RETROFITTING THE UK'S HOMES: OPPORTUNITIES FOR THE ECONOMY

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Foreword

In Britain we have a deep-seated relationship with our homes. Not only do they impact on many of the day-to-day decisions we make such as where we shop, work and how we travel, but also the decisionsc
value and aesthetics.

The property market and building trade have both been badly hit by the economic crisis in 2009. And in the current financial climate, greening our homes could be seen as an unnecessary luxury that can simply be put on hold. But this report highlights that widespread installation of energy-efficient measures could not only contribute to pulling the UK out of recession but also protect people from future economic shocks.

It is no secret that the UK's homes are responsible for 26% of the UK's total carbon emissions. Much of this is down to old, inefficient homes that can be draughty, expensive to run and less comfortable to live in. A national programme of low-carbon refurbishment of the UK's existing housing stock offers an exciting opportunity to slash our emissions, and provide people with homes that are more pleasant and cheaper to live in. It would also create new jobs and protect existing ones, as well as safeguarding the UK against future financial traumas by moving us to a more sustainable economic model.

WWF-UK believes that the only way for us to protect people and nature, and avoid dangerous climate change, is to move to a future where we all live within the means of our planet – a One Planet Future Now is the time for us to invest in that future and create a national low-carbon retrofit programme that will significantly reduce the carbon emissions from our homes and help secure a path to a low-carbon economy.

If you would like to know more about our work to reduce the environmental impact of the UK housing stock, please contact zleader@wwf.org.uk

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Executive summary

Climate change is one of the most serious threats facing the planet and human development, and demands urgent global and national action. Scientific consensus is that a rising concentration of greenhouse gases, such as carbon dioxide, in the atmosphere owing to human activity is a key contributing factor to global climate change. In the UK, around 26% of the country's carbon dioxide (CO_2) emissions arise from energy use in homes (equivalent to 142 $MtCO_2$ or 38.7 MtC). Although many technologies and measures to secure substantial savings in energy use already exist and are commonly available, carbon emissions from the UK residential sector have not reduced substantially since 1990.

Addressing carbon emissions for the existing housing stock will be crucial in enabling the UK to reduce its emissions to levels now required by law (at least 80% below 1990 levels by 2050). In March 2008, WWF published a report called *How Low: Achieving optimal carbon savings from the UK's existing housing stock*. This explored the idea that a large-scale roll-out of energy efficiency measures which are cost-effective over their lifetime could lead to a 35% reduction in carbon emissions from existing housing by 2020.

There is now increasing and broad-based political support to encourage such a large-scale roll-out of retrofit measures. Several recent reports have demonstrated the urgent need for action in this field. Others have illustrated how a large-scale programme of retrofit measures may practically be implemented. Nonetheless, to achieve the scale of retrofit required will necessarily involve a massive level of upfront investment, notably in the purchase and installation of energy-efficiency measures and low and zero-carbon (LZC) technologies.

This report explores the opportunities for the economy presented by such a large-scale retrofit programme. This is important in the context of the recession, which has hit the construction industry particularly hard. It draws on the *How Low* report's Scenario 1b ('Economic potential') as the basis for its figures. The report discusses the (gross) direct employment created through the installation of such measures, as well as the effect such a programme could have on indirect job creation (through the manufacturing supply chain and servicing). In addition this report explores the potential for household financial savings through reduced fuel bills, and the knock-on impact of the additional expenditure elsewhere in the economy. It finishes by examining the issues around the deliverability of a large-scale retrofit programme, including skills and employment levels, and expands on the policy recommendations proposed in the *How Low* report.

SAVINGS FOR HOUSEHOLDS

Installing energy-efficiency measures and LZC technologies will lead to lower fuel bills and save households money. These savings will have particular resonance for households in the current economic climate. The impact on the householder's pocket will however depend on how the initial payment for the installation is financed.

The balance of costs and lifetime savings of measures varies by country and depends critically on the assumptions made. However, the installation of a large package of energy-efficiency measures and LZC technologies could enable households to make substantial savings. Overall fuel savings for the UK population associated with a large-scale programme of retrofit are projected to be between £76bn (£70bn in England) and £131bn (£120bn in England) over the lifetime of the measures, depending on the set of assumptions used.

