)



1. DEFRA (2007) The UK Energy Efficiency Action Plan (page 17) 2. AEA Technology (2006) Scottish Energy Study

The same study gave a breakdown of residential emissions by fuel showing that the use of gas is the biggest source of emissions within the residential sector.

Figure 1.2
Residential Sector Emissions by Fuel in Scotland 2002 ($MtCO_2$)



A higher figure for residential emissions is suggested by the Scottish House Condition Survey (SHCS 2004). The SCHS report states that:

> **"This figure is based on a theoretical model and does not represent the actual level of emissions of carbon dioxide from the domestic sector. It is provided here only to demonstrate the change in the level of emissions due to improvements in the energy efficiency of dwellings and the use of cleaner fuel".**

The SHCS estimates that around 4.27 MtC were released from domestic energy use in Scotland in 2003/04, a reduction of 12% on the 1996 baseline figure of 4.85 MtC of carbon dioxide[1].

This disparity in the official sources on residential energy demand and consequent emissions means that there is no definitive official base-line for monitoring the impact of programmes to cut emissions in the sector.

Based on estimates by the Centre for Sustainable Energy, a 1990 baseline figure for residential emissions of 3.92 MtC has been calculated (see Appendix 1 for how this figure was calculated) and it is this figure that is used throughout this report[2]. This is based on the UK Kyoto target. An 80% reduction produces a figure of 0.78 MtC for residential emissions in 2050 as the target for the retrofit strategy set out in this report. What is undisputed is that the residential sector's contribution to total Scottish emissions is very substantial and a strategy to reduce them must be at the heart of the Scottish Government's efforts to meet its 80% reduction target.

Factors affecting residential energy demand and emissions

Total energy demand and emissions from the residential sector are being pushed up by a number of factors including:

- Number of households - in 2006 there were 2.29 million households in Scotland.[3] The number of households in Scotland is projected to increase to 2.5 million between 2004 and 2024. This is an increase of 13%, or 14,800 households per year with an expected increase in single adult households and an aging population.[4]

- New housing development – over the last decade, the rate of new build has been running at between 20-25,000 dwellings per year some of which is replacing housing which had been demolished. The Scottish Government has indicated it would like to see this rate increased to 35,000 per year by the middle of the next decade.[5]

- Poor condition of the housing stock – in particular where this also results in poor thermal efficiency and lack of modern efficient heating systems. In 2002, 20,000 dwellings failed to meet the tolerable standard.[6] In 2007, 67% of Scotland's social housing fell beneath the new Scottish Housing Quality Standard.

- Increasing demand for energy services – generally there has been a demand for warmer homes and increasing consumption of hot water. Average internal temperatures have increased in UK homes from 13°C in 1970 to 18°C in 2000.[7] Fuel poor households often need to take the benefit of improving the energy efficiency of their homes in warmth rather than reducing energy consumption.

- Ownership and use of appliances – the average UK home had 17 electrical appliances in 1970, whereas the number may be as high as 47 in 2004.[8] Residential electricity consumption rose in Scotland by over 25% between 1990 and 2002, due to an increased demand for electrical consumer goods, domestic appliances, PCs etc.[9]

- Climate change - warming of 0.3 to 0.5°C per

1. SHCS (2006) Energy Efficiency and estimated emissions from the Scottish housing stock 2003/04)
2. An alternative baseline figure has also been calculated which takes into account of the lower carbon intensity of Scottish electricity compared to the rest of the UK – this gives a 1990 baseline of 3.83 MtC
3. SCHS (2007b) Scottish House Condition Survey – Key Findings 2005/06
4. Figures from General Register Office for Scotland
5. Scottish Government (2007) Firm Foundations
6. SCHS (2007a) Scottish House Condition Survey – Key findings 2004/05
7. DTI (2002) Energy Consumption in the United Kingdom
8. Boardman B. (2007) Home Truths quoting Energy Saving Trust (2006) The rise of the machines – a review of energy using products in the home from 1970s to today.
9. AEA Technology(2006) Scottish Energy Study Vol.2

decade is expected in Scotland with cooling degree days increasing everywhere resulting in a modest growth in energy demand in summer for cooling homes.[1]

Downward pressure on total residential energy use and emissions is resulting from a number of factors:

- Energy consciousness of householders – where increasing awareness of energy use and its emissions is resulting in behaviour change. The Scottish Government reports that in 2005/6, 80,000 Scottish householders were provided with advice and information producing an estimated lifetime savings of 524,000 tonnes of carbon and financial savings of £24m.[2] Whether this results in real reductions in carbon emissions over those modelled through the Scottish House Condition Survey is questionable. In most instances the advice results in the eradication of blatantly wasteful behaviour as opposed to improvements on the standardised behaviour assumed by the National Home Energy Rating.

- Decarbonisation of energy supply – Scotland already has lower carbon electricity than the rest of the UK because of the high proportion of non-fossil fuel generation (in 2002 111gC or 0.406 $kgCO_2$/kWh in Scotland compared to 118gC or 0.432 $kgCO_2$/kWh for the UK as a whole).[3] The Scottish Government has set a target for 31% of its electricity to come from renewable sources by 2011 and 50% by 2020.[4] If these targets are achieved, it will further reduce the amount of carbon emissions per unit of electricity consumed in Scotland's homes. It is also possible for renewable electricity and heat to be generated at a community or household level further decarbonising energy supply to the residential sector.

- Climate change - Warming of 0.3 to 0.5°C per decade is expected in Scotland with heating degree days decreasing everywhere resulting in a reduction in heating demand particularly in winter.[5]

- Improvement in the energy efficiency of appliances is an important factor in mitigating emissions from this source and counteracting the impact of increasing appliance ownership and use.

- Improvement in the energy efficiency of the housing stock is the most significant factor providing downward pressure on carbon emissions from the residential sector. This is discussed in greater detail below.

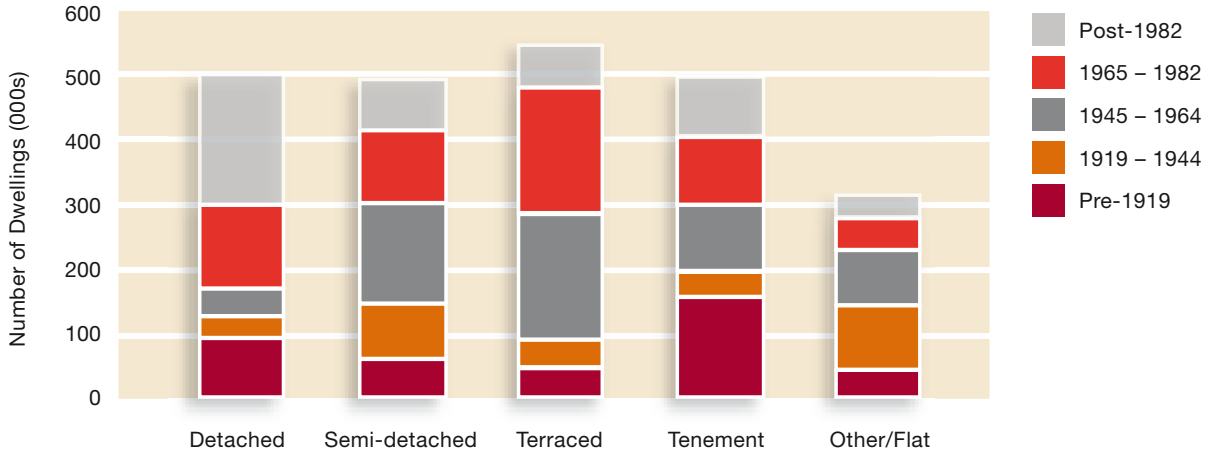
A successful residential carbon reduction strategy will need to address all of these factors.

1. Taken from UKCIP02 high emissions scenario for 2080
2. Scottish Government (2007a) Energy Efficiency and Microgeneration: Achieving a low carbon future; a strategy for Scotland – Consultation draft March 2007
3. AEA Technology(2006) Scottish Energy Study Vol.2
4. Scottish Government Press Release 29/11/07
5. Taken from UKCIP02 high emissions scenario for 2080

The current state of the housing stock

The make-up of the housing stock

Figure 1.3
Scottish Housing Stock – Age and Type 2004

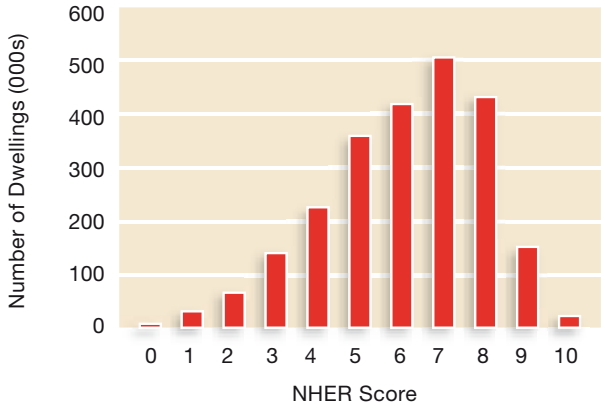


The Scottish House Condition Survey 2004 shows that Scotland has a high proportion of tenements and flats with 31% of the tenement blocks dating to the pre-1919 period. These represent a housing type that is generally more expensive to improve than other housing types and require a different package of measures. In contrast, 43% of the newest housing is detached houses which, though built to higher energy efficiency standards than older stock, represents a built form that is inherently less energy efficient than other housing types (because all walls and the roof are exposed surfaces).

Energy efficiency of the housing stock

The most recent SHCS data[1] show that 47% of Scotland's existing housing stock in 2005/6 had an NHER score of 7 or more and was deemed to have a 'good' energy efficiency rating by today's standards. This showed a marked improvement from 2002 when only 31% had a 'good' rating but this improving trend is now slowing. In 2005/6, about two thirds of social rented dwellings had a 'good' NHER rating, compared to 43% in 2002. Over the same period, the proportion of private sector dwellings rated 'good' increased from 27% to 40%. This shows that improvement has been fastest in the social housing sector.

Figure 1.4
Number of dwellings by NHER score 2005/6 (000s) (Scottish House Condition Survey 2007)



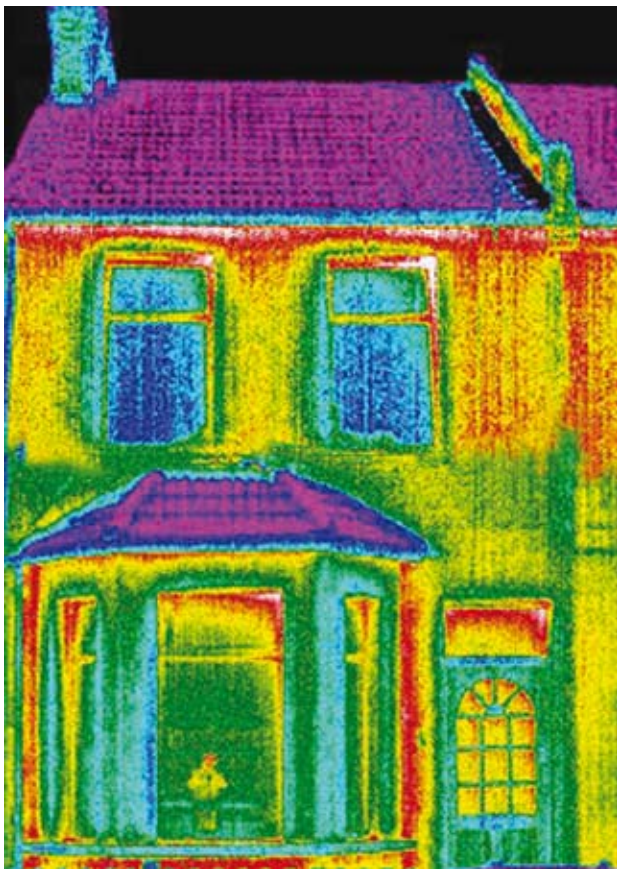
SHCS data for 2005/06 also indicates that 251,000 Scottish homes are affected by dampness or condensation and that in 2002, 20,000 dwellings (0.9% of the stock) failed to meet the tolerable standard. The poorest housing in terms of energy efficiency is concentrated in the private rented sector. Poor general house condition needs to be dealt with alongside measures to improve energy efficiency.

Scottish housing differs significantly from that found in England. While government statistics indicate that both countries have a similar proportion of properties with cavity walls (almost 70% in England[2] and 74%[3] in Scotland), this masks the fact that many of the so-called cavities in Scotland are in timber-framed houses where traditional cavity wall insulation is unsuitable. Cavities in Scotland are also bigger than those in England and

1. SHCS (2007b) Scottish House Condition Survey: Key findings 2005/06
2. DCLG (2007) English House Condition Survey 2005: Annual Report
3. SHCS (2002A) Scottish House Condition Survey 2002

therefore cost significantly more to fill with insulation. In addition, Scotland has 10% of dwellings classified as 'non-traditional', split between concrete, timber and metal-framed housing[1]. All these types of property are 'hard-to-treat' in energy efficiency terms. Around 25% of all homes in Scotland do not have a loft, due to the large number of flatted and tenemental properties that are prevalent in many of its cities and towns[1]. It can be much more expensive to improve the energy efficiency of these hard-to-treat property types and bring them up to an adequate level of thermal comfort.

So the current picture of the energy efficiency of the housing stock is one of modest continued improvement but at a level that would fall far short of achieving an 80% reduction in emissions. According to UK data presented in the *How Low* report, continued reliance on 'cost-effective' measures, as defined by government, will only deliver a maximum 23% reduction in residential sector emissions. A step change is required in the scale and rate of improvements with a particular focus on the poorest housing.



© IRT Surveys

Current programmes to improve energy efficiency

Current programmes in Scotland cover the following measures and are achieving the following installation rates:

Programme	Potential Measures	Installation Rate
Warm Deal	Draught proofing, loft insulation, cavity wall insulation, hot tank and pipe insulation	5,259 homes (2007/08)[2]
Central Heating Programme	Central heating and loft, cold tank & pipe insulation; cavity wall insulation; and draught proofing	14,377 homes (2007/08)25
EEC/CERT (UK wide requirement on energy suppliers)	Cavity Wall insulation, loft insulation, draught proofing, energy saving bulbs, energy efficiency advice, new provision for microgeneration measures, CHP, Biomass	No published figures available for Scotland
Scottish Community and Householder Renewables Initiative (SCHRI).	Solar water heating, solar PV, micro-hydro, micro-wind, wood pellet boiler/ stoves, ground source heat pumps	45 community schemes 314 households (2 years – 2004 and 2005)[3]
Works undertaken by local authorities reported under HECA (excluding Warm Deal but likely to overlap with EEC/ CERT)	2003-2005[4] Window replacement heating installations CFLs daught proofing loft insulation cavity wall insulation hot water tank jackets solid wall insulation floor insulation	 43,234 92,873 41,109 25,208 36,950 13,870 1,560 6,810 24

1. SCHS (2002) Scottish House Condition Survey 2002
2. Scottish Government Press Release 21/04/08
3. Halcrow (2006) Evaluation of the Scottish Community and Household Renewables Initiative
4. Scottish Government (2007c) Fourth HECA Progress Report for the Scottish Parliament 2007

Scottish Government Schemes

The Scottish Government review of fuel poverty in Scotland (May 2008 [1]) suggests that more than half of the households benefiting from the Scottish Government's fuel poverty programmes are not actually in fuel poverty. There is also overlap between these fuel poverty programmes financed from the public purse and CERT (described later) which is financed by energy suppliers. The Scottish Government has re-established the Scottish Fuel Poverty Forum, and asked it to develop proposals for the reform of the fuel poverty programmes within existing budgets. There is a clear need for more effective targeting of government expenditure.

The Scottish Government delivers two programmes aimed at tackling fuel poverty: the Warm Deal and the Central Heating Programme.

Warm Deal

The Warm Deal offers grants of up to £500 to eligible households in receipt of certain means-tested benefits for basic energy efficiency measures. People aged over 60 years who are not in receipt of a means-tested benefit, and are a home owner or tenant of a privately rented property can receive works of up to 25% of the full grant, up to £125. The Home Energy Efficiency Scheme (Scotland) Regulations, effective from January 2007, extended the Warm Deal programme to households with children with disabilities and receiving the Disability Living Allowance.

Scottish Gas administers the Warm Deal on behalf of the Scottish Government for private sector housing. Local authorities and housing associations get a direct grant from the Government to administer the programme for their own stock.

1. Scottish Government (2008b) Review of Fuel Poverty in Scotland

A total of £80m was spent on the Warm Deal in the private and social sector from 1999-00 until 2007-08. Over that period, the programme has resulted in nearly 280,000 improved dwellings with the average NHER of homes treated improved from 5.3 to 6.0.

Central Heating Programme

The Scottish Central Heating Programme provides central heating, insulation and advice to all households in the private sector who lack central heating and where the householder or partner is aged 60 or over. Scottish Gas administers the Central Heating Programme for private sector households on behalf of the Scottish Government. Social sector landlords (local authorities and housing associations) have already delivered the programme for tenants whose homes lacked a central heating system.

The package of measures available through this grant, up to a value of £3,500, includes central heating system, cavity wall insulation, insulation, draught proofing, and energy advice.

Since the beginning of the programme in 2001, up to March 2008, nearly £300m was spent by the Scottish Government installing central heating systems in nearly 100,000 homes in the private and public sector.[2] This would appear to be an impressive achievement but the majority of installations have been to replace older boilers. This will still achieve carbon savings because new boilers are more efficient. Central heating boilers do have a limited life (typically 15 years) and so the need for replacement as well as new installations means that there is an on-going requirement for this support.

Renewable heating

Alongside the Central Heating and Warm Deal programmes, the Scottish Government launched a two-year pilot study in 2006 to explore the potential of renewable energy technology options for heating in a variety of domestic settings across Scotland with a view to considering including these technologies in the main Central Heating Programme at a later date.

Scottish Housing Quality Standard

The Scottish Housing Quality Standard (SHQS), introduced in February 2004, is not an energy efficiency programme as such but it has stimulated spending by primarily social landlords on energy efficiency improvements. The SHQS applies (and progress on compliance is measured) across all housing tenures. The Scottish Government is encouraging

Case Study

Impact of Measures funded under the Central Heating Programme1

Mr and Mrs G are a pensioner couple living in a semi-detached house in South Edinburgh. Their home was built in the 1950s and, located close to the Pentland hills, can be exposed to high winds due to its height above sea level. Prior to installation, the property was heated by a smokeless fuel open fire in the lounge and portable electric heaters to supplement this. There was no insulation in the loft.

The Central Heating Programme provided a new gas combination heating system, fully controlled with a timer, room thermostat and thermostatic radiator valves. The new combination boiler would provide well-controlled heat to all the rooms as well as supplying instantaneous hot water all day. In addition, the cavity walls and loft were fully insulated.

The impact of the improvements was to:

- raise the NHER score from 0.0 to 7.7;
- cut CO_2 emissions from 27.7 tonnes to 5.3 tonnes per year;
- reduce estimated annual fuel bills from £2,100 to £751 per year;
- reduce weekly average fuel bills from £40 to £14.

As a pensioner couple, Mr and Mrs G receive at least £174.05 from pension credit. The improvements have lifted them out of fuel poverty (where more than 10% of disposable income is spent on fuel)

This example demonstrates that a comprehensive package of improvements can transform the conditions in poor housing and cut CO_2 emissions by 81%.

1. Communities Scotland (2006) Central Heating Programme & Warm Deal 05-06 Annual Report
2. Scottish Government (2008b) Review of Fuel Poverty in Scotland

local authorities to use it to monitor the condition of private housing as well as their own stock. Social landlords are required to ensure all their housing meets this standard by 2015 though a small proportion may be exempt from meeting the basic energy efficiency standard if the costs prove 'disproportionate'.

In broad terms, to meet the SHQS a house must be:

- above the tolerable standard which is the absolute minimum standard that a house must meet;
- free from serious disrepair both internally and externally;
- energy efficient so it must have basic loft, water tank/pipe and cavity wall insulation and a full, efficient central heating system provided with modern facilities such as kitchen and bathroom fittings that are in a good and safe condition;
- safe and secure, for example it must have a smoke detector, secure doors and safe electrical and gas systems.

A recent report on SHQS progress[1] found that:

- for the period 2006/07 over 31,500 social sector dwellings were brought up to the Standard and within this total over 11,000 local authority dwellings received energy efficiency improvements. Just under £215m was invested by local authorities;
- by 2007, 126, 000 Registered Social Landlord dwellings met the SHQS. This was just over 50% of the entire RSL sector.

Fuel Company Schemes: Carbon Emissions Reduction Target

Under the Carbon Emissions Reduction Target (CERT), formerly the Energy Efficiency Commitment, electricity and gas suppliers are required to meet carbon saving targets by providing energy saving measures and advice to households across the UK. At least 40% of these energy savings must be focused on a priority group of low-income consumers in receipt of certain benefits and tax credits/ pension credit and over 70s. The money derived from consumer fuel bills and spent by fuel companies is used to fund various energy efficiency schemes. The schemes can be UK-wide, local, or carried out in partnership with local councils, housing associations and other relevant agencies. Most of the schemes offer home insulation, usually at a 50% discount, and some may offer interest free repayment packages as well. Those householders in receipt of certain benefits may be eligible for free insulation measures.

Under CERT 2008-2011, suppliers are able to promote microgeneration measures, biomass community heating and CHP, and other measures for reducing supplied energy consumption. However there are some limitations on the support for these technologies.

CERT is probably the most significant of the existing programmes in terms of total funding and number of homes improved but there is no specific data for Scotland. Estimates by the Scottish Government anticipate spending of approximately £80m per annum[2]. The widening of the programme to include new technologies is an important enhancement of this programme.

Overlap between existing programmes

In its recent review of fuel poverty[3], the Scottish Government highlighted that Scotland may not be receiving a proportionate share of CERT funding. The review also suggests that the measures currently available through the Warm Deal are generally the same as those that are available through CERT and recommends that there should be greater interaction between CERT and Scottish Government fuel poverty schemes in Scotland. A Scottish CERT Strategy Steering Group is to be established to investigate the options for maximising the benefits from CERT and Scottish Government funding for energy efficiency and fuel poverty schemes in Scotland.

It should be emphasised that this retrofit strategy would make Scotland more attractive for CERT investment given that large-scale use of mechanisms such as 'Low Carbon Zones' (see Chapter 4) will deliver more carbon savings for every pound spent by the energy suppliers.

This report argues for a refocusing of the existing programmes so that they genuinely complement each other. It is unacceptable for the Scottish Government to be funding from the public purse exactly the same insulation measures, for the same groups, that could be funded by energy suppliers using CERT. Instead monies from the public purse should be redirected to either pump priming other measures (e.g. solid wall insulation), or other groups (e.g. families in fuel poverty with children under 5 years old).

1. Scottish Government (2008) *Scottish Housing Quality Standard Progress Report*
3. Scottish Government (2008b) *Review of Fuel Poverty in Scotland*
4. Scottish Government (2008b) *Review of Fuel Poverty in Scotland*

Chapter 2 Measures to tackle Scotland's housing

This chapter looks at the challenge of improving the energy efficiency of Scotland's existing housing stock by examining what range of measures need to be employed. Case studies are used to set out successful approaches to improving Scotland's many 'hard-to-treat' homes.

In looking at the range of energy efficiency improvement measures that should be included in the retrofit strategy, there is a hierarchy in which they might be applied.

Basic energy efficiency measures

These are the cheap and simple measures that should be applied in all homes and can be carried out by the householder or a low skilled installer:

- tank and pipe insulation;
- draught proofing;
- 270mm loft insulation;
- compact fluorescent lights.

Heating measures

Provision of efficient central heating is a basic measure to create healthy, comfortable homes and, in most circumstances, means the installation of a condensing boiler. However, for homes without a mains gas supply, alternative technologies are appropriate. Looking further into the future, gas condensing boilers will need to be replaced by even lower carbon technologies:

- gas/oil/LPG condensing boiler;
- air source/ground source heat pump;
- biomass boiler;
- ground source heat pump;
- micro-CHP.

More expensive insulation measures

These are all measures that are more disruptive and require skilled professional installation. The retrofit strategy will require much wider implementation of solid wall insulation:

- cavity wall insulation;
- internal wall insulation;
- double glazing;
- insulated render;
- external wall insulation.

Micro Renewables

These technologies are high cost but will need to be part of the mix to take the carbon emission reductions in the residential sector towards the 80% cut. These technologies will play a part in decarbonising energy supply to the residential sector and it is possible that some homes could be net electricity producers in the future:

- solar hot water;
- micro wind turbine;
- solar photovoltaic.

Combined Heat and Power (CHP) and District Heating

The development of community-wide heat supply is another key measure to drive down emissions in the residential sector. These are special measures that do not fit simply into the hierarchy at a household scale. Given an appropriate situation, such as multi-storey flats or rural community off mains gas, combined with heat load from non-domestic buildings, CHP and District Heating can be an extremely effective measure in providing low carbon affordable warmth (see Case Study page 16). Developing

heat networks also provides opportunities for linking to a variety of decentralised energy sources such as biomass heating plant (usually wood) and solar thermal farms at a community scale.

In order to identify the opportunities for these technologies, local authorities need to undertake heat mapping exercises and build databases of available heat loads[1]. This needs to be built into the planning process to combine heat loads from new developments with those from existing housing to develop viable schemes.

Decarbonising centralised energy supply

As will be shown in the next chapter, physical measures at a household and community level will be insufficient to deliver an 80% reduction in residential emissions. A key measure will be to decarbonise the energy supplied to homes through the electricity and gas mains supply.

Decarbonising electricity supply means improving the efficiency with which electricity is generated using carbon-based fuels, when it is available introducing carbon capture and storage technology, and greatly expanding Scotland's renewable energy capacity. New nuclear power stations are not part of the solution because there are significant environmental impacts and safety issues as well as a concern they will divert resources away from energy efficiency and renewables. In Annex 1, it is shown that Scotland's electricity generating mix is already less carbon intensive than that in the rest of the UK. Some argue that because the electricity grid is structured on a UK–wide basis, we can only take account of the carbon intensity of the UK generating mix. Another view is that Scotland is a net electricity exporter to England and so the greater part of the electricity used in Scotland is generated in Scotland. Taking this latter viewpoint, Scotland is already committed to a more ambitious renewable energy target than England and meeting that target is essential to achieving an 80% reduction of residential carbon emissions. To achieve this target will not only mean developing large-scale renewable energy resources such as infrastructure wind and wave but also the upgrading of the grid.

It is also possible to decarbonise mains gas supply. This can be achieved, by introducing into the gas grid, methane derived from the treatment of waste, anaerobic digestion of agricultural organic matter and from landfill sites. Methane from these carbon-neutral sources would therefore be mixed with natural gas (also methane). It is anticipated that 10% of the gas supplied could be from such sources by 2050.

Behaviour change

Influencing consumer behaviour and increasing energy and carbon awareness is a necessary adjunct to all the physical measures listed above. The baseline is to ensure that the savings expected from physical measures are not compromised by wasteful behaviour by householders. Beyond this, householders need to be aware how even small changes in their patterns of energy use can result in substantial monetary and carbon savings. A key aid to improving this awareness would be the rapid introduction of smart meters with displays showing real-time energy use to every home.

Hard-to-treat homes

It is a premise of this report that *all* of Scotland's homes need to be brought up to a good standard of energy performance in order for an 80% reduction in emissions to be achieved in the residental sector. This will include improving so-called 'hard-to-treat' homes which form a significant part of the housing stock. Hard-to-treat homes are those that are either expensive or technically difficult to insulate (such as those with solid walls or those with flat roofs or have restricted loft space); are remote from the mains gas supply resulting in the use of expensive (and frequently high carbon fuels); are of 'non-traditional' construction; or are where their listed status restricts the use of standard measures. This report assumes the current rate of demoliton does not change, as demolition can prove more expensive than refurbishment and can lead to disruption in community cohesion and sense of place.

Homes without a natural gas supply

25% of Scottish homes[2] do not have a mains gas supply. These homes have to use more expensive and commonly more carbon-intensive energy sources for their heating (eg. solid fuel, oil or electricity). These are primarily homes in rural areas and in the more remote towns in the west and north of Scotland. It is generally uneconomic to take mains gas to dispersed rural communities. A common approach has been to install condensing oil and LPG central heating boilers but the following case study shows how new heating technologies can make more significant reductions in emissions in homes without a mains gas supply.

Air source and ground source heat pumps are technologies that have a significant role in the retrofit strategy set out in this report. The following barriers to large-scale implementation of this measure in Scotland are:

- lack of knowledge of the technology and consequent lack of confidence from stakeholders and marketplace in general;
- resistance to change – it's always easier to specify something you have used before.

1. Dodd N. (2008) Community Energy: Urban Planning for a Low Carbon Future
2. Figure provided by Scotia Gas Networks July 2008

- lack of personnel trained in heat pumps and other renewables to conduct site surveys and to install and maintain the systems;
- capital costs of heat pumps are still high.

These barriers could be overcome by:

- promote micro-renewables particularly in the social housing, construction industry and architectural journals.
- more dedicated and informed advice on air and ground source heat pumps;
- addressing training and capacity issues through the relevant Sector Skills Councils (see also Chapter 5).

'Non-traditional' construction

Scotland has 10% of dwellings classified as 'non-traditional', split between concrete, timber and metal-framed construction. These dwellings present particular problems in raising energy performance and improvements are generally far more expensive than other dwellings. However, these dwellings will need to be treated under a retrofit strategy as they also represent some of the most energy wasteful properties in the housing stock. The case study on structural external wall cladding (page 13) shows how an effective technique has been developed to improve

CASE STUDY

Air source heat pumps, Servite Housing Association

Servite Housing Association has commenced a project to install air source heat pumps in 53 properties located in Perth and Kinross, Angus and Fife using Ecoliving as the main contractor. The project was funded in part using a grant from the Scottish Community and Householder Renewables Initiative.

Heat pumps work on the same principle as a refrigerator but in reverse, and the useful heat output generated can be up to four times the input energy. This means that although the heating fuel is electricity (which is relatively expensive), the running cost of the heat pump is low – one unit of electrical energy produces up to four units of heat energy. These heat pumps provide heating, hot water and whole house ventilation all from one unit which is slightly larger than a fridge-freezer.

Many of the tenants are over pensionable age and/or have disabilities. This often means that they will spend most of the day in their home and will generally require high levels of thermal comfort. While other tenants may be in active employment, various indices identify rural areas as having a high proportion of low income households and a relatively high incidence of fuel poverty.

All the properties are off the gas network and were heated by electric storage heating systems installed when the houses were built 15 – 20 years ago. The heating controls on these storage heaters are very basic and so are unresponsive to external temperature changes. This makes the heating difficult to regulate and costly to run. While alternatives, such as wood burned in multi-fuel room heaters, are an option, these appliances require daily attention, are not suitable for the more vulnerable elderly or disabled tenants and depend on a reliable supply of fuel. In addition, none of the properties involved in the project has a suitable existing chimney or hearth.

© Ecoliving

Costs and benefits

While the average cost of running the pumps installed so far has not been calculated yet, a project carried out by Orkney Housing Association involving the same kind of heat pumps in 2006/07 found that average bills for heating, hot water and ventilation were £12 per week during the coldest period (December – February). The heat pumps will use an off-peak tariff, so further cost savings for tenants should result.

While running costs are important the other issues raised by tenants when Ecoliving surveyed the properties, were comfort levels and controllability. The heat pump delivers a constant, set indoor temperature so that the comfort level is higher than with electric storage heaters where the output tails off as the day wears on. Almost everything is self-regulating and the householder can increase or decrease the heating temperature at the turn of a knob. The heat pump is also weather compensated which means that it works in relation to the outdoor temperature and regulates the heat delivered to the radiators accordingly. These heat pumps provide whole-house ventilation which has health benefits too. Damp, stale air is ducted out of the bathroom and kitchen and fresh air brought in to replace it. Over 80% of new homes in Sweden have a heat recovery heat pump installed. Heat pumps have a relatively long design life of 20 years.

Feedback and lessons

Initial feedback from residents has been good and the installation process is fairly quick in comparison to the installation of conventional heating systems, for example gas central heating. One lesson has been that householders do not readily understand the differences between the way a heat pump operates compared to a traditional system i.e. weather-compensated and on all the time but not necessarily working compared to switching on and off. This could be overcome by pre-installation surveys by experienced advisors who are able to explain how the heat pump works and how the householder will notice the differences day to day.

one type of dwelling of non-traditional construction.

Listed buildings

Scotland has a proud heritage of fine buildings located within conservation areas, many of which are also listed. This greatly restricts the range of measures that can be applied to improve energy performance. External wall insulation and, in many instances, internal wall insulation are ruled out because these alter the appearance and character of these properties. Similarly, mass produced double glazing is inappropriate. The case study on the Energy Heritage Project (page 14) shows that despite these restrictions, it is still possible to make substantial improvements to the energy performance of such properties. These improvement measures are widely replicable.

Tenements and High-rise Flats

Just over 797,000 dwellings, or 34% of Scottish housing, is in the form of flats or tenements. There are about half a million tenement flats in approximately 50,000 3-4 storey blocks, many of these are grouped together. In addition there are approximately 750 medium to high rise blocks. These high density building types provide scope for the use of efficient low carbon energy supply via District Heating and large-scale Combined Heat and Power (CHP). The case study on CHP in Aberdeen (page 16) shows how one Scottish city has made huge strides in cutting emissions and providing affordable warmth for tenants by developing an extensive CHP scheme.

CASE STUDY

Structural external wall cladding on timber-framed dwellings, Stirling Council

Stirling Council has undertaken a project to install structural external wall insulation in 175 units of its housing stock of timber framed construction with eaga Scotland as the main contractors.

These properties are Weir Timber construction comprising of timber studs and timber cladding. The local authority was keen to improve the properties using a structural external insulation that would be able to cope with the significant wind and rain exposure and with what is a poor substrate.

The wall specification was for a structural stainless steel system over 50mm Polyisocyanurate (PIR) insulation, which was anchored back to the timber studs, sprayed with a polymer modified render, the second coat having a dry dash finish. The continuous stainless steel cage wraps the building and provides reinforcement capable of spanning the structural members and provides resistance to wind load, water tightness, air permeability and impact resistance.

The aim was to improve not only the thermal efficiency of these hard-to-treat homes, but also the aesthetic finish of the properties. The idea was to vastly reduce the fuel costs at the same time as improving the complete living environment.

Costs and Benefits

After the work had been carried out, it was calculated that the thermal performance of the properties had improved from 0.45 W/m2K u-value to 0.3 W/m2K u-value, which actually matches the new homes standard in Scotland and exceeds the English standard of 0.35 W/m2K.

The project was completed in December 2007 and the total cost was £2,600,000. It took 94 weeks to complete, costing £14,857 per dwelling.

Feedback and lessons

Although tenant feedback has not yet officially been sought, the initial responses have been very positive, with residents describing their heating requirements as having been greatly reduced. The success of this approach has led the local authority to undertake a third phase to improve this type of non-traditional property.

A key lesson of this project was the knock-on impact on owner-occupiers living in similar properties. Having seen the improvements on tenanted properties, a large number of the owner occupiers have approached eaga Scotland to enquire about having the work done in their own properties. eaga Scotland addressed this by working together with Stirling Council to achieve the most economical solution for owner-occupiers. The company has an ongoing programme of future business with the local authority in light of this interest.

CASE STUDY

Energy Heritage project City of Edinburgh Council and Changeworks

In 2005, Changeworks[1] and The City of Edinburgh Council identified that one of the areas of Edinburgh which had the highest risk of fuel poverty was the Old Town, which is a conservation area and forms part of the UNESCO World Heritage Site. The majority of buildings in the Old Town are of traditional construction with generally poor levels of energy efficiency. Due to their historic status, they are closely protected by planning regulations, which can make improvement works particularly complex.

In 2007, Changeworks secured funding from Eaga Partnership Charitable Trust for a project which would identify acceptable and effective solutions to improving energy efficiency in domestic historic buildings. Funding for the capital costs of the project was provided by the following bodies:

- Edinburgh World Heritage;
- Communities Scotland (now Scottish Government);
- Lister Housing Co-operative;
- ScottishPower Energy Efficiency Commitment (EEC).

Historic Scotland also participated in the project.

The project involved three phases:

- research and extensive negotiations with key organisations;
- a pilot study, carrying out a series of improvements to listed homes and monitoring their impact;
- production of best practice guidance and promotion to encourage replication.

The pilot study involved a series of energy efficiency improvements to a stair of nine flats in a Georgian tenement building which was built in the 1820s. The building is B-listed, lies in the Old Town Conservation Area and forms part of the World Heritage Site.

Different combinations of measures were installed in each flat, depending on the location of the flat and the preferences of the householder. This allowed the impact of the measures to be monitored both in isolation and in combination, as well as allowing side-by-side comparisons.

Measures installed included combinations of the following:

- bespoke secondary glazing (designed specifically for historic buildings);
- integral draught proofing;
- shutter reinstatement (where shutters existed but were sealed shut);
- new 'A' rated condensing boilers;
- slimline floor insulation (a new system which minimises intrusion into the room);
- top-up loft insulation to 300mm (current best practice standard);
- low energy lighting;
- smart monitors;
- home energy advice visits.

Costs and Benefits

As a result of the project the following benefits were reported:

- the annual energy bills of each flat were reduced by an average of £175 (and in some cases up to £400);
- the annual CO_2 emissions of each flat were reduced by an average of 1 tonne (and in some cases up to 2.4 tonnes);
- the annual energy consumption of each flat was reduced by an average of 5,000 kWh (and in some cases up to 12,000 kWh);
- the National Home Energy Rating (NHER) of each flat was increased to an average of 8.9 (in some cases increasing by up to 1.5).

Feedback and lessons

Changeworks reported a satisfaction level of 9 out of 10 for the project as a whole. Householders noticed improvements in comfort levels, increased awareness of energy efficiency and reduced energy costs.

1. Changeworks is an organisation based in Edinburgh which aims to deliver innovative projects in the areas of energy efficiency, waste minimisation and sustainable transport.

The lessons for Changeworks included the critical importance of partnership working and effective communication, thorough research, willingness to negotiate and (naturally!) the availability of funding. An additional factor which helped to increase householders' awareness of the need for the improvement measures was the thermal imaging. Thermal photographs were taken of the properties, which provided a graphic illustration of the impact of adding different measures to the properties.