Using a set of moderate assumptions (outlined in Chapter 3), aggregate savings over the lifetime of measures outweigh the costs of installing the measures by approximately £38bn at a UK level, or £1.64bn per year.

Rebound effects (the propensity of cost savings to lead to increased consumption – in particular, increased household consumption of other goods and services) enhance the importance of reducing emissions across all sectors of the economy, not just housing.

Little hard evidence exists of uplift in value of homes linked to energy efficiency improvements although there are studies indicating that some house purchasers are willing to pay a premium for low-carbon houses.

EMPLOYMENT EFFECTS

The research reviewed the impact on employment of previous similar programmes. Three types of impact were examined:

- The **direct impact** – the impact on the firms directly *installing* the energy-efficiency measures and ancillary jobs (such as administration, management, technical support and monitoring).
- The **indirect impact** – the impact on the supply chain associated with the installation of measures, including the *manufacture and servicing* of the energy efficiency measures.
- The **induced impact** – the impact from the *shift in household expenditure* (of money freed up by less expenditure on energy following the installation of energy efficiency measures).

The effects on output (Gross Valued Added – GVA) are also noted, although the positive benefit is limited to the direct effect associated with the installation of energy-efficiency measures (estimated in *How Low* to be £27.3bn in the UK and £22.8bn in England by 2020).

Table 1 provides a summary of our headline findings of the impact that previous energy efficiency policies and programmes have had on employment in England[1]. The figures available from the model used in the *How Low* report only allow for extrapolation in England; further modelling would be required to provide robust figures for other UK countries.

Table 1 – Summary of employment impacts of domestic carbon mitigation measures (England)

	Employment impact (per £1m invested)	**Employment impact (expected for *How Low* Scenario 1b)**
Direct	+ 11.5 (total FTE per £1m invested)	68,300 FTE staff per year
Indirect	+ 1.5 :1 (ratio to total direct employment)	102,500 FTE staff per year
Induced	+ 32.0 (total FTE per £1m saved on energy)	58,100 FTE staff per year

Sources: SQW, WWF (2008), ACE (2000), Committee on Climate Change (2008)

Note: Employment impact is estimated by averaging total employment arising from expenditure under Scenario 1b over 15 years, the typical lifetime assumed for measures in the How Low *report*

The largest number of jobs are expected to arise from the indirect impact associated with the retrofit programme, i.e. the manufacturing and servicing of the energy-efficiency measures.

[1] Employment is measured in full-time equivalent (FTE) man-years of employment. Employment can arise in the year the public money is spent (e.g. grant-funded installation) or over the lifetime of the measure (e.g. servicing jobs).

However, the ability to fulfil this potential within the UK will depend on investment in, and support of, domestic companies manufacturing energy-efficiency and LZC technologies. The rate of leakage (the proportion of job creation outside the UK associated with the intervention) did not form part of this research.

DELIVERABILITY

A significant opportunity exists for cost-effective energy-saving measures to be rolled out across the UK. The deliverability of a large-scale retrofit programme will be vastly improved if it is tied to key delivery points, including 1) point of sale, and 2) planned renovation work.

The UK has already achieved a lot in tackling energy efficiency with programmes such as Decent Homes, Warm Front and CERT (and its predecessors). Over two-thirds of the available housing stock has already been upgraded with basic cavity wall and loft insulation and other 'quick win' measures. Continued improvement in home energy efficiency will rely on a 'whole-home' approach, with policies (including financial support) expanding to cover all home types and the full range of energy-efficiency measures available.

From 2015 onwards, the 'long wins' will have to take precedence, including solid wall insulation and measures dealing with listed buildings. It can take many years to design and implement effective policy measures, and to affect change in the construction sector. To encourage widespread uptake of such measures by 2015, the policies to affect change need to be put in place now.

Construction industry

The recession has had a significant impact on the construction industry. The volume of construction output from first quarter 2008 to first quarter 2009 fell by 6% compared with the previous 12 month period. New housing work fell by 10%. And repair, maintenance and improvement (RMI) work fell by 9%. Estimates put job losses over the period of the recession as high as 450,000 – as much as 20% of the construction workforce.