Learning points for working with householders included the following:

- the importance of taking time to involve householders and explain the project;
- smart monitors are a useful tool to make people think about their energy usage;
- the secondary glazing reduced heat loss but also reduced noise from outside;
- householders now have a better understanding of their actual energy usage;
- using professional, tidy contractors is important;
- installing energy efficiency measures can lead to householders taking ongoing action, because of an increased awareness of the benefits.

CASE STUDY

Combined Heat and Power, Aberdeen City Council

Aberdeen City Council carried out an options appraisal in 2002 to determine the most appropriate form of replacing electric storage heating in multi-storey blocks of flats to achieve the aims of:

- reducing fuel costs for tenants (and so "fuel poverty proofing" these flats);
- reducing carbon emissions;
- being affordable for the Council in capital terms.

The recommendation was to install Combined Heat and Power (CHP) into clusters of multi-storey blocks of flats. There are 4,500 flats in multi-storey blocks in the Aberdeen City area and most are 'hard-to-heat' homes. It is estimated that around 70% of the occupants in electrically-heated multi-storey flats are in fuel poverty.

The Council set up Aberdeen Heat & Power Co Ltd (AH&P) as a locally based, not-for-profit organisation in 2002 to develop and run CHP schemes. Being not-for-profit means that AH&P can keep the prices down for the end-user of the heat. The company is run by a voluntary Board of Directors. Any surplus income generated by AH&P goes to offset the capital costs of other CHP schemes in the city.

The strategy adopted by AH&P is to develop 'heat islands' and then link them together to eventually form a ring heat main around the city being supplied by multiple plant using a range of fuels.

Schemes developed to date:

- the Stockethill CHP scheme, providing low cost, low carbon heating and hot water to 288 flats in four multi-storey blocks, was completed in 2004/05;
- the Hazlehead scheme, which was completed in 2006, provides heating and hot water to Hazlehead Academy, the swimming pool, 2 houses, 184 flats in 4 multi-storey blocks, and 48 flats in an adjacent sheltered housing scheme. Electricity is also supplied directly into the Hazlehead Academy private wire network;
- Seaton phase 1 provides heating and hot water to six multi-storey flats (three of which are sheltered blocks), a cluster of public buildings by the Beach (the Beach Ballroom, Leisure Centre and Ice Rink), and the Aulton sports changing facility. This scheme is due for completion at the end of March 2008. It is expected that by then 420 of the 503 flats will have been linked into the district heating system.

Future schemes planned:

- Ashgrove Court is a stand alone sheltered multi-storey block which is not near to other buildings that are likely to be linked into a district heating scheme in the foreseeable future. Work is due to start in September 2008 to replace the electric heating in this block with a heat only communal heating system;
- Seaton phase 2: three other multi-storey blocks in the Seaton area have been identified as the next homes to be linked into an expanded Seaton CHP district heating system;
- The Aberdeen Sports Village which is currently under construction by a private sector company will also be provided with heating and hot water from the Seaton CHP scheme.

The Stockethill cluster was identified as the first priority for the development of a CHP scheme. This cluster comprised 288 flats in four multi-storey blocks. The council owned 98% of the flats, with the remaining 2% owned by private individuals. The flats had electric storage heating and 70% of the residents were estimated to be in fuel poverty.

Costs and benefits

Prior to the installation, those in sheltered blocks were paying up to £7.80 per week for their heating and water, and tenants in the general needs housing up to £15. In addition, each householder used an average of 2000kWh of electricity per year, at a cost of £181. Immediately following the introduction of CHP, tenants began to pay a flat rate of around £4.75 per week for 48 weeks per year for heat and water. Those choosing to buy their electricity from Aberdeen Heat and Power paid approximately £159 per year. This represented a total fuel cost of £387 per year, or just £7.44 per week, against costs of up to

£18.48 per week before CHP. The very high efficiency of the CHP scheme means that the cost to tenants for space and water heating is much lower than it would be with other forms of heating.

After the CHP district heating system had been installed, the National Home Energy Rating (NHER) increased from 3.3 to 6.0 and all of the residents were lifted out of fuel poverty.

Electricity produced by AH&P is sold via a consolidator to residents and local businesses over the public distribution network.

Aberdeen City Council has invested more than £700,000 into the Hazlehead scheme from the city's Housing Capital Programme; with much of the remaining funding coming in the shape of a £600,000 grant from the Community Energy Programme (a two-year UK Government funding programme, launched in 2002).

Total capital costs for the Seaton scheme (503 flat in the 6 multistorey blocks, plus 4 public buildings) was around £3.8 million and should reduce carbon emissions by approximately 45%.

Feeback and lessons

The main lessons for Aberdeen City Council were:

- the pump priming finance from the Community Energy Programme was an essential element in the success of the project;
- the establishment of an arms length Energy Service Company (ESCO) has given scope for a more commercial business model for these improvements;
- the use of heat loads from non-domestic buildings is a key part of building up a heat network that is financially viable.

The wider roll out of successful schemes such as that in Aberdeen will depend on a number of factors:

- Since this scheme was initiated in Aberdeen, the Community Energy Programme has been closed down removing a key piece of support for CHP and community energy schemes. Representatives from local authorities visiting the Aberdeen scheme cite the lack of up-front support for the high capital costs of distribution pipes as a key barrier to replication of this scheme. This suggests that a capital grant specifically directed toward the cost of distribution pipes for district heating schemes is required to bring forward large numbers of further schemes. Further incentives could be provided by exempting community CHP district heating schemes from Business Rates (as applies in England). Many commentators also now favour either a low carbon heat obligation or feed-in tariff to provide revenue support for such schemes.

- Scotland does have a good track record in the establishment of ESCOs (Energy Service Companies) with further examples in Wick, Shetland, Oban, Fife, Banchory and Edinburgh. These are an effective vehicle for developing District Heating and CHP schemes and there is a need to draw on this experience to encourage other Local Authorities to go down the same road.

- There should be recognition that viable CHP schemes work well when they combine heat loads from high density housing with non-domestic buildings. This means that there should be stronger requirements applied through the planning system to assess and link up heat loads that might form a heat network supplied by CHP plants. For example the heat load from a new commercial development would be linked to the heat load from existing high rise housing to create a viable scheme.

- CHP in high density housing can combine effectively with heat pump technologies in lower density housing. This is because peak electricity loads from heat pumps would match peak electricity output from the CHP plant.

- Such schemes can also harness community scale solar thermal and geothermal sources of heat.

Key points for the retrofit Strategy

- A very broad range of physical measures needs to be employed in the retrofit strategy in order to make the substantial improvements in the energy performance of the housing stock. This will include much wider use of microgeneration technologies and external insulation in addition to other insulation measures.

- Installation rates of measures will need to be radically increased.

- The improvement of hard-to-treat homes will require special packages of measures and extra funding but it is technically feasible to bring such homes up to a good energy performance standard.

- Scotland has a high proportion of dwellings where District Heating or large-scale CHP could be used to provide low carbon energy supply. This is best integrated with heat loads from non-domestic buildings. Financial support measures are needed to meet the high up-front costs of developing District Heating.

Chapter 3
How Low in Scotland

In May 2008, WWF published: *How Low? – achieving optimal carbon savings from the UK's existing housing stock.* Using the data derived from this report, this chapter sets out the potential for cutting residential emissions in Scotland. The main targets for 2020 and 2050 along with the emissions reductions modelled through scenarios are summarised below in Figure 3.1. The figures given in the final column show the level of residential emissions in million tonnes of carbon after the percentage reduction over the 1990 baseline.

© WWF Scotland

Figure 3.1
Summary of Targets and Scenarios for Residential Emissions in Scotland

Base Year 1990	
Residential emissions	3.92 MtC
2020	**Level of emissions (MtC) after % reduction**
In line with the UK Energy Efficiency Action Plan[1]	2.70 MtC
% reduction	31%
Market potential (Scenario 1a)	3.01 MtC
% reduction	23%
Economic potential (Scenario 1b)	2.75 MtC
% reduction	30%
Shadow potential (Scenario 1c)	2.70 MtC
% reduction	31%
2050	
Scottish Government target (MtC)	0.78 MtC
% reduction	80%
Technical potential (Scenario 2a)	1.11 MtC
% reduction	72%
Theoretical potential (Scenario 2b)	0.65 MtC
% reduction	83%

1. DEFRA (2007) UK Energy Efficiency Action Plan

Scenarios

The potential to cut emissions has been calculated through the modelling of five scenarios for the UK as a whole and then the Scottish figures have been imputed from the UK results (see Annex 2). The five scenarios build upon one another and so are cumulative. They are as follows:

Scenario 1a (2020) - market potential modelled the implementation of measures in the housing stock based on the "intention" stated in the UK Government's 2007 Budget that, "by the end of the next decade, all householders will have been offered help to introduce energy efficiency measures with the aim that, where practicably possible, all homes will have achieved their cost- effective energy efficiency potential". In principle, this scenario represents what is taken to be the market potential for emissions reductions – i.e. reductions in emissions that in theory should come about with little-to-no government intervention because they are highly cost-effective.

Scenario 1b (2020) – economic potential was developed according to two criteria. The first was to consider individual measures or combinations of measures to be cost-effective if they carried a positive net present value over their lifetime. The second was not to include micro-wind turbines. The discount rate used was the Treasury's own (real) discount rate for appraising public policy – 3.5%. This more pragmatic definition of cost-effectiveness significantly expanded the measures and combinations of those measures which were applied to the housing stock.

Scenario 1c (2020) – shadow potential has the same assumptions as scenario 1b but factors in the social cost of carbon. At the time the modelling was carried out, the research team was advised by DEFRA to use £25 per tonne[1].

Scenario 2a (2050) – technical potential developed to consider the potential carbon savings if all current measures, regardless of cost-effectiveness, were applied. The scenario represents a pragmatic appraisal of the carbon savings that could be achieved in the housing stock from energy efficiency and low to zero carbon (LZC) technologies. The scenario includes constrained levels of both PV and microwind turbine installations. The modelled savings associated with these measures alone thus represents the technical potential for reducing emissions from the existing stock – i.e. the emissions reductions achievable from the set of currently available technologies.

Scenario 2b (2050) – theoretical potential for reducing emissions from the existing stock. It makes stronger assumptions than the other scenarios about less certain factors, not covered by the model. These include the volume of emissions reductions, based on improving and new technologies and behavioural change.

All the scenarios have been developed using conservative assumptions about the technologies that have been applied and the magnitude of the savings that might be achieved (see Annex 3 for a full description).

The modelling under the various scenarios focused on the physical measures that might be applied to the housing stock. The results of this modelling are shown in Figures 3.2. and 3.3. Scenario 1a relies on measures that are cost-effective under current market conditions - mainly basic insulation measures and condensing boilers - and so does not include the microgeneration technologies included in the other scenarios. This is also the reason that electricity use increases in all but Scenario 1a as heating technologies such as heat pumps (requiring electricity) is substituted for oil, LPG and solid fuel and low carbon electricity is generated using micro-CHP and PV technologies. It can be seen that by 2050, the modelling shows that a 46% reduction in energy use could be achieved.

The results shown in Figure 3.2 and 3.3 below are for Scotland. The results for the UK as a whole showed that Scenario 1a would improve the average SAP[2] rating of all dwellings from 52.4 to 68.5 whereas Scenario 1b would improve the average SAP from 52.4 to 91.0.

Figure 3.2
Reductions in energy use in Scotland (%)

	2020			2050
Fuel Type	1a	1b	1c	2
Gas	26%	48%	51%	68%
Electricity	13%	-17%	-18%	-24%
Solid Fuel	25%	46%	49%	66%
Oil & LPG	30%	57%	59%	80%
All	21%	32%	34%	46%

Figure 3.3
Reduction in energy use in Scotland (GWh)

	2020			2050
Fuel Type	1a	1b	1c	2
Gas	9439	17671	18556	25099
Electricity	1725	-2144	-2252	-3046
Solid Fuel	654	1225	1286	1740
Oil & LPG	1052	1969	2068	2797
All	12870	18721	19659	26589

1. DEFRA have subsequently published detailed guidance on the shadow price (see http://www.defra.gov.uk/environment/climatechange/research/carboncost/pdf/HowtouseSPC.pdf). The 2008 figure is £26 and is expected to rise in the future. The 2007 figure was £25.5 so it can be assumed that in 2004, the baseline year for Scotland the figure would have been lower, but the price isn't retrospectively available for 2004.
2. SAP (Standard Assessment Procedure) ratings were used in the *How Low* study whereas NHER (National Home Energy Rating) is more commonly used in Scotland. For details of both rating schemes see the Glossary.

This modelled reduction in energy consumption was then combined with the impacts of other factors on residential carbon emissions. For the 2020 scenarios these included:

- behaviour change and has assumed that this factor will reduce remaining emissions by between 5%-20% depending on the scenario;
- improved appliance efficiency based on the 'Early Best Practice' scenario (extrapolated from 2020 to 2050) of the Market Transformation Programme.

For the 2050 scenarios, two further factors were included:

- decarbonising electricity;
- green gas would account for 10% of gas supplied to homes. 'Green gas' is primarily methane derived from the treatment of waste, anaerobic digestion of agricultural organic matter and landfill gas would be injected into the natural gas grid network.

These combinations were brought together to show the potential for emissions reduction in the residential sector in 2020 as set out in Figure 3.4 and in 2050 as set out in Figure 3.5.

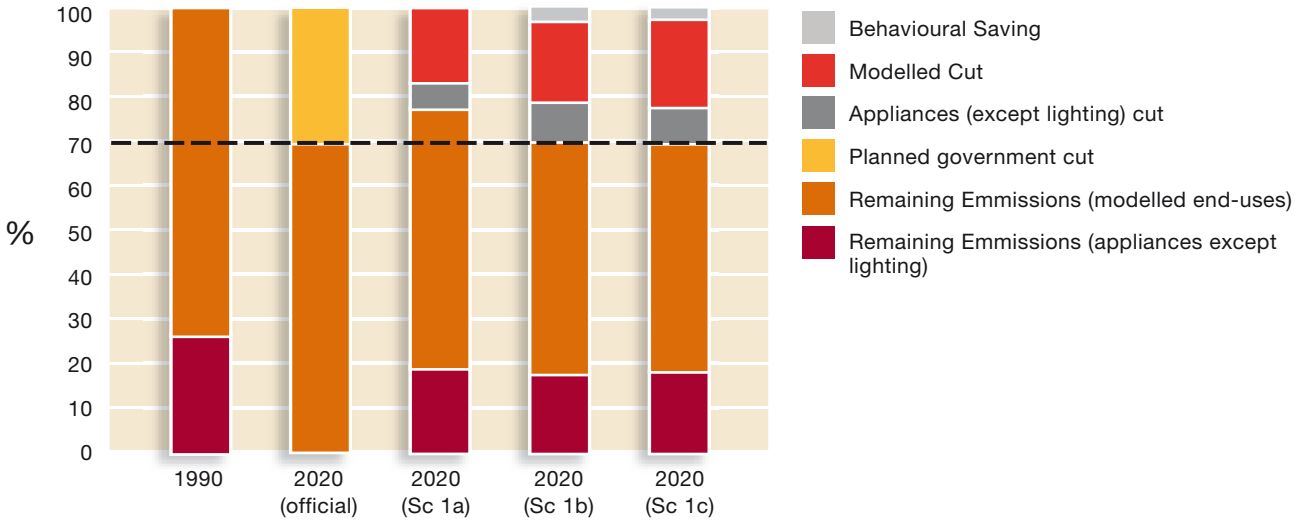
In Figure 3.4, the dashed line represents the 31% carbon emission reduction for the residential sector for 2020 set out in the UK Energy Efficiency Action Plan. It can be seen the most substantial portion of the emissions reductions under all three scenarios is achieved through the modelled improvements to the energy efficiency of dwelling. Smaller additional savings are made through improving the efficiency of appliances and behavioural change.

Emission reduction by 2020

In the modelling, the significant difference between Scenario 1a – Market Potential - and Scenarios 1b and 1c is that scenario 1a fails to pave the way for substantial future reductions in emissions. Scenario 1a is predicated on measures that are fully developed now and are cost-effective in current market conditions. To achieve the substantial emission reduction shown in Scenarios 2a and 2b as set out in Figure 3.5, market transformation in respect of microgeneration technologies will need to begin now and this has been built into Scenario 1b and 1c. Some technologies, such as fuel cell micro-CHP will need to be fully commercialised by 2020, and the renewable energy industry will need to be developed in order that there is the capacity and expertise to achieve the 80% emissions reduction (see also Chapter 5). The modelling did not include the expansion of CHP / District Heating proposed in this report. This factor taken with the conservative assumptions used to develop the scenarios means that a more demanding target than 31% for 2020 is feasible. The earlier action is taken the greater the cumulative emissions reductions[1]. In order to put Scotland securely on a trajectory for an 80% reduction in residential emissions by 2050 it would be wise to go for a 35% reduction target for 2020.

In Figure 3.5, the dashed line represents the level of emissions resulting from the 80% reduction target set by the Scottish Government. It can be seen that the modelled cut achieved through physical measures with improved efficiency of appliances and behaviour change is insufficient to achieve the 80% reduction. It is only with decarbonisation of electricity as shown in Scenario 2a and then the introduction of green gas, as shown in Scenario 2b, that the 80% reduction is achieved.

Figure 3.4
Result for Scenarios 1a, 1b and 1c – Emissions reduction in Scotland 2020



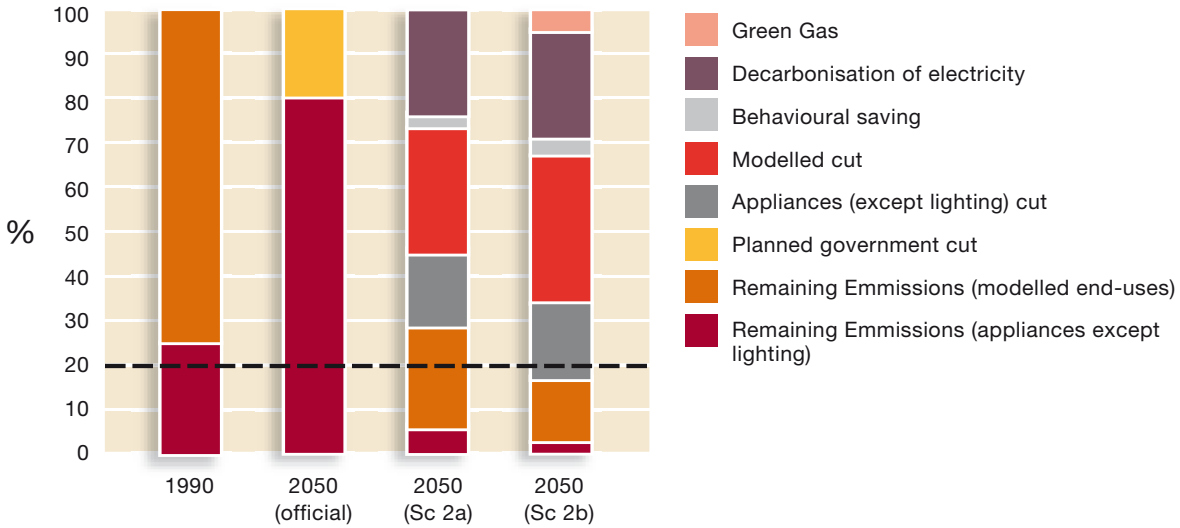
This modelling exercise emphasises the importance of achieving Scotland's ambitious targets for electricity generated from renewable sources but also points to the need to utilise carbon capture and clean coal technologies in order to deliver substantially decarbonised electricity to consumers by the middle of this century. Waste management regimes will also have a major role in Scotland's ability to supply green gas through the gas grid.

Key points for the retrofit Strategy

- Modelling shows that a 31% reduction in residential emissions by 2020 is achievable even under conservative assumptions. Given the benefits of earlier action it is proposed that Scotland should be aiming at a 35% emissions reduction target in the residential sector for 2020 to put it on a secure path to an 80% reduction by 2050.
- To put Scotland on a trajectory to achieve an 80% reduction in residential emissions it will be necessary to implement a range of measures that go beyond those that are currently narrowly judged to be 'cost-effective' under current market conditions. These conditions are rapidly changing with rising fuel prices which could make some measures more cost-effective.
- A significant transformation of the market for a range of microgeneration technologies needs to be included in the actions up to 2020.
- A substantial decarbonisation of electricity supply is essential by 2050 if Scotland is to achieve the 80% target.
- The introduction of green gas into the gas supply to homes will also be necessary to achieve the 80% target.

© Aberdeen City Council

Figure 3.5
Scenarios 2a and 2b – Emissions reduction in Scotland 2050



1. See for example Boardman B. (2007) Home Truths pages 10-13

Chapter 4
Delivery mechanisms for an integrated strategy

This chapter addresses the issue of how to develop an integrated housing retrofit strategy to deliver the potential set out in the previous chapter. The term 'integrated' is used to indicate that a successful housing retrofit strategy needs to bring together related policy objectives, and a suite of delivery mechanisms.

Priorities

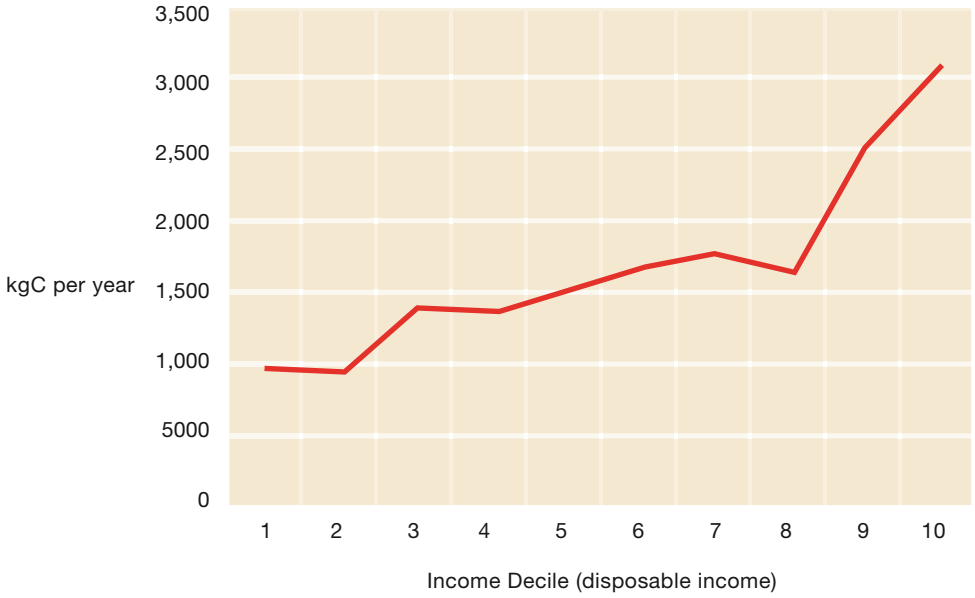
Though the focus of the proposed housing retrofit strategy is firmly on achieving substantial cuts in carbon emissions, this cannot be carried through without regard for the wider policy agenda. The priorities put forward here are a recognition that social justice and wider economic benefit need to go hand in hand with tackling climate change. Taken together this means that the priorities of a retrofit strategy should fit well with the Scottish Government's strategic objectives of 'greener, healthier, smarter, wealthier and fairer, safer and stronger'.

Figure 4.1 shows that household carbon emissions increase with income. Given this relationship, it might be logical to focus any policy on carbon emission reduction on the richest households. However the findings of the modelling work undertaken for WWF's *How Low* report detailed in the last chapter show that the whole housing stock needs to be improved in order to meet the 80% target. In addition any strategy that focused primarily on 'fuel rich' households would be increasing inequalities and therefore at variance with the Scottish Government's priority of cohesion. This report argues that far from focusing on the fuel rich, a successful strategy needs to include tackling fuel poverty as a top priority in order that the entire population can share in the benefits of healthier, more energy efficient housing.

Despite efforts to the contrary, fuel poverty has consistently increased in Scotland since 2002[2] and the recent rapid increases in fuel prices seriously puts into question the likelihood of the Scottish Government meeting its target to eradicate fuel poverty by 2016. The most recent figures from the Scottish House Condition Survey KeyFindings 2005/06 Report show that there were 543,000

Figure 4.1
Average Annual Carbon Emissions by Income Decile (Scotland)

Derived from: CSE (2008), Distributional Impacts of Personal Carbon Trading[1]



1. There is currently no representative survey of personal carbon emissions in the UK. To analyse the distributional impacts of personal carbon for DEFRA, CSE created a partial dataset based on the ONS Expenditure and Food Survey (EFS), using price information and emissions factors to convert EFS expenditure records into energy consumption and carbon emissions for household and private road transport fuels (i.e. 'personal' emissions).
2. Scottish Government (2008b) Review of Fuel Poverty in Scotland

households living in fuel poverty in Scotland in 2005/06, representing 23% of the total. According to figures produced by Communities Scotland early in 2008, for every 1% rise in fuel prices an estimated 8,000 more households would go into fuel poverty. Based on these figures Energy Action Scotland estimates that in spring 2008, 700,000 households, almost one in three, were in fuel poverty in Scotland[1].

These statistics demonstrate the need to re-invigorate efforts to improve the energy efficiency of the homes of the fuel poor in order to 'insulate' them from fuel price rises and from the cold. The pressing need to address fuel poverty in Scotland presents a clear priority for a housing retrofit strategy. This would include addressing some other areas of social inequality that are bound up in the broader issue of fuel poverty. One such issue is the urban/rural social divide. The Scottish Government's Review of Fuel Poverty in Scotland (2008) included this observation:

> **"Urban dwellings are around twice as likely to have a good NHER rating and around six times less likely to be rated 'poor' than those in rural areas."**

These represent many of Scotland's most energy inefficient homes and together with the impact of rising heating oil prices (which have greatly outstripped rises in other fuels[2]) have left the rural fuel poor in a dire position. While these rural homes will be expensive to treat, they should be a top target for a retrofit strategy as they are the homes of people in the greatest need who are at the same time users of high carbon fuels in very inefficient heating systems.

Later in this chapter a case study of an area-based approach to rural fuel poverty is described and in Chapter 2 there is a case study showing how a specific technology, ground and air source heat pumps, are appropriate to many rural locations. More generally, tackling fuel poverty needs to be identified as a specific priority within the retrofit strategy and this could be delivered primarily through a 'Low Carbon Zone' approach described later in this chapter.

Involving communities

The recent announcement of the establishment of the 'Climate Challenge Fund'[2] is an indication that the Scottish Government recognises that tackling climate change needs to involve the whole community. The retrofit strategy would work in tandem with this initiative in significantly reducing emissions bringing wider social and economic benefits to improve quality of life in communities.

Scotland's Rural Development Programme is another possible source of funding. The Scottish Government has set out five key outcomes for recipients of this funding, which are to deliver business viability, enhanced biodiversity and landscape, improved water quality, tackling climate change, and enhanced development of rural communities. It could be anticipated that a retrofit strategy would overlap with at least one of these desired outcomes and that some of this funding could be directed into delivering particular aspects of the retrofit strategy in rural communities e.g. development of biomass District Heating schemes and the supply chain for biomass fuels to domestic consumers.

Improving energy efficiency standards to provide high quality housing

The retrofit strategy should be seen as a major contribution to the agenda set by the Housing (Scotland) Act 2006, which introduced the Scottish Housing Quality Standard (SHQS) and related measures to tackle the chronic disrepair in Scotland's housing stock. A significant element of the SHQS is the provision of efficient central heating and insulation to meet a minimum NHER of 5 and a consequent reduction in carbon emissions. It is proposed that as part of the integrated retrofit strategy a more demanding energy efficiency requirement within the SHQS should be used as an instrument to drive up standards of energy efficiency and cut emissions in the existing stock. As with Building Standards for new housing, the SHQS energy efficiency requirement would need to be ramped up in predictable steps. It is also envisaged that there should be a direct linkage between these requirements and the Energy Performance Certificate scale.

The overall impact of the retrofit strategy will be to make existing homes more affordable to a wider range of householders as running costs will be significantly reduced.

Delivery mechanisms

'Opt in' or 'Opt out'

To date, energy efficiency programmes have largely been based on the idea of 'opting in' i.e. volunteering to participate. This has centred on advice and marketing backed by a limited range of financial support through programmes such as CERT. This has achieved some success in that UK households have improved their energy efficiency by a factor of two since 1970 and reduced carbon emissions by 30 MtC per annum. Efforts need to continue to persuade householders to opt in but this will be insufficient in terms of the rate or scale of improvements that are required to meet an 80% reduction target by 2050.

The alternative is to put the greatest emphasis on programmes where everyone is expected to make

1. SHCS (2008) Estimate of Fuel Poor Households in Scotland 3 March 2008
2. Scottish Government News Release 03/06/2008

improvements when the opportunity is offered and can only 'opt out' if there are compelling special circumstances (such as the disruption of building works would be detrimental to the health of the occupier). It is an approach that relies on tighter and more demanding regulations and standards backed up by good support in the form of advice (face-to-face is most effective), and finance in the forms of low-interest loans for better-off households and grants for fuel poor households.

The retrofit strategy set out in this report, includes both 'opt in' and 'opt out' approaches to delivery but it firmly shifts the emphasis to the latter.

Area-based approaches – towards 'Low Carbon Zones'

Area-based approaches to improving the condition of the housing stock have been with us for a long time. The simple idea is that all homes within an area are offered an improvement package to bring their homes up to a required standard no matter what the tenure or financial circumstances. There are economies of scale in that contractors are treating a large number of dwellings in close proximity with a similar package of measures. This approach began back in the 60s throughout the UK to ensure homes in poorer areas were weather-proof and had basic amenities such as an indoor toilet and a bathroom. 'Home improvement areas' and 'renewal zones' are continuing to be used to tackle areas of deprivation and poor housing.

Over recent years, 'Warm Zones' have been established in a number of areas in England as an evolution of the area based approach. In 2008, the first Warm Zone in Scotland was announced in Aberdeen. Here, funds and grants from a wide range of sources are pooled to deliver benefits such as energy efficiency, carbon savings, fuel poverty reductions, benefits advice, health improvements, fire and home security, employment skills and training. The aim is to deliver 'something for everybody' across all housing sectors whilst securing substantial leverage from existing funding sources and encouraging local community partnerships to shape the priorities and direction of what is done in the area.

While not labelling itself as a Warm Zone, the following case study is an example of the successful use of an area-based approach in Scotland.

CASE STUDY

Hadyard Hill Community Energy Project

This is a rural community, living around a new large-scale wind farm, in homes without a mains gas supply. Many properties are old, on high ground and exposed, with the result of higher than average fuel bills. Before the project started, insulation was generally poor in the majority of households. A third of households surveyed were on benefit and over 40% were found to be in fuel poverty.

Background

The area-based approach taken in this project resulted in a 63% uptake of insulation measures from surveyed properties in the target area as well as income maximisation and renewable energy installations. The project went beyond a simple insulation project by considering the total carbon footprint of the households and the community as a whole with the intention of informing a future long term sustainable energy strategy for the area as well as ensuring all the fundamental insulation measures were installed.

The project was designed by South Ayrshire Council drawing on the experience and lessons learned from the Warm Zones in England and the Dundee Community Energy Project. The major funder was Scottish & Southern Energy (SSE) and the project was developed and managed on a day to day basis by the Energy Agency. The Energy Agency is a charitable organisation providing free, impartial, expert advice on energy efficiency, renewable energy and sustainable issues in South West Scotland. A project steering group was set up with representation from South Ayrshire Council and the three community councils within the area.

Britain's first 'plus 100MW' wind farm was constructed by SSE in 2006 at a cost of £85m. SSE set aside £300,000, which was in addition to the more general Community Benefit Fund, to invest in energy efficiency advice and free insulation for the local community. Further funding from South Ayrshire Council, SSE Energy Efficiency Commitment and renewable energy grants brought the total budget to almost £500,000.

Delivery

The project started in December 2006, with thermal images taken of the majority of properties in the area. The purpose of the images was to generate an interest in the project by the community and persuade those who may have been undecided of the benefits of the free insulation measures on offer.

Lots of work was done in the local community to raise awareness of the project, including articles in the local press, meetings with the community councils, a launch event in the community hall and direct mail was sent to all 828 properties involved, including local businesses, providing regular updates. A brand was developed in the form of a house with a scarf and this was included with all correspondence to provide a consistent message and raise awareness.

In March 2007, using three trained surveyors, of whom two were recruited locally specifically for the project, doorstep surveys were conducted to gather data relating to build and form of the property, heating fuel and systems. This enabled an energy efficiency rating to be calculated. The doorstep surveys were tremendously successful with 90% of targeted properties in the area being surveyed and receiving low energy bulbs and an energy efficiency report. Each household received a report based on the information they provided during the survey, showing their individual ecological footprint, an energy efficiency rating for their property and useful tips on further measures to save energy and money.

Insulation measures were installed between March and August 2007 with 63% of surveyed households benefiting from either free draught proofing, loft or cavity wall insulation. The next stage of the project was to use some of the remaining budget to provide grants for insulating coomb ceilings in roof rooms which were not covered by the first stage of the project. Additional grants were available for those on benefits. Five households took up this offer.

The community is also keen to encourage installation of renewable energy technologies in homes. To raise the profile of renewable energy, the three local schools were fitted with solar photovoltaic panels and grants have been offered to home owners for the installation of solar panels. Fuel poor households are being further supported with grants for households whose main source of water heating is solid fuel, e.g. coal fired back boiler. To date, six households have taken up the offer of grants for domestic hot water solar panels. The future plan is to carry out a postal survey to guage the level of interest in a micro-renewable rental scheme using the remaining £150,000 in the budget to secure match funding.

The average annual fuel saving for each household which received an insulation measure is in the region of £178. The community is producing over 744 tonnes less CO_2 each year as a direct result of the project.

In this instance, the community has had a central role in developing the project and it seems likely that it will progress further with installation of microgeneration technologies – ground source heat pumps being the most obvious choice. It is an interesting example of the use of 'planning gain' from the development of the wind farm. Further projects following this model are in development at Girvan, Ayr Lochside and Fintry supported by the South West Scotland Energy Agency.

Brenda Boardman[1] has suggested a further development of this area-based approach – 'The Low Carbon Zone'. As part of the integrated strategy, it would have the following features:

- as with Warm Zones, they would be defined around areas of known poor-quality housing and concentrations of people in fuel poverty;
- unlike Warm Zones, the packages on offer would include the provision of low and zero carbon technologies in addition to insulation measures;
- they would cover an area of about 10,000 properties (in urban areas) where about quarter would be fuel poor households (the number of properties is likely to be lower in rural areas);
- the first step would be for every home to have an Energy Performance Certificate (see later) in order to identify appropriate measures for each dwelling;
- installers would then work their way through the zone, street by street, carrying out enveloping measures (loft, wall insulation, replacing windows, draught-proofing) and where appropriate installing low and zero carbon technologies for heating and hot water;
- in some instances CHP/District Heating could be installed as well;
- the intensive effort in the zone is also likely to impact on behaviour because of the shared experience;
- the objective would be to raise every dwelling to at least NHER of 8 during the zone's existence (possibly five years) and to eradicate fuel poverty in all homes in the zone.

This focused approach across a whole area has much to commend it as a means of addressing concentrations of poor housing and rapidly bringing them up to good standard. As shown by the Hadyard Hill case study it is an approach than can be used in rural areas as well as in towns and cities.

The use of an area-based approach was advocated in the Scottish Government's Review of Energy Efficiency and Microgeneration Support in Scotland (May 2008) with this statement:

"In order to best target resources to communities with lower levels of energy efficiency, it is recommended that a more strategic area-based approach be considered. An area-based approach also provides greater potential to provide face-to-face energy audits to households by generating much higher economies of scale in the provision of this service."

Selling and renting homes - Enhanced Energy Performance Certificates

From December 2008, all home sellers in Scotland or their agents must provide a 'Home Report' to prospective buyers. Included in the 'Home Report' will be an Energy Report[2] giving recommendations for improvements with sources of advice and Energy Performance Certificates (EPCs) which will give the property ratings from A-G for energy consumption and for carbon impact. The Home Report will be prepared by qualified surveyors. This mirrors similar requirements which have been introduced in England and Wales. The specific requirement for EPCs is the result of the European Energy Performance of Buildings Directive. The introduction of EPCs is a limited measure designed to stimulate awareness of energy performance at the point of sale, to have this recognised as a factor affecting the value of a dwelling and to encourage the buyer or seller to carry out improvements. It is also a way of collecting information about the housing stock and this has been recognised as it is intended that data from EPCs will be fed into the EST's Home Energy Efficiency Database (HEED) which is discussed on page 33. This is a welcome development which, if care is taken to ensure that the data is compatible with other data sources such as the Scottish House Condition Survey, will provide valuable information about the energy efficiency of the stock in general, and the privately owned housing stock in particular.

However it is possible to take the approach of a survey, energy report and energy certificate at the point of sale a step further as is the case in Berkeley, California – see case study.

1. Boardman B. (2007), Home Truths
2. http://www.scotland.gov.uk/Topics/Built-Environment/Housing/BuyingSelling/Home-Report

CASE STUDY

The Residential Energy Conservation Ordinance, Berkeley, California, USA

This ordinance was introduced in the City of Berkeley in 1987 to improve energy and water efficiency in Berkeley's 44,000 homes.

The ordinance states that every home or apartment building sold or transferred in Berkeley or undergoing renovations with a total value of $50,000 or more must meet specified energy and water efficiency requirements. These requirements include efficient toilets, showerheads and taps, insulating pipes and roofs, draught-proofing and low energy light bulbs in common areas. As such it is not a very demanding energy efficiency requirement but it does mean that basic measures have to be installed. The ordinance also puts a price cap on the measures required by limiting total costs to a percentage of the property's value or total renovation costs.

The ordinance covers private owners and landlords alike. The responsibility for complying with the ordinance can be passed on to a new owner but only once. It is backed by subsidised loft insulation with free and low-cost installation of measures for people on low incomes through a not-for-profit organisation, The Rising Sun Energy Centre. This support is funded through the California Energy Commission's Public Goods Fund (effectively energy supplier funding).

Inspections to assess compliance with the ordinance are carried out by inspectors from Community Energy Services Corporation – an arms-length company set up by the City Council to undertake energy services functions. Inspections can be organised within five days and for a home-owner selling a house or flat will cost $100 with re-inspection of non-complying dwelling costing $50. A certificate of compliance is issued following a satisfactory inspection and has to be filed at a cost of $15 with the City Council. If the requirements of the ordinance are not met the sale of a property can be stopped or a $500 fine imposed on the buyer.

The introduction of the ordinance resulted in residential energy consumption and carbon emissions reducing by 13% over the five year period 2000-2005.

Berkeley is now planning to revise the ordinance to be performance-based as well as prescriptive based to allow some flexibility in the measures employed.

For further information see: www.ci.berkeley.ca.us/sustainable/residents/ResSidebar/RECO.html.

CASE STUDY

Grants and Green Mortgages -

Canada ecoENERGY Retrofit for Homes

This programme is a Canadian federal government initiative to provide home and property owners with grants of up to $5,000 to offset the cost of making energy-efficiency improvements. The grants apply to a range of measures that reduce energy consumption including draught-stripping, insulation of all types, installing new energy efficient heating and hot water systems including heat pumps and solar water heating, energy efficient ventilation and cooling, and water conservation measures. The grants vary according to the impact of measures on CO_2 emissions e.g. $3,500 for a ground sourced heat pump to $30 for replacing a window or a skylight with a high rating model.

The programme is aimed at private home-owners who are:

- having problems keeping warm and comfortable in their home;
- planning to sell their house;
- renovating or retrofitting their home;
- upgrading their heating and cooling system.

Only homes that have undergone a residential energy efficiency assessment by an NRCan (Natural Resources Canada) licensed advisor are eligible for the grants. Assessments are carried out to determine what measures are most effective and then another following the work being completed to confirm what has been installed. The pre-retrofit assessment includes:

- a detailed energy evaluation;
- a 'blower door' test to find air leaks;
- a printed report on what you can do to improve your home's energy efficiency;
- an energy efficiency rating label.

Once a pre-retrofit assessment has been carried out the home-owner has 18 months to complete the work and qualify for a grant.

Owners of detached, semi-detached and terraced houses and low-rise residential buildings of three storeys or less (with a footprint of less than 600 square metres), as well as mobile homes on a permanent foundation are all eligible for the grants.

For further information see:

www.ecoaction.gc.ca/ecoenergy-ecoenergie/retrofithomes-renovationmaisons-eng.cfm

Green Mortgages

Some of the financial institutions have also set up their own programmes providing green mortgages sitting beside this federal grant programme and hence providing an additional incentive for energy efficient retrofits. Home buyers purchasing an energy-efficient home or home-owners refinancing an existing home to make energy-saving renovations are eligible to receive a 10% policy refund and an extended repayment period (up to 40 years). The schemes on offer typically require homes being purchased to be of a Canadian EnerGuide Rated 77+ and for homes being renovated to be increasing their rating by at least five points to a minimum EnerGuide rating of 40. As with the federal grant scheme, assessments by an NRCan licensed advisor are required before and after measures are installed.

© J. Grant / WWF Scotland

Putting the elements of these two case studies together it is possible to envisage an enhanced EPC regulation which would have the following elements that include both stick and carrot.

- A requirement that owners selling, renting, or extending properties have to meet a basic energy efficiency standard (such as a E rating on the current EPC scale) before they can transfer the property or alternatively the purchaser takes on the legal obligation to meet the standard within one year.
- Initial assessment by an accredited surveyor provides advice and recommendations for the cost-effective improvement measures needed to meet the required standard (these should be free to people on low incomes but everyone else should pay a modest fee).
- This initial assessment is a prerequisite for financial support for the owners to meet the required standards in the form of grants for low-income groups (geared to carbon emission reduction like the Canadian example) or low interest loans for better-off households (following the German model). An upper limit on costs might be considered as with the Berkeley example.
- Compliance with the required standard is confirmed by a further assessment and issue of an EPC.
- Periodically (say every three years), the standard required is raised. This needs to be flagged up well in advance so everyone is aware that the bar will be raised in predictable steps.
- Financial institutions offering 'green mortgages' on favourable terms based on the rating of properties would provide a further incentive to exceed the minimum requirement.

All data from assessments and certification is registered with HEED (see page X) to aid the overall monitoring of improvements in the privately owned housing stock.

So enhancing and extending the scope of EPCs has the potential for driving forward improvements in the energy efficiency of private owned and privately rented property and to provide a key method of broadening our detailed knowledge of the state of the housing stock. It must also be recognised that it will take time for the coverage of EPCs to spread, so this cannot be the only data source for monitoring improvements or for stimulating improvements in privately owned and rented housing.

Improvement to existing housing on the back of new development – Balance Trading

The aim of the strategy is to reduce residential carbon emissions by 80% by 2050 but the fact is that new development will be adding to emissions until all new homes are built to zero carbon standards. A recommendation from the Sustainable Development Commission has sought to address this problem in relationship to the Growth Areas in the South East of England:

> **"Offset any increase in CO_2 emissions or water consumption in the new Growth Areas by matching this with a commensurate reduction in carbon emissions or water consumption in existing homes in the same region"**[1].

This concept which has become known as 'balance trading' has since been further developed by EAGA[2] and others. Balance trading could include the following elements:

- identifying the volume of carbon emitted by a new development;
- allow for renewable energy production on site;
- save the remaining amount of carbon by improving existing homes in the area – this could operate in a similar fashion to a 'Low Carbon Zone' in that all households in a specified area would be offered the opportunity to improve their homes;
- ensure additionality by offering grants for measures not provided through other schemes.

This approach is particularly attractive to developers on small, constrained sites where the practicalities of the use of on-site renewable energy are very difficult. It also provides another income stream for the improvement of existing homes while ensuring overall residential emissions are not pushed up by new development and helps to minimise local hostility to new housing developments. The latter point is particularly important given the Government's ambitious targets for new housing. Although balance trading is as yet untried in the field there is considerable interest from a number of large English cities. This measure should not be seen as an easy get-out for developers and compliance with building standards would need to be strictly policed.

Supporting CHP / District Heating Schemes and Energy Service Companies

We have already seen in Chapter 2 how Aberdeen is successfully improving its electrically heated high-rise blocks of flats through the introduction of CHP. This has been achieved through the establishment of an arm's length

1. SDC (2006), Stock Take – Delivering improvement in existing housing
2. EAGA plc. Presentation by Mitesh Dhanak Making new development carbon neutral affordably

energy service company (ESCo) – Aberdeen Heat and Power. The need to combine heat loads from housing with non-domestic buildings has also been highlighted. CHP and district heating schemes can also utilise biomass and be supplemented by solar water heating. Using biomass can also make it a very effective measure in areas without a gas supply as shown by the scheme being developed in Wick, in Caithness.

Using the Aberdeen model, Wick District Heating Scheme was developed by Highland Council working in partnership with the local distillery through a not-for-profit company – Caithness Heat and Power. The scheme is designed to eventually provide heat and power from woodfuel for 2100 houses, the local hospital, high school, hotels and commercial and industrial premises. The first heat-only phase provides heat for around 600 local authority owned houses in the vicinity of the distillery, utilising both waste heat from the distillery generated from woodfuel, as well as water heated directly from woodfuel. The project is estimated to halve the cost of energy for both the distillery and for the local consumers. It is innovative in that it is intended to use wood fuel gasification to minimise carbon emissions. The fuel substitution alone is estimated to save 5000 tonnes of carbon.

Scotland is performing better on the introduction of CHP than the UK average with installed capacity in Scotland of around 743 MWe (around 16% of UK CHP capacity) but much of this capacity is purely industrial and further measures are required to expand low carbon heat supply to the residential properties. This will require an approach that combines:

- support through land-use planning with positive encouragement for heat mapping by local authorities
- financial support for the up-front costs of District Heating schemes
- revenue support through mechanisms such as a low carbon heat obligation or a low carbon feed in tariff
- direct support to Local Authorities in establishing ESCos to carry forward the development of CHP / District Heating Schemes.

As a first step the Scottish Government in partnership with COSLA could establish a task force to address all the barriers to widening the number of residential properties served by CHP and District Heating.

The single gateway – the role of the Energy Saving Trust

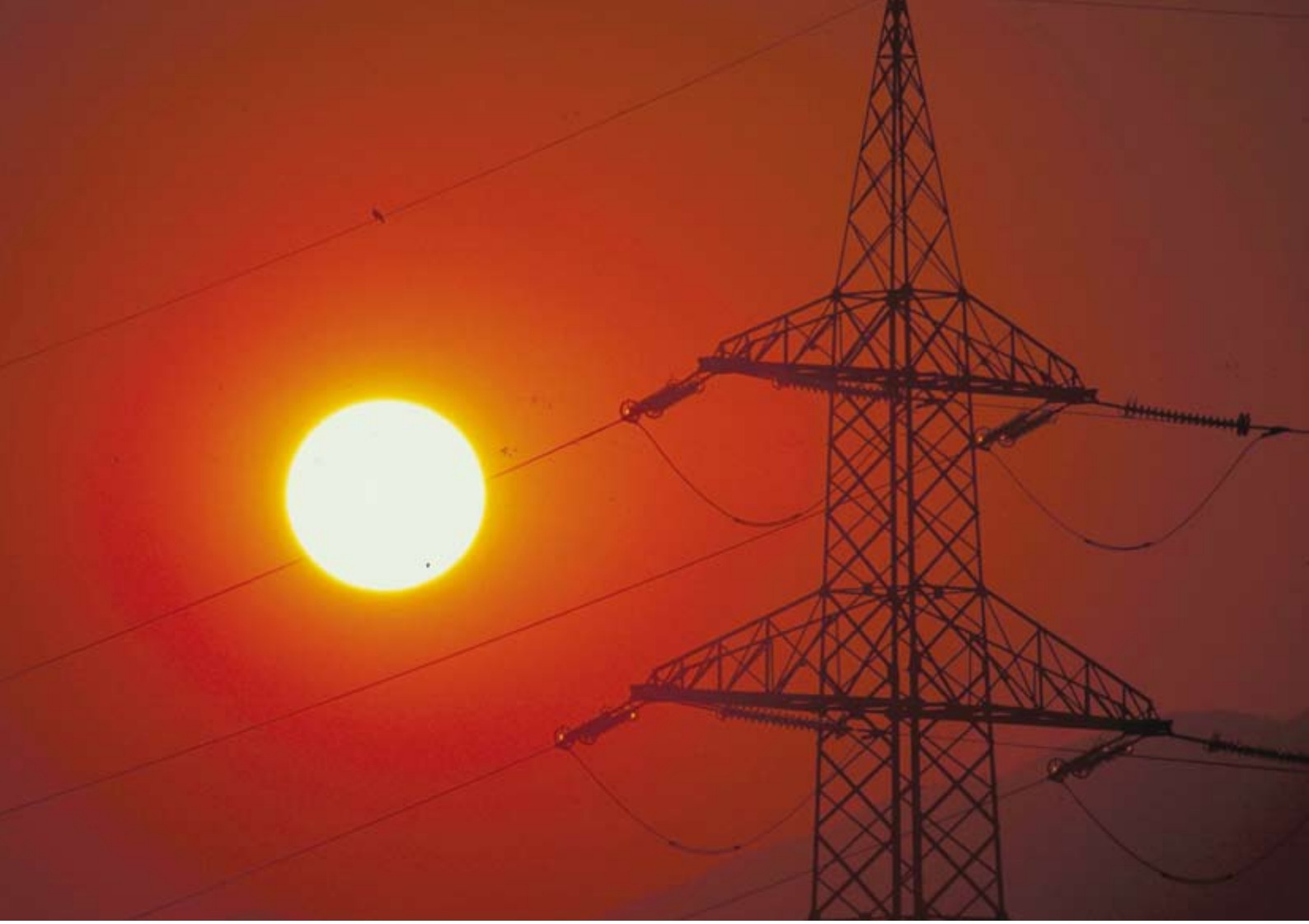
The Energy Saving Trust is the principal, but not the only, organisation delivering energy efficiency advice and information to the residential sector. Much of this advice is delivered through a single advice line telephone number, the EST website and a network of Energy Saving Scotland Advice Centres which have now been re-branded as the Energy Saving Scotland advice network. The Scottish Government has also announced[1] that the EST will roll out a new 'Home Help' service providing face-to-face support on microgeneration options for householders. There has been much use in recent times of the term 'one-stop-shop' in relationship to these advice services and this is what the Advice Centres have always attempted to provide – so it is not a new idea but it is still not quite the reality. Sitting alongside the EST are other advice services provided by energy suppliers, local authorities and some trade bodies. There is also a multiplicity of different sources of financial support under different programmes that householders are directed to in order to make separate applications.

What is evident from the experience in other countries (e.g. Deutsche Energie-Agentur or German Energy Agency) is that to have a single high profile gateway for information, advice and financial support is a key ingredient to effective action in the residential sector. The German Energy Agency finances much of its operations through public private partnerships. Currently, the EST is an independent company funded by government and private sector partners. The private sector funding for the EST could be increased by a direct levy on energy suppliers as a means of financing the enhancement of its services detailed below. Such a levy could be associated with a relaxation of suppliers' license obligations to provide energy efficiency advice themselves. This would mean that there should not be additional costs being passed through to consumers.

While the service provided by the EST has become more effective over the years and its brand more widely recognised there is still some way to go in it providing a 'single gateway' for support to householders in improving their homes; the new Energy Saving Scotland advice network is a big step towards this role. In this retrofit strategy, the EST is the key player continuing with the 'opt in' approaches to delivery of energy efficiency improvements. To do this effectively it needs to provide a very simple and easy route for householders wishing to improve their homes. Its role could be defined as follows:

- to be recognised as the one authoritative source of advice (covering all energy efficiency measures, microgeneration and renewable technologies) and for its brand to be universally recognised;
- to continue to provide advice and information channelled through a single advice line telephone number, website and network of advice centres;
- to be the accreditation body and contact point for independent energy assessors, who could be commissioned by householders for a modest fee to

1. Scottish Government (2008c) Scotland's Climate Change Programme: 2nd Annual Report



provide detailed assessments (that include EPCs) and face-to-face advice;

- to be the single gateway to financial support for all householders with the EST staff putting together a funding package for each applicant from all available sources for all types of measures i.e. the householder makes a single application rather the current multiple applications;
- to provide 'hand holding' assistance to householders in implementing measures e.g. providing model specifications for measures, finding accredited installers etc. This is of particular importance with the installation of more expensive measures such as solid wall insulation and microgeneration technologies.

Some of this is already happening as part of the Energy Saving Scotland Advice Centre network but other components, such as a single gateway to financial support, are not yet in place and would require government action. There are issues that should be addressed about ensuring Advice Centre staff are adequately trained and accredited to provide advice related to loans and grants.

Monitoring progress – Home Energy Efficiency Database

In Chapter 1, it was highlighted that there is still some discrepancy between official sources on the current contribution of the residential sector to total emissions. The Scottish House Condition Survey has been the most detailed source of information on the energy efficiency of the housing stock but this is based on modelling the energy consumption of a sample of dwellings and so provides a 'low resolution' picture of what is going on. A new 'higher resolution' source of information, the Home Energy Efficiency Database (HEED) is now in development.

HEED[1] has been developed by the Energy Saving Trust on behalf of the UK Government and devolved administrations to register the uptake of sustainable energy measures and related survey data throughout the UK housing stock. The database registers these installations on a property-by-property basis with data from a wide variety of sources including energy suppliers, government scheme managing agents, local authorities and other landlords, EST Home Energy Checks as well as other EST programmes. The main objectives are:

1. EST (2008) HEED Online User Manual 1.5

- to assist the UK in meeting its carbon reduction and fuel poverty goals by providing detailed information on energy use and carbon saving potential from UK housing – recognised in the Energy White Paper as one of the main areas for carbon saving to 2020;
- to provide a key source of information to assist local, regional and central government, in monitoring and reporting on their housing duties, including the Home Energy Conservation Act or its successor;
- to provide a means of assessing the penetration of sustainable energy measures, including microgeneration, over time and by area, including the overall UK position, by country, and by other regional/ local areas;
- to provide a means of assessing the future potential for energy saving measures and to facilitate better targeting, increased uptake and improved cost-effectiveness.

In the short term, HEED has some shortcomings in terms of its coverage and there are still issues to be resolved in respect of energy supplier data on installations funded through EEC /CERT. However, if HEED is adequately resourced and given the status it deserves by UK and Scottish Governments, it is potentially a very powerful tool. As described, HEED is an essential tool in the delivery of a housing retrofit strategy. Data captured through EPCs will also be incorporated into HEED and so there is the potential for moving towards having accurate data on a significant proportion of the housing stock on a property-by-property basis in a short period of time. Brenda Boardman[1] has suggested that it would be useful to have further triggers for EPCs to aid the building of a database for the whole housing stock. These triggers might include:

- when properties are remortgaged;
- when new tenancy agreements are issued for rented properties;
- when planning permission or building regulation approval is sought.

It has been shown in other countries that having property-based information of this kind can be invaluable in directing investment and resources to where it is most needed. The Danish building register is administered by its local authorities for local tax and census purposes and has been used for over twenty years to collect basic information on heating, building size and stock condition. It has, for example, enabled full consideration of the effect of investment in improving the thermal efficiency of buildings as against further investment in new energy supply and facilitated the planning of large-scale CHP schemes.

Key points for the retrofit strategy

- The retrofit strategy should dovetail other policy objectives with the objective of reducing carbon emissions through setting specific priorities. The priorities should include tackling fuel poverty, involving communities, and improving overall housing standards.

The main delivery mechanisms should include:

- area-based ‘Low Carbon Zones’
- an enhanced Energy Performance Certificate requirement that specifies that basic energy efficiency standards have to be met before dwellings can be rented, sold or extended
- introduction of ‘balance trading’ to ensure that new developments do not add to the carbon footprint of an area and to provide further investment in the existing housing stock
- accelerating the introduction of CHP/District Heating to Scotland’s existing homes through a package of support measures for local authorities
- an enhanced role for the Energy Savings Trust in providing the ‘single gateway’ for support to householders on funding and installation of energy efficiency improvements
- the rapid development of the EST’s Home Energy Efficiency Database as the main tool for monitoring progress

1. Boardman B. (2007), Home Truths

Chapter 5
Funding and Capacity

This chapter deals with the issues of where to find the increased investment required for a retrofit strategy. This sits beside the need to ensure that energy efficiency and renewable energy industries are able to ramp up their capacity to deliver measures in line with what is proposed in this retrofit strategy.

Funding a Retrofit strategy

Current spending

The total annual expenditure on energy efficiency and microgeneration technologies in existing homes from all sources is far from clear. The most comprehensive official source of information is the reporting by local authorities under the Home Energy Conservation Act. The fourth progress report[1] covering the two year period 2003-2005, gave a total expenditure of £471.6m, equivalent to £235.8m per annum. This included local authority programmes, Warm Deal and some expenditure from other sources including Housing Associations and from EEC.

However some caution is required in using the expenditure figure given in the HECA progress report as it is a compilation of the reports from Scotland's 32 local authorities. The quality of these HECA reports varies considerably as does the robustness of the information they contain.

© Ecoliving

It is also possible to look at the budgets for specific funding programmes as set out in the table below:

Figure 5.1
Expenditure on existing programmes in Scotland

Funding stream for what purpose	Funding source	Managed by	Total funding	Estimate of portion going to existing homes / annum
Energy advice through Energy Saving Scotland advice centres	Scottish Government	EST	£3.1m	About £2m
Warm Deal and Central Heating Programme (to tackle fuel poverty)	Scottish Government	Scottish Gas	£45.9m	£45.9m
EEC / CERT	Energy Suppliers	Energy Suppliers	No figures for Scotland	£80m (assuming pro rata of UK)[2]
Scottish Community and Household Renewables Initiative	Scottish Government	EST and Highland and Island Enterprise	£13.5m	£3.5m to householders[3] (£5.25m to community schemes)

1. Scottish Government (2007c) Fourth HECA Progress Report for the Scottish Parliament 2007
2. Scottish Government (2008a) Review of Energy Efficiency and Microgeneration Support in Scotland. At time of going to print additional funding for CERT had been agreed by the UK government. It is unknown what this will mean for Scotland.
3. Scottish Government Press Release 19/03/08

Householders are a significant source of expenditure on improvements to existing housing. The Scottish House Condition Survey 2002[1] reported that approximately one million households (48%) had carried out work of some kind to their dwellings in the twelve months prior to the SHCS fieldwork. This amounted to some £1.9bn of expenditure on home repairs and improvements excluding decorating. Householders had paid for 1.5 million of the 2.2 million total jobs carried out. Work to heating and insulation is the most common job category undertaken (28% of households), with central heating servicing accounting for an expenditure of £172m.

It has not proved possible to combine the figures from these various sources of information in any meaningful way as there are clear overlaps and the data cover different time periods. It is perhaps a mark of the lack of policy on existing homes and carbon emissions that there is an absence of any official source on current total expenditure on energy efficiency and microgeneration technologies in existing housing. The focus of policy to date has been on other important objectives such fuel poverty, improving energy efficiency standards in new housing and implementation of the Scottish Housing Quality Standard in social housing. However, now it is necessary for the Scottish Government to carry out a full audit of expenditure to inform its future policy on cutting carbon emissions in the residential sector.

Costs of the proposed programme of energy efficiency and microgeneration improvements

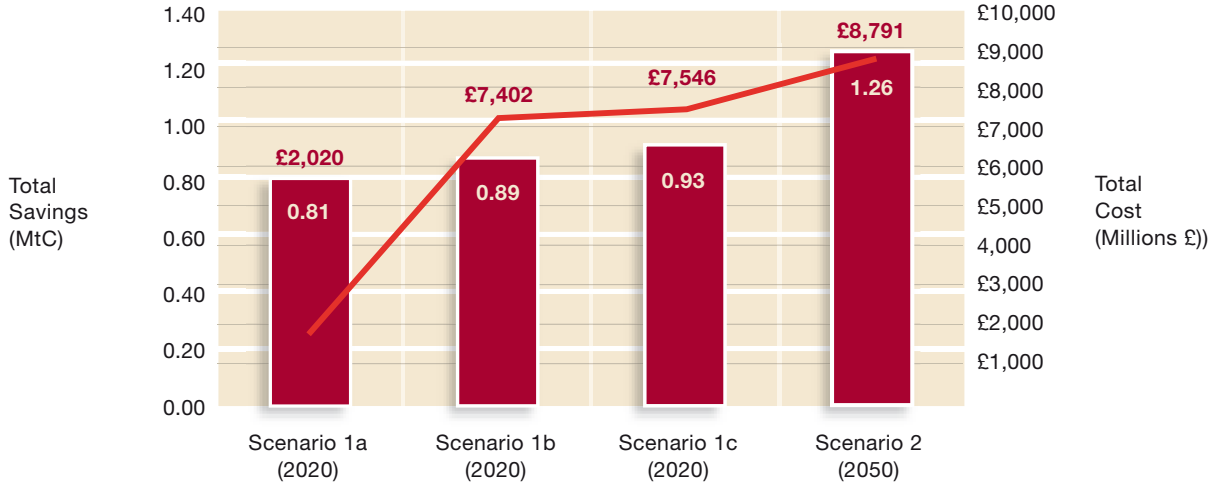
In Chapter 3, the potential for carbon reductions was illustrated through a number of scenarios. In Figure 5.2 below, the estimated costs of achieving various levels of carbon reduction in terms of total cost and cost per tonne of carbon emissions saved are given for the following four scenarios:

- Scenario 1a (2020) – Market potential (currently 'cost-effective' measures)
- Scenario 1b (2020) – Economic potential (measures that meet 3.5% discount rate)
- Scenario 1c (2020) – Shadow potential (including the shadow social cost of carbon)
- Scenario 2a (2050) – Technical potential (applying all measures)

(See Chapter 3 for full description of scenarios)

The costs per tonne of carbon saved increase across the four scenarios in line with the level of ambition they represent. The costs represented here are for physical energy efficiency improvements and the installation of microgeneration technologies in properties and excludes district heating and CHP. To ultimately achieve the 80% reduction target by 2050, additional investment will be required to decarbonise energy supply which will add to the costs for Scenario 2 as set out here.

Figure 5.2
Comparative costs of carbon reductions in different scenarios, residential sector, Scotland



1. SHCS (2002A) Scottish House Condition Survey 2002

© Ken Slater

Figure 5.3 sets out costs against economic benefits (in terms of Gross Value Added, savings on fuel bills and the value of carbon savings) showing that scenarios 1b, 1c and 2 all deliver a substantial net economic benefit to Scotland of about £2.5bn, if somewhat less than the 'market potential' Scenario 1a. The costs shown here are based on a large programme of activity and, as such, include some economies of scale.

These figures demonstrate that there is the potential to strengthen Scotland's economy through a retrofit strategy and deliver an 80% cut in residential sector emissions.

The Funding Gap

Modelled expenditure to reduce the emissions as shown in Scenario 1c, Figure 5.3, which would be sufficient to achieve a 31% reduction by 2020 and set Scotland on the necessary trajectory to achieve 80% reduction by 2050 is estimated to require an average £542m per year on physical measures to properties (over the period 2004-2020). Part of this expenditure would be covered by money already committed to existing programmes as detailed above.

Extra financial support would be needed for:

- up-front costs of District Heating/ CHP schemes developed by local authorities (assuming support for one new scheme per year at £1m)
- enhancing the advice and support services provided by EST and the Advice Centres (assuming an extra £2m per annum)
- development and administration of Low Carbon Zones (assuming all local authorities have one zone in development at any time at £0.5m per Local Authority gives £15m per annum)
- the provision of a revolving loan fund and enhanced grant support for fuel poor (assuming underwriting costs for the loan fund of £5m per annum and extra

Figure 5.3
Modelled costs and benefits of energy efficiency improvements

Scenario	Scenario 1a (2020)	Scenario 1b (2020)	Scenario 1c (2020)	Scenario 2 (2050)
Modelled Savings (MtC)	0.81	0.89	0.93	1.26
COSTS				
Total costs (£m)	£1,638	£6,560	£7,043	£11,066
Average annual expenditure (£m)	£126	£505	£542	£242
BENEFITS				
GVA (£m)	£451	£1,949	£2,118	£3,328
Fuel saving 2006 (£m)	£476	£340	£357	£483
Lifetime fuel savings (£m)	£9,521	£6,812	£7,153	£9,675
Value of Carbon Shadow (£m)	£405	£444	£466	£631
Total Benefit - (£m)	£10,378	£9,206	£9,739	£13,636
Net Benefit (£m)	£8,740	£2,646	£2,695	£2,569

grants including CERT of £20m)

- contributing to further development and administration of HEED (assuming an extra £0.5m /annum)

This indicates additional costs in the region £43.5m for this extra financial support.

With the information currently available it is not possible to give a firm figure for the funding gap but it would appear likely that at least a doubling of current expenditure will be needed. As was demonstrated by the Stern Review, the key message is that increased investment is required now; delay will only raise the costs of cutting back emissions.

The potential sources for filling the funding gap are to increase investment by:

- home owners;
- private landlords;
- energy suppliers;
- Scottish Government and local authorities.

Home owners

Householders in general and homeowners in particular represent the biggest potential source for the increased expenditure required to implement the retrofit strategy. Since the Scottish House Condition Survey last published data on householder expenditure there has been a dramatic hike in fuel prices which has transformed the price messages to consumers providing a much stronger incentive to invest in energy efficiency measures. Given this change, it could be anticipated that there is a bigger potential for homeowners to invest in improving the energy performance of their homes.

For illustrative purposes if we take the total number of non-fuel poor homeowners in Scotland (approximately 1,123,000) and their total average fuel bill in 2007-08 (£882)[1] and then assume that they could be persuaded to spend on measures that would save 30% of their fuel bill and would pay back in three years. This would deliver a potential investment pot of £891m. If the payback period is increased to five years then the potential investment pot would grow to £1,485m.

While it would be unrealistic to expect all of these householders would invest in energy efficiency measures at this level, this calculation does give an indication of the scale of the potential pot. This source would also be drawn on over a period of time i.e. this is not the annual theoretical potential from householders. However, it is reasonable to assume that householders could make this order of investment several times over the 40-year duration of the strategy. Householders who currently use oil as opposed to gas have an even stronger incentive to invest as heating oil prices have risen more steeply than other fuels.

We know that price signals are insufficient on their own to induce householder investment, particularly at the rate required. So the retrofit strategy should include a range of incentives to lever in this investment. These should include the following:

- green mortgages linked to EPC ratings (see Chapter 3);
- low-interest loans – these have been used to great effect in Germany for example but to date only a few local authority schemes exist in Scotland. The recent Review of Energy Efficiency and Microgeneration Support in Scotland (2008) found that provision of low-interest loans was a far more cost-effective approach than direct grants and subsidies;
- feed-in tariffs for electricity and heat produced by microgeneration technologies installed in homes have been shown to be highly effective in other countries such Germany and Spain in stimulating the market for these technologies in the residential sector;
- tax incentives, such as local tax rebates for householders installing measures or improving homes to a given standard;
- regulations such as a requirement to have properties meeting a basic energy efficiency standard before they are sold, rented or extended (see Chapter 3).

Private Landlords

In many instances home owners have become landlords during the 'buy to let' boom of the last fifteen years and many of the same measures can be used to stimulate their investment in measures to improve the energy performance of their properties. In particular:

- an enhanced EPC regulation that requires them to bring their properties up to a basic energy performance standard before they can be let;
- the provision of low interest loans to make improvements;
- the promotion of the Landlords Energy Saving Allowance (LESA) (which provides a tax free allowance of £1,500 for investment in energy efficiency measures)

1. Average standard credit gas and electricity bills 2007-08 for Scotland taken from BERR (2008) Quarterly Energy Price Tables

alongside other incentives such as Enhanced Capital Allowances and CERT.

Energy Suppliers

It is estimated that Energy Suppliers could be making an annual investment of around £80m through CERT in Scotland[1] and this needs to be maintained or indeed increased in the future and any subsequent form of supplier obligation. The implementation of many of the mechanisms described in Chapter 4 would create a more favourable environment to attract increased CERT investment as suppliers could expect to achieve a high level of carbon savings for each pound invested.

In addition the international experience suggests that feed-in tariffs for both electricity from microgeneration technologies and heat from a range of low carbon technologies including solar water heating, heat pumps, micro-CHP, District Heating and large scale CHP would be a powerful mechanism to stimulate the take-up and installation of these measures. A recent report by Element Energy[2] suggested feed-in tariffs of over 40p/kWh for renewable electric technologies such as wind and PV, over 5p/kWh for micro-CHP derived electricity and over 2p/kWh for heat technologies.

Scottish Government and Local Government

It has been shown above that there are substantial economic benefits flowing from the proposed retrofit strategy and so there is a powerful argument for both Scottish Government and local government to increase budgets for improving the housing stock. Given the potential contribution from the other players already discussed, this need not be a great increase and could be achieved through refocusing of existing budgets on outcomes that would help to deliver the 80% emissions reduction target. This should include:

- support for the upfront costs for district heating / CHP schemes;
- underwriting a soft loan scheme for homeowners;
- enhanced advice provision by the EST.

As set out in Chapter 6, this will require the Scottish Government to work with local government in the context of indicators already in place as part of the Single Outcome Agreement. In the longer term, it would be desirable to include a specific performance indicator on carbon emissions reductions from housing to focus local government investment into appropriate measures to drive down emissions in the residential sector.

Capacity, skills and employment

There is a picture of fragmentation and lack of coordination of training for domestic energy efficiency. A report for the Energy Efficiency Partnership for Homes[3] stated that:

> **"In each sector of the economy there needs to be a driver to identify and deliver the skills that employers need to raise productivity to internationally competitive levels. The new Sector Skills Councils are leading that drive through the Skills for Business Network. However, a Sector Skills Council with responsibility for energy efficiency does not exist, nor is one planned for the future. The interests of those people engaged in occupations involving domestic energy efficiency are, in fact, covered by eight licensed SSCs and a further three aspirant SSCs. This fact, and the fact that energy efficiency forms only a part of the function of many occupations, means that energy efficiency does not always get the attention that it needs."**

A similar fragmented approach is evident in small-scale renewables with five Sector Skills Councils covering the range of domestic-scale technologies.

Scotland has devolved responsibilities that include education, enterprise, skills development and lifelong learning but the newly formed UK Commission on Employment and Skills and the individual Sector Skills Councils have been set up on a UK-wide basis.

1. At time of going to print the UK government announced a three-year enhancement to CERT. It is unknown what this will mean for Scotland.
2. Element Energy (2008) The Growth Potential for Microgeneration in England, Wales and Scotland
3. DG Associates (2005) A review of skills and training for domestic energy efficiency

Insulation sector

A report for DEFRA[1] reviewing the UK insulation sector supply chain assessed the capacity of the industry to meet various targets (1.7–3.4 million installations) for cavity wall and loft insulation in the 2008-11 period linked to EEC. The report concluded that:

> **"...all of those spoken to, from all areas of the supply chain, emphasised that given sufficient lead time and commitment from government, there was the will and ability to expand operations to meet higher targets."**

But this conclusion came with a health warning:

> **"Of key importance, for an industry sub-sector so reliant on government programmes, are clear, consistent and timely signals from government about future targets and carry-over rules to allow expansion to take place."**

The domestic insulation sector in Scotland is highly reliant on the Scottish Government's Warm Deal and Central Heating Programme programmes and CERT for its survival. This has led to a very uncertain situation in the last two years with smaller companies going out of business as a result of the utility companies achieving their annual targets and the tendering and delivery of the Scottish Government's fuel poverty programmes. The stop/start nature of the schemes has had a very negative impact on the insulation industry which has struggled to survive. There are currently only 12 companies working on the Warm Deal and Central Heating Programme in Scotland compared with 19 companies three years ago. Energy Action Scotland calculated that there have been around 200 jobs lost in this industry in the last three years. There are now concerns about the impact of the transition from EEC to Carbon Emission Reduction Target (CERT).

The skill levels vary for different forms of insulation from 'high' for solid wall insulation (internal and external) to medium (cavity wall insulation, roof and floor insulation) to low (loft insulation and draught proofing)[2]. The insulation industry has to compete with the building industry for workers. For external wall insulation companies, undertaking a more complex and skilled activity, this competition is an important factor in their ability to maintain and increase capacity. The lack of job security resulting from the stop/start nature of the grant schemes makes it very difficult to recruit and retain skilled installers. The current downturn in house building has mitigated some of these issues but this may only be a temporary blip.

Central heating installers

It has been reported that the average age of a central heating engineer is 54 demonstrating the fact that there is a need to recruit significant numbers of younger people into the industry. It takes around two years to train a central heating engineer to HND level of competency and this type of occupation has traditionally been attractive to people who do not want to follow an academic route.

In 2002, there were 109,000[3] households in Scotland with no central heating and with most central heating boilers having an expected life of around 15 years, it can be anticipated that the implementation of this retrofit strategy will require a significant increase in the numbers of central heating engineers being trained. In addition, existing engineers will need re-training to carry out installation of new technologies such as Micro-CHP.

Renewables industry

Scottish Renewables, the trade association for the renewables industry in Scotland, recently launched its first careers brochure in an effort to encourage graduates to pursue careers in the renewable energy industry. An unpublished survey of Scottish renewables members found that recruitment is the third most significant barrier to future growth in the industry, behind planning issues and access to the electricity grid.

To take the example of one renewable technology area, biomass, it is possible to see some of the generic problems facing the whole renewable industry. The following assessment was made for one of the Sector Skills Councils. There is limited current capacity in the UK to produce wood chips and pellets though there is a new plant in

1. ESD (2006) Review of UK insulation sector supply chain
2. MBD (2007) Residential Energy Efficiency Report Jan 2007
3. SHCS (2002b) Fuel Poverty in Scotland

Scotland. Much of the currently-available equipment is manufactured in Scandinavia and Austria. There are many lessons to be learnt from countries such as Austria where government assistance in the early stages has now created a sustainable industry. But in the UK, there is a low level of awareness amongst architects and limited accreditation systems for installers.[1]

In a workshop, convened as part of the research for this report, it was also highlighted that there are problems in finding skilled engineers for maintaining some of the newer technologies e.g. biomass District Heating. This has a knock-on effect on the reputation of technologies as they can become associated with unreliability. This is of particular importance in local authorities and housing associations where system failures with a particular technology can lead to it being ruled out of the frame for future improvement programmes.

Other skills gaps

The recent Communities and Local Government Committee report into Existing Housing and Climate Change (April 2008)[2] reported that:

> **"Several witnesses to our inquiry have identified significant skills gaps that will act as barriers to market spread unless skills develop."**

In particular they pointed to unfilled posts in planning and building control departments at local authorities and difficulty of finding trained engineers.

The employment opportunities

According to *The Path is Green Report* by Careers Scotland, there are currently around 80,000 'green jobs' in Scotland but this is expected to increase by 50,000 in the next 15 to 20 years if Scotland is to meet the target of meeting 50% of its electricity generation from renewable sources by 2020. In the same report, it is estimated that Scotland's natural resources are already worth £17bn per annum to the economy.

While it has not been possible to carry out a detailed analysis it has been estimated that delivering scenario 1b or 1 c in Scotland by 2020 would increase jobs directly related to installing retrofit measures by five fold from around 1,000 to 5,000.

Key points for the retrofit strategy

Funding

- There is no official source of information on Scotland's current expenditure on energy efficiency and microgeneration technologies in existing homes, a situation that needs to be rectified.
- It is likely that at least a doubling of current investment is needed for carbon reduction measures in existing homes in order to put Scotland on track to deliver an 80% reduction in emissions by 2050 in the residential sector, with further investment needed to decarbonise energy supply.
- The SHCS data show that householder expenditure on home improvements is very substantial. High fuel price rises are providing a very strong price incentive for owner-occupiers to invest in energy efficiency but experience shows this is not enough on its own. With some additional incentives, householders could provide the largest part of the additional investment required.
- Energy suppliers should provide additional investment through feed-in tariffs for renewable electricity and low carbon heat. The regressive impacts of feed-in-tariffs on the fuel poor need to be counteracted by prioritising fuel poor households for improvements.
- The broader benefits to Scotland's economy provide justification for the Scottish Government and local authorities directing more investment to deliver better energy performance standards in existing housing.

Capacity, skills and employment

- Provided there are unambiguous policy signals from the Scottish Government, in tandem with good management of programmes (to avoid stop-go), the insulation industry should be able to respond to the increased level of installations required for the strategy.
- There are real concerns about the numbers of skilled central heating and renewable energy engineers being trained and re-trained. There is a lag time of several years, between a decision to increase numbers on training courses to having trained staff ready to go into the field and this requirement needs to be built into the retrofit strategy.
- Attention is also needed to ensure there are sufficient numbers of building control officers and local authority planners familiar with the low carbon agenda.

1. Adams C. (2007) Occupational and Functional Map of the Renewable Energy Sector
2. House of Commons Communities and Local Government Committee (2008) Existing Housing and Climate Change

Chapter 6
Policy to promote an integrated retrofit strategy

In this chapter, we set out what we consider to be the necessary policy changes that might be required to promote an integrated strategy. The main focus is on the role of the Scottish Government but inevitably some matters that need to be addressed are reserved powers and consequently require action by the UK Government. This is followed by a discussion of who should be charged with driving forward an integrated strategy. The main message is that the Scottish Government needs to provide unambiguous leadership, setting out progressive targets for improvement of the energy performance of existing housing. An overall objective for the Scottish Government should be to make it simple and easy for home owners and landlords to improve the energy performance of the housing stock.

Policy recommendations

Residential emissions targets

Targets are a signal of intent and direction and specific emissions targets should be set out for existing housing to sit alongside the proposed 2016 zero carbon target for all new housing. With the overall 80% emission reduction target for the whole Scottish economy, it will be necessary to set out a specific residential sector target with intermediate targets along the way to ensure adequate progress is being made in improving the housing stock. It will also be more meaningful if these targets are expressed both as percentage reductions from the 1990 baseline and in absolute amounts of carbon emissions saved so there is no ambiguity in what is expected[1]. These targets should appear in all relevant Scottish Government policy documents and be linked to minimum energy performance standards for existing housing set by the Scottish Housing Quality Standard for new housing and house extensions set by the Building Standards (see below).

It is recommended that the Scottish Government establishes progressive targets for reduction of emissions from existing housing up to 2050 from a 1990 baseline.

The following targets are suggested; those for 2010 and 2016 relate to the UK Energy Efficiency Action Plan:

- **1990** baseline of residential emissions of 3.92 MtC
- **2010** 11% cut reducing residential emissions by 0.43 MtC to 3.49 MtC
- **2016** 22% cut reducing residential emissions by 0.86 MtC to 3.06 MtC
- **2020** 35% cut reducing residential emissions by 1.22 MtC to 2.5 MtC
- **2050** 80% cut reducing residential emissions by 3.14 MtC to 0.78 MtC

The Home Energy Conservation Act and the National Performance Framework

The Home Energy Conservation Act (HECA) was introduced in the UK Parliament in 1995. It has never been properly resourced so its impact has been variable, depending on the success of local authorities in securing funding from a wide variety of sources. HECA imposes a bi-annual reporting requirement on all Scottish local authorities. They must set out a strategy showing how they are progressing towards their agreed target for improving the energy efficiency of the housing stock in their area. It also requires the reporting of estimates of carbon dioxide emissions from the housing stock.

Despite its many limitations, HECA has provided a policy focus for energy efficiency improvements of the existing housing stock and has resulted in most local authorities having a 'HECA officer'. DEFRA has recently consulted on the future of HECA in England and it is likely that HECA will be repealed. This position has been justified by the fact the Performance Management Framework for England includes performance indicators on per capita reduction in CO_2 reductions in the local authority area and tackling fuel poverty.[1] However, as one of many indicators, there are concerns that there will be inadequate attention to a challenging retrofit agenda. For Scotland, it is possible to keep HECA in some form even if Westminster decides to repeal the Act for England.

1. These targets will need to take into account, and correct for, changes to the carbon content of electricity supplied to the residential sector.

It is recommended that HECA should be retained in Scotland, properly resourced, with a clear focus on carbon emission reduction and eliminating fuel poverty and with more rigorous reporting systems. These systems should be linked to the development of the HEED database.

As of 2008, the Scottish Government signs a Single Outcome Agreements (SOA) with every local council, based on an agreed set of outcomes based on Scotland's National Performance Framework. Unlike its English equivalent, it is much less specific about local authorities delivering CO_2 reductions, however it includes:

- a 'purpose target' on sustainability to reduce emissions over the period to 2011 and to reduce emissions by 80% by 2050;
- a 'national outcome' – We reduce the local and global environmental impact of our consumption and production'; and
- 'National indicators and targets' 32. Reduce overall ecological footprint and 38. 50% of electricity generated in Scotland to come from renewable sources by 2020 (interim target of 31% by 2011).

It is recognised that the Scottish Government is seeking to have a 'lighter touch' relationship with local government but in the longer term the National Performance Framework needs a more specific measure related to the energy performance of the housing stock and resulting emissions. All of Scotland's local authorities have also signed up to the Scottish Climate Change Declaration which includes the commitments on greenhouse gas reduction measures and to work with the local community to reduce emissions following commitments:

- It is recommended that the Scottish Government should work with local authorities to reduce residential carbon emissions in the context of the Single Outcome Agreement and the Scottish Climate Change Declaration. In the longer term, in negotiation with COSLA, a specific national indicator on the energy performance of the housing stock and associated carbon emissions that is linked to progressive national targets for residential emissions should be established.

Energy performance standards for existing housing

In 2007, the Sullivan report, *A Low Carbon Building Standards Strategy for Scotland*, was published. This made only brief comment on existing housing but included a specific recommendation that there should be 'Consideration of developing practical performance standards for existing buildings (aligned with the energy performance certificates)'[1]. Establishing minimum energy efficiency standards for the existing stock is an essential element of this strategy. In Chapter 4, we have

1. DEFRA (2007) Consultation on the Review of the Home Energy Conservation Act 1995 (HECA)
2. Scottish Government and COSLA (2007) Concordat

© ISTOCK

already discussed the potential use of an enhanced Energy Performance Certificate regulation that would require home owners to meet a specific standard (on the EPC scale) before they could sell, rent or extend a property.

- It is recommended that the Scottish Government implements the Sullivan Report proposal that primary legislation is sought to allow Scottish Ministers the opportunity to extend the provision and type of Energy Performance Certificates.

Having established this competence, this would then enable the Scottish Government to take the next step and actively use the Scottish Housing Quality Standard as an instrument to drive up the energy performance of the entire housing stock.

- It is recommended that the Scottish Government establishes minimum energy efficiency performance standards (related to the EPC scale) for existing housing to be applied through a revised SHQS. It should be signalled in advance that these performance standards will be progressively raised.

Establishing a set of progressively improving standards against a clear timetable is necessary to allow the insulation, central heating and microgeneration technologies energy industries to plan for expanding their capacity. This measure should be linked to the following regulation:

- It is recommended that the Scottish Government requires any domestic property owner to meet the minimum energy efficiency performance standard before they can sell, rent or extend a home[2]. This measure needs to be backed by a comprehensive support package of advice, low-interest loans for better-off home owners and with grants for low-income home owners to be administered by the EST.

It should also be recognised that the ramping-up of Building Standards requirements on energy efficiency and on-site renewable energy for new housing will have a positive impact in preparing the manufacturers and installers for the expansion of their markets that would be generated by this strategy to improve existing housing. The effect will be to stimulate the market transformation that will be required for this strategy to be successful. This argues for a rapid improvement of the Building Standards for new build to pave the way for improved standards in existing housing. This will include the commercialisation of new technologies such as fuel cell micro-CHP and development of fuel supply chains for domestic biomass boilers and community biomass CHP.

Financial incentives

A key theme of this report is that financial support for home owners and landlords needs to be readily available and easy to obtain. To this end, it is suggested that the Scottish Government:

- seeks to rationalise and simplify the current financial support regimes for energy efficiency measures and microgeneration technologies;
- works with the financial institutions to establish a substantial revolving loan fund that is available to home owners and landlords for measures to improve the energy performance of the housing stock at very favourable rates of interest. This would require the Scottish Government to underwrite the loan fund;
- encourages mortgage providers to expand the availability of 'green mortgages' that help finance improvements to the energy performance of homes;
- ensures there is no regulatory constraint to home owners who make improvements to their homes receiving council tax rebates as a reward;
- at the earliest opportunity, works with the Energy Saving Trust to establish a simple single application for home owners seeking financial support (for grants, loans or rebates) for improvements to their homes;
- promotes the Landlord Energy Saving Allowance to all private sector landlords;
- working through the already established CERT strategy group, should seek to create a good environment for increased CERT investment by suppliers by implementing mechanisms such as Low Carbon Zones.

1. Scottish Building Standard Agency (2007) Low Carbon Building Standards Strategy for Scotland
2. Extensions to properties would be under the governance of the Building (Scotland) Act 2003 and covered by the Building Standard – so in the future there will need to be a linkage between the energy performance required by the Building Standards and SHQS.

Energy Utility Regulation

This is a reserved power but there are a number of matters where the Scottish Government should be seeking to influence the UK Government's decisions on the future direction of Energy Utility Regulation to support the implementation of a retrofit strategy for existing housing:

- the introduction of a financial support mechanism for heat from low-carbon sources (e.g. CHP and District Heating) and zero carbon microgeneration technologies (e.g. solar water heating);
- the introduction of a simple feed-in tariff for electricity generated by home-owners who have microgeneration technologies installed in their homes. Feed-in tariffs have been successfully employed in Germany to support the expansion of the use of PV technologies by German homeowners;
- the UK Government needs to give a clear mandate to the energy supply industry for the rapid roll out of smart metering[1]. If the smart meter also includes consumer displays they can provide better information to consumers about their energy consumption. Smart meters also enable energy suppliers to more effectively manage generating technologies and reward consumers for investment in microgeneration technologies. It is a stated aim of the UK Government that every household should have a smart meter within ten years but progress to date has been very slow because of the lack of direction being provided by government.

VAT and domestic appliance standards

These two matters are determined through negotiation by the UK Government within the EU. It is a necessary part of this strategy outlined in this report that the Scottish Government should seek to influence decisions on the following the matters:

© Aberdeen City Council

- there is a current anomaly in the way that VAT is charged that makes it more financially attractive to demolish homes than to refurbish them to a high environmental standard. This anomaly needs to be removed;
- press for a zero VAT rate on all insulation products;
- support should be given to the rapid raising of mandatory domestic appliance standards through the Framework Directive for the Eco-design of Energy Using Products. A rapid and progressive raising of appliance energy standards is essential if an 80% reduction in residential carbon emissions is to be achieved.

Who leads?

The integrated strategy outlined in this report would represent a very significant investment in Scotland's housing with a big impact on the lives of most Scots as well as being the most significant part of Scotland's carbon reduction policy. As such it is appropriate that it should be led from the Scottish Government at cabinet level. This would mean the Cabinet Secretary for Health and Well Being (whose responsibilities include housing and regeneration) while recognising that the cabinet has a collective commitment to addressing the challenge of climate change.

The Scottish Government will need to work in partnership with the key players which include: local authorities, housing associations, private landlords, energy suppliers, the insulation, central heating and microgeneration technologies industries, and key agencies such as the EST. The potential roles of these partners are set out in Figure 6.1. On the whole, these roles are not significantly different to what currently pertains. The main distinction is that:

- the EST leads on persuading home owners to 'opt in' and improve the stock by marketing and a 'single gateway' to advice and financial support;
- whereas the local authorities working with Housing Associations would focus on the systematic implementation of area-based schemes where home owners will only be able to 'opt out' in special circumstances. This will also require support from the Energy Saving Scotland Advice Centres. COSLA will also have an important role as the interface of local authorities with the Scottish Government and supporting councils in their delivery through running training workshops, providing written advice, guidance and information for local authorities.

1. A decision on a mandate for England, Scotland and Wales expected in Dec 2008.

Feedback

Any effective strategy needs to include mechanisms for monitoring and review. As shown in Figure 6.1, the main mechanism for monitoring the impact of the programme would be data collected through HEED. Emphasis will need to be given to monitoring:

- whether programmes and measures are delivering the desired level of actual emissions reductions;
- and whether installation rates are at an appropriate level.

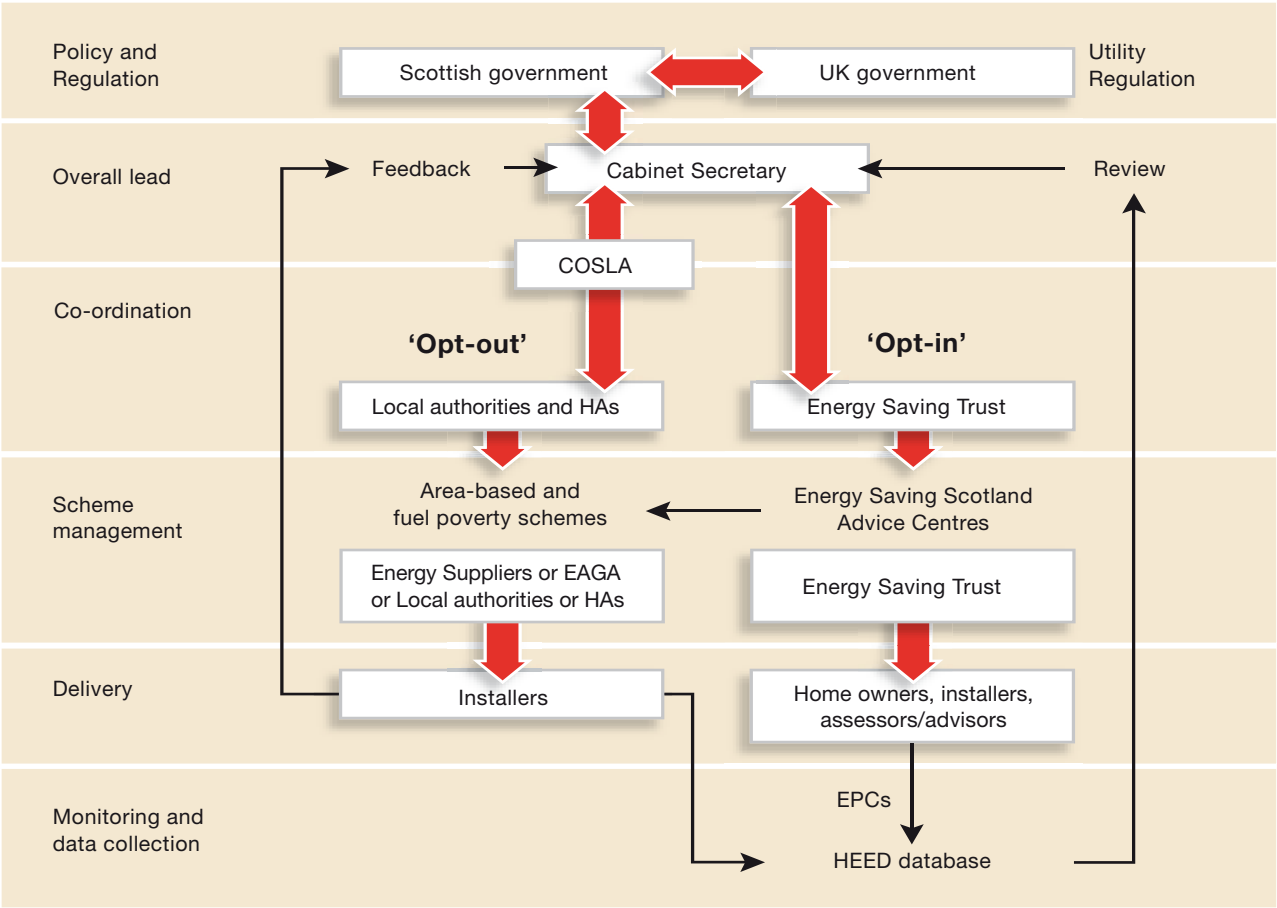
Installers should be represented on the CERT Strategy Group and Fuel Poverty Forum. It is most often those at the delivery end that can see what small changes are needed to improve effectiveness. In the past, programmes have been compromised by 'stop/start' flows of funding (see Chapter 5) and other management failures. For this retrofit strategy to succeed, it is essential that any problems with funding and delivery are sorted as quickly as possible.

Key points for retrofit strategy

Policy recommendations

- Establish residential emission targets for existing housing up to 2050, with interim targets at 2010, 2016 and 2020.
- Give local authorities clear responsibility for reducing emissions in the housing sector and eradicating fuel poverty through Single Outcome Agreements and the Home Energy Conservation Act.
- Establish minimum energy performance standards for existing housing
- Make financial incentives for homeowners and landlords readily available and easy to obtain.
- Influence UK Government's decisions on the future direction of Energy Utility Regulation to support a retrofit strategy for existing housing
- Lead from the cabinet level, working with local authorities on 'opt out' and EST on 'opt in' strategies
- Ensure regular feedback through HEED database, CERT Strategy Group and Fuel Poverty Forum to assess progress.

Figure 6.1
Who does what?



Conclusion

This report makes the case for a Scottish Government retrofit strategy to deliver low carbon homes in Scotland, focusing on the existing housing stock. Home energy use accounts for nearly one-third of Scotland's CO_2 emissions. This report demonstrates how a retrofit strategy could deliver emissions reductions from the existing stock by 80% by 2050 and 35% by 2020.

To be successful, the strategy must include a complete package of measures on delivery, funding and capacity, and policies to promote emissions reduction combined with strong leadership from government. The package will go far beyond the government's current approach which relies on the voluntary uptake of short payback energy efficiency measures. In addition to basic insulation measures, a radical uplift in installations of measures such as solid wall insulation and microgeneration technologies is required. Finally, the strategy must apply to all Scottish homes.

Implementation of this strategy will require approximately a doubling of current investment for energy efficiency – between £500-600 million per year. Given the right balance of standards, regulation and incentives, it is suggested that a significant portion of this investment could be levered in from private householders. This strategy would also make Scotland a more attractive environment for CERT through the area-based approach, thus attracting more funding from the private sector. Jobs related to retrofit could increase five-fold by 2020 given this level of investment. The broader benefits to Scotland's economy provide justification for the Scottish Government directing more investment to deliver better energy performance standards in existing housing.

The integrated strategy outlined in this report would represent a very significant investment in Scotland's housing with a big impact on the lives of most Scots as well as being the most significant part of Scotland's carbon reduction policy.

The key components of a retrofit strategy should be:

- Residential emissions targets
- Minimum energy efficiency standards at point of sale, rent or extension
- Financial support package based on need
- Area based 'low carbon zones'
- Increased support for Community Heating schemes
- Balance trading - ensure new developments do not add to an area's carbon footprint by investing in retrofit of existing homes
- Single gateway for advice – Energy Savings Trust
- Effective monitoring and review

Early gains in emissions reductions can be achieved while at the same time addressing concerns of fuel poverty and health, and growing a new retrofit industry. It is clear that we must act now if we are to meet the 2050 target and avoid the worst damages of climate change – to humans and wildlife. It will require strong policies and financial support, sending an unequivocal message that all homes can and must be low carbon, warm and healthy. The level of investment required is minimal compared to the cost of doing nothing and delaying action will only add to costs. The Stern Review[1] estimated the cost to the economy of mitigating the harmful impacts of climate change to be 10 times that of acting now.

The main message is that the Scottish Government needs to provide unambiguous leadership, setting out progressive targets for improvement of the energy performance of existing housing – 35% emissions reduction by 2020 and 80% by 2050. Put simply, the Scottish Government should make it simple and easy for home owners and landlords to improve the energy performance of the housing stock and to do so with urgency.

1. Stern, N. *The Economics of climate Change: The Stern Review* (2007)

Glossary

Combined Heat and Power (CHP)

When energy is generated using conventional generation technology most of the energy in the fuel is lost waste heat. Combined Heat and Power systems recover this waste heat which can then be used for district heating in conjunction with centralised boilers.

District Heating (sometimes called Community Heating)

When heat is supplied on a community scale from centralised boiler plant or CHP plant (see above) via a district heat network of pipes to homes, businesses and community buildings.

Energy Performance Certificates (EPCs)

Energy Performance Certificates tell you how energy efficient a home is on a scale of A-G. The most efficient homes - which should have the lowest fuel bills - are in band A. The Certificate also tells you, on a scale of A-G, about the impact the home has on the environment. Better-rated homes should have less impact through carbon dioxide (CO_2) emissions. The calculation methodology used is SAP 2005, this is simplified for existing dwellings by using Reduced Data SAP.

Microgeneration

A general term for small-scale technologies employed at a building level that produce electricity and/or heat. It is term that includes technologies using conventional fuels such as gas as well as micro-renewable technologies such photovoltaic arrays.

National Home Energy Rating scheme (NHER) (compare with SAP)

NHER calculates the energy efficiency of the house on a scale of 0 to 10, with 0 being the least efficient and 10 being the most efficient. NHER calculates all fuel use and takes into account the geographic location of the home unlike SAP. Since 2007, NHER is calculated on a scale of 0 to 20. For more information visit: http://www.nher.co.uk/

Standard Assessment Procedure (SAP) (compare with NHER)

SAP measures the energy efficiency of the house on a scale from 1 to 120, with one being the least efficient and 120 being the most efficient. SAP assumes the location of each house is the same unlike NHER. It only calculates space and water heating, not all fuel use. Since 2005, SAP is calculated on a scale of 1 to 100 and now includes energy required for lighting. For more information visit:

http://projects.bre.co.uk/sap2005

Annex 1 Calculating a baseline for Scotland

Establishing a 2004 distribution of emissions

The energy improvement model used in the *How low?* report quantifies the overall reduction in energy need associated with a modelled scenario by fuel type. In reality modelled energy need is always higher than actual consumption. The proportional change must therefore be applied to actual energy usage before the reduction in emissions can be calculated. The model uses regional energy statistics published by BERR[1] to quantify energy demand.

The total energy use figures published by BERR can be converted to carbon emissions using the appropriate DEFRA emission factors. However, the final totals for carbon emissions do not agree with those published by DEFRA[2] i.e. 41.7 MtC for the UK residential sector. The figures produced by AEA Technology for DEFRA use a different methodology for the apportionment of energy consumption to non-domestic small scale users. The baseline of emissions in 2004 used in the study is therefore based upon the distribution of emissions associated with BERR's consumption data which is then inflated by a factor of 3.98% for all areas.

The methodology used by AEA Technology to calculate carbon emissions for DEFRA has been changed recently. The 2005 DEFRA local area emissions statistics are used as a baseline for local authorities in England and Wales to report their progress against National Performance Indicator 186. Further guidance from DEFRA and BERR

Table 1
1990 and 2004 baseline of residential carbon emissions (MtC)

	1990 Emissions	2004 Emissions	Proportion
UK	42.4	41.70	
England	35.48	34.89	83.7%
Wales	2.21	2.17	5.2%
Scotland	3.92	3.86	9.3%
Northern Ireland	0.79	0.77	1.9%

1. http://www.berr.gov.uk/energy/statistics/regional/index.html
2. http://www.defra.gov.uk/environment/climatechange/uk/ukccp/index.htm

regarding the best method of rationalising changes in the methodology for the production of emissions statistics would help nations, regions and local authorities report progress.

Establishing a 1990 baseline

The 1990 baseline of emissions used in *How low?* of 42.2 MtC are based on the UK's Kyoto targets. In order to obtain a breakdown of emissions by fuel type and nation the study has estimated 1990 emissions based on their distribution in 2004 i.e. the proportional distribution of emissions in 1990 are similar to those experienced in 2004. Table 1 shows Scotland's emissions in 1990 as 3.92 MtC based on the UK's distribution of emissions in 2004. This is the baseline that has been used in this report.

The assumption relies on the residential sector in each nation experiencing relatively similar changes in income, efficiency, housing growth, fuel use and demographics. In reality each nation is likely to have experienced different rates of growth and decline in each area; however, each nation has been subject to broadly similar changes to economic growth and energy markets. The expansion of the mains gas network and associated household switch over to gas has had the largest long-term impact on household emissions. The switch over was at its height in the 1980s with the majority of households already having switched their main heating fuel by 1990.

Impact of carbon intensity of electricity supply

Whilst the nations may have experienced relatively similar long-term trends at the household level, Scotland has always had a higher proportion of renewable energy than the rest of the UK. Scotland could therefore argue that the emissions factor associated with electricity production and distribution is lower than that experienced in the rest of the UK. The team has therefore applied an emissions factor of 0.406 kg per kWh for electricity produced by AEA Technology in the Scottish Energy Study[1] to revise the 1990 and 2004 baseline.

Table 2 shows Scotland's baseline of emissions to be 3.83 and 3.77 MtC in 1990 and 2004 respectively. The application of a lower emissions factor for Scotland increases the emissions factor for electricity in the UK to 0.43g per kWh. The overall benefit of Scenarios 1b and 1c would also see a marginal improvement in carbon savings of 0.015 and 0.016 MtC respectively, as the growth in electricity demand would be associated with a lower intensity fuel.

Table 2
Revised 1990 and 2004 baseline of residential carbon emissions (MtC)

	1990 Emissions	2004 Emissions (Scotland)	Proportion
UK	42.4	41.70	
England	35.51	34.92	83.7%
Wales	2.21	2.18	5.2%
Scotland	3.83	3.77	9.0%
Northern Ireland	0.75	0.74	1.8%

1. AEA Technology (2006) Scottish Energy Study

Annex 2 Imputations for Scotland

In the model, the type of measure or package selected for each sample dwelling is governed mainly by the generic dwelling type, particularly the original heating fuel used, the wall construction and whether the dwelling is a house/bungalow or a flat. The selected measure or package is also defined by the fuel used after improvement. The extent of measures required is determined by the existing standard of heating and insulation in each dwelling prior to improvement.

The imputation is based on the assumption that dwellings in Scotland are of the same generic type – i.e. with the same main heating fuel, wall construction, the same built form, and with the same level of energy efficiency as those in England – and will require the same type of energy measures and generate the same savings and improvement costs.

For the imputation, the full list of 36 generic dwelling types has been reduced to 20. This has been achieved by combining non-traditional construction with solid walls, and by using just two built forms – houses/bungalows and flats – for dwellings heated by electricity, solid fuel, oil and LPG (which tend to be the least frequent generic types).

Each of these 20 generic dwelling types, however, has been broken down by the fuel used after improvement, and by the original level of energy efficiency. For the final fuel used, six categories are used: electricity, solid fuel, oil, LPG and gas, with the latter fuel being sub-divided into that used in a condensing boiler and that used in CHP systems. For the level of energy efficiency, five SAP bands are used – under 35; 35 to 45; 45 to 55; 55 to 65; and 65 or more – to reflect the existing standard of heating and insulation.

Like the English Housing Condition Survey (EHCS), the Scottish Housing Condition Survey (SHCS) survey includes the variables required to determine the generic dwelling type and SAP rating of each sample dwelling. However, as the fuel after improvement is unknown for Scotland, the address codes of the SHCS are used to randomly distribute the Scottish samples to the same fuel or a new fuel, in the same proportions as those generated by the English improvement model. Including the use of gas CHP, up to five fuel switch categories are used for each existing fuel – for example, solid/gas, solid/CHP, solid/electricity, solid/solid and solid/oil.

A common variable comprising the 20 generic dwelling types, 22 possible fuel switches and the 5 SAP bands, and including up to 380 potential categories, is then computed for the EHCS and similarly for the SHCS survey samples.

For the imputation of the installation costs, the mean cost is determined for each of these categories from the results of the English model and then applied to the same categories in the Scottish samples. To determine the total costs, the imputed means are simply multiplied by the number of occupied dwellings in each category in Scotland. Finally, the outputs are provided, broken down by each type of fuel switch, wall type and house/flat type.

To determine the energy savings, the same 380 potential categories are used to impute the energy requirements for space heating both before and after improvement. However, as the energy requirements for water heating, lights and appliances and cooking are less dependent on the thermal standard of the dwelling, each of these is imputed using only 76 categories, derived from the generic dwelling types and possible fuel switches alone. Also here the outputs for space and water heating, lights and appliances and cooking are provided, broken down by the fuel switch type alone. As in the calculation of fuel costs in the EHCS, dual fuel (gas and electric) cookers are assumed where there is gas heating, with all electric cookers being assumed elsewhere.

Annex 3
How Low: Conservative Assumptions

The modelling of scenarios used in this report are based on earlier work in CSE, ACE and Moore (2008), *How Low*: Achieving Optimal Carbon Savings from the UK's Existing Housing Stock. We reproduce here the description of the assumptions used in the modelling exercise which focused primarily on England and policy at a UK level.

Conservative Assumptions

The study has made a number of conservative assumptions about the technologies that have been applied and the magnitude of savings generated. This conservative approach should reassure readers that the savings presented are achievable with concerted government action.

Furthermore, the costs of the measures required and the magnitude of the savings generated represent the worst-case scenario. The measures associated with Scenario 2 more than pay for themselves if projected system costs are used and the full payback is included – i.e. GVA, lifetime fuel savings and value of carbon.

Listed buildings and conservation areas

The *How Low?* study has assumed that solar power systems and internal/external wall insulation will not be applied systematically to listed buildings or to homes in conservation areas. While there are clearly further carbon savings to be made, there is likely to be significant public resistance to the wide-scale deployment of micro-renewables and external cladding in rural communities and historic areas.

Green gas percentage

Ernst & Young's recent study of the initial business case for supporting the UK renewable heat sector did not examine the feasibility of biogas injection to the domestic gas supply network.

However, a response to the Renewable Heat Obligation consultation by Panthol Ltd76 (a supplier of domestic oil and biofuels) stated that the UK could possibly secure 10% of its current natural gas energy needs, or 15% of its current electricity needs, by 2020, through the production and use of biogas from indigenous UK agricultural output. The study has therefore made a conservative assumption of a total residential green gas supply of 10% by 2050.

Decarbonisation of electricity

The report team has linearly extrapolated the projected carbon intensity of delivered electricity (2008-20) to estimate a 2050 carbon factor of 0.059kgC/kWh (see Figure 2). The recent IPPR,

The RSPB and WWF study to identify whether it would be possible to reduce the UK's carbon emissions by 80% of 1990 levels by 2050 identified decarbonised electricity as a key measure – i.e. a carbon factor of 0.005kgC/kWh. For reasons of conservatism this study has not assumed as high a level of decarbonisation as the IPPR report, which took a downward path to a zero carbon electricity sector by 2050. This serves to highlight that there is room to manoeuvre and go beyond an 80% cut in the residential sector.

Measures costs – mass marketing LZC technologies

Scenario 2 requires a total expenditure of £130 billion, with a GVA of £38bn. This cost is based on today's prices for insulation and LZC technologies, which are likely to fall significantly between now and 2050. The recent Renewables Advisory Board (RAB) report on the 'Essential role of renewables generation in achieving zero carbon homes' examined the projected cost of LZC technologies from 2007 to 2025. If the cost reductions predicted are applied to scenario 2, costs fall by £36bn to £94bn in total, which would mean that as compared to the £99bn cost of this scenario, they achieve a net positive economic position.

Fuel prices

This represents a conservative estimate of the actual savings achieved, as the fuel prices are based on 2007 averages. The DTI baseline projections for fuel prices by 2020, shown below, demonstrate an average price rise of 21%. If the figures for each fuel are applied to the lifetime savings generated at 2007 fuel prices, the total savings for Scenario 1a and 1b rise by 25% and 13% respectively. Conversely, they fall for Scenario 2a and 2b, as electricity has the largest overall price rise, and this scenario creates an additional demand for this fuel.

Fuel	2020 Increase
Solid	7.5%
Gas	16.5%
Electricity	40.5%
Oil	19.4%

Measures lifetimes – 15 years

The study has assumed a 15-year lifetime for all measures. This is a conservative estimate based on the shortest lifetime among the measures applied. The insulation measures and solar power systems typically have a 20-30 year lifetime. If a 20-year lifetime were applied, the lifetime savings would increase by 33%.

Annex 4
Further Research

This project used the findings of WWF's How Low report as its starting point. As such the project team has been faced with providing Scottish equivalents to the findings from a study which focussed primarily on England within a UK policy context. At times it has proved impossible to find data that is specific to Scotland. It has also been difficult, within the resources of this project, to provide all the quantitative data relating to the delivery of an integrated housing retrofit strategy. We highlight here the important areas where further information and research is required.

- A specific base-line for residential carbon emissions in Scotland is needed in order to set future targets. Neither the information from Scottish Energy Study or the Scottish House Condition Survey, provide a robust and appropriate base-line.
- Developing a methodology for factoring in the decarbonisation of Scotland's electricity supply into the monitoring and targets for a retrofit strategy
- Information on numbers of installations and spending in Scotland through EEC/CERT should be made available by energy suppliers (possibly through HEED) to the Scottish Government.
- An audit of expenditure on energy efficiency and microgeneration in existing housing in Scotland from all sources should be carried out to identify the current total, help target resources and plan for future resourcing of a retrofit strategy.
- A compilation of data on installation rates for all programmes to identify current capabilities and to plan for expanding those capabilities.
- Research into the skills, training needs and capacity of all the key industrial sectors that might be involved in implementing a retrofit strategy.
- Research into the potential for an expansion of CHP / District Heating serving existing housing to identify the main areas where support is needed.
- Research into the wider benefits of a significant improvement in the energy performance of all Scottish housing with a primary focus on health and well-being.

Research into the comparative economic benefits of retrofitting Scotland's existing housing with other carbon reduction options.

References

Adams C. (2007), *Occupational and Functional Map of the Renewable Energy Sector*, a report for Energy and Utility Sector Skills Council

AEA Technology (2006a), *Scottish Energy Study Vol. 1,* for Scottish Executive, Edinburgh

AEA Technology (2006b), *Scottish Energy Study Vol.2,* for Scottish Executive, Edinburgh

BERR (2008) *Quarterly Energy Price Tables*, Department of Business, Enterprise and Regulatory Reform, London

Boardman B. (2007), *Home Truths: A low-carbon strategy to reduce UK housing emissions by 80% by 2050,* a research report for the Co-operative Bank and Friends of the Earth

Communities Scotland (2006), *Central Heating Programme & Warm Deal 05-06 Annual Report*

CSE (2008), *Distributional Impacts of Personal Carbon Trading,* a report for DEFRA

CSE, ACE and Moore D. (2008), *How Low: achieving optimal carbon savings from the UK's existing housing stock,* a report for WWF-UK.

DCLG (2007), *English House Condition Survey 2005: Annual Report,* Department for Communities and Local Government, London

DEFRA (2007a), *Consultation on the Review of the Home Energy Conservation Act 1995 (HECA),* Department of Environment and Rural Affairs, London

DEFRA (2007b), *UK Energy Efficiency Action Plan,* Department of Environment and Rural Affairs, London

DG Associates (2005), *A review of skills and training for domestic energy efficiency*, a report for the Energy Efficiency Partnership for Homes

Dodd N. (2008), *Community Energy: Urban Planning for a Low Carbon Future*, a report for TCPA, CHPA and English Partnerships

DTI (1995), *Digest of UK Energy Statistics 1995, Fuel Expenditure on heating – climatic variations,* Department of Trade and Industry, London

DTI (2002), *Energy Consumption in the United Kingdom,* Department of Trade and Industry, London

EAGA plc, Presentation by Mitesh Dhanak, *Making new development carbon neutral affordably*,

Element Energy (2008), *The Growth Potential for Microgeneration in England, Wales and Scotland*

ESD (2006), *Review of UK insulation sector supply chain*, report for DEFRA, London

EST (2006), *The rise of the machines – a review of energy using products in the home from 1970s to today*, Energy Saving Trust, London

EST (2008), *HEED Online User Manual 1.5,* Energy Saving Trust, London

Halcrow (2006), *Evaluation of the Scottish Community and Household Renewables Initiative*, Scottish Executive Social Research

House of Commons Communities and Local Government Committee (2008), *Existing Housing and Climate Change*, Seventh Report of Session 2007-2008, Report together with formal minutes HC432-1, 2nd April 2008

Hulme M. et al. (2002), *Climate Change Scenarios for the United Kingdom, The UKCIP02 Scientific report,* United Kingdom Climate Impact Programme, Oxford

MBD (2007), *Residential Energy Efficiency Report*, National Insulation Association

Scottish Building Standard Agency (2007), 'The Sullivan Report', *Low Carbon Building Standards Strategy for Scotland*

Scottish Government (2007a), *Energy Efficiency and Microgeneration: Achieving a low carbon future; a strategy for Scotland,* Consultation draft March 2007

Scottish Government (2007b), *Firm Foundations, Discussion Paper on the future direction of Scottish Housing*

Scottish Government (2007c), *Fourth HECA Progress Report for the Scottish Parliament 2007*

Scottish Government (2008a), *Review of Energy Efficiency and Microgeneration Support in Scotland*

Scottish Government (2008b), *Review of Fuel Poverty in Scotland*

Scottish Government (2008c), *Scotland's Climate Change Programme: 2nd Annual Report*

Scottish Government (2008d), *Scottish Housing Quality Standard Progress Report*

Scottish Government and COSLA (2007), *Concordat*

Scottish Government Press Release 03/06/08, *Climate Challenge Fund*

Scottish Government Press Release 19/03/08, *Scottish Community and Household Renewable Initiative*

Scottish Government Press Release 21/04/08, *Warm Deal*

Scottish Government Press Release 29/11/07, *Renewable Electricity Targets*

SDC (2006), *Stock Take – Delivering improvement in existing housing,* report for the Sustainable Development Commission

SHCS (2002a), *Scottish House Condition Survey 2002*

SHCS (2002b), *Fuel Poverty in Scotland*

SHCS (2006), *Energy Efficiency and estimated emissions from the Scottish housing stock 2003/04*

SHCS (2007a), *Scottish House Condition Survey: Key findings 2004/05*

SHCS (2007b), *Scottish House Condition Survey: Key findings 2005/06*

SHCS (2008), *Estimate of Fuel Poor Households in Scotland, 3 March 2008*

With thanks to

Printed on recycled paper

For more information contact:
WWF Scotland
Little Dunkeld
Dunkeld
Perthshire PH8 0AD
t: 01350 728200
f: 01350 728201

wwfscotland.org.uk

The mission of WWF is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature by:

- **conserving the world's biological diversity**
- **ensuring that the use of renewable natural resources is sustainable**
- **reducing pollution and wasteful consumption**

WWF

for a living planet®