While output and employment in the construction sector are expected to pick up after the recession, the effects on the RMI sub-sector may persist. Therefore a large-scale programme of retrofit could provide an important boost to this sub-sector, which is characterised by a high number of small-to-medium enterprises (SMEs) and is particularly vulnerable to the impacts of the recession as disposable incomes fall and consumers cut back on non-essential work. If rapid enough, a package of policy incentives to support the roll-out of retrofit measures on a large scale could help many thousands of SMEs to remain solvent in these challenging economic times.

The overall expansion of the construction sector immediately post-recession is predicted to create an annual recruitment requirement (ARR) of 37,000 jobs across the sector. A major retrofit programme would more than double this requirement. The implementation of an ambitious national retrofit programme will require a significant recruitment drive on top of current industry projections.

A 'whole-house' approach to retrofit would be most effective. But if coordinated effectively this will require significant skills development and training, particularly in project-management (see below). Any retrofit programme must be designed for ready engagement from industry professionals, and therefore it must be cognisant of the key elements of 'buildability', set out in Chapter 5 of the report.

Skills

Many of the required retrofit skills need small amounts of training, with relatively short training courses. Some of this will be provided by manufacturers and/or paid for by the construction industry itself through a training levy[2].

However, a new set of skills will become necessary to ensure that builders of all trades and at all levels understand the importance of energy efficiency and how different building works can affect this. A thorough understanding of building energy performance will become increasingly important, and sufficient training must be provided to ensure that enough project managers are available with a solid understanding of the 'whole-building' approach.

S/NVQs must continue to develop to reflect the importance of the retrofit agenda. But courses will only attract trainees in large enough numbers if there is a clear signal that this work is going to take place. Innovation in skills training is likely to start with the development of short courses.

POLICY RECOMMENDATIONS

Future policy development for retrofit needs to be built on two basic objectives:

1. creating confidence in future public sector support for the retrofit agenda (long-term certainty will encourage investment and innovation)[3], and
2. moving the low-carbon retrofit market away from a reliance on grants (i.e. developing incentives for householder action and engaging with the mainstream RMI construction sector).

A strong set of policies will take several years to develop and implement. The government must not take a short-term view in policy-making; it must instead actively plan for and develop the policies needed for stimulating the retrofit market – both immediately, and to 2020 and beyond.

A large-scale retrofit programme is feasible and deliverable. However, the scale of home-ownership across the UK, coupled with large numbers of SME installation operators, means that delivery will not be easy. There was one over-riding consistent message from our consultations: **creating/stimulating market demand for retrofit measures is an essential first step**. The building industry may be disparate and slow-moving, but it will respond readily to a significant growth in client demand.

The £38bn question is: how do we create demand for low-carbon housing? A range of key examples of, and principles for, policies from the literature and from our consultations are provided in Chapter 6. These include:

- Designing financial incentives that will stimulate demand.
- Developing a **standards-based approach**, based on house sales and planned renovation work, is an obvious medium-term goal for government.
- Retrofitting **public housing** should lead the way in developing a market that, at the same time, enables the development of skills and understanding of materials and techniques, creating a market ready for delivery to the private sector.

[2] The vast majority of industry training is already paid for through the annual CITB-ConstructionSkills levy.

[3] SQW Consulting (2007).

- Prioritising a **major public information campaign** (not necessarily led by the government).
- Rolling-out **smart-meters** nationally to make energy use in the home more 'visible'.
- Drawing up a range of recommendations for **training skills and standards**, and the need for a major recruitment drive across the RMI sub-sector.
- **Engaging the large number of existing construction workers** with the agenda from an early stage, for example through messaging/training provided through relevant trade associations, and working in partnership with supply chains from product manufacturers to builders merchants.

1 Introduction

1.1 BACKGROUND TO THE STUDY

Climate change is one of the most serious threats facing the planet and human development, and demands urgent global and national action. To prevent average global temperatures from increasing by more than 2°C above pre-industrial levels – a threshold above which severe and irreversible tipping points in the climate become increasingly likely – the world's emissions of greenhouse gases must peak and start to fall steeply in the next 5 to 10 years, and drop by 50-60% below 1990 levels by mid-century. Industrialised countries such as the UK need to be aiming to fully decarbonise their economies by 2050.

The UK government acknowledges the challenge – and opportunity – that this represents:

The transition to a low-carbon world will transform our whole economy. Lord Stern's landmark Review in 2006 set out the economic case for action on climate change and for investment in a low-carbon economy[4]. Recognising that economic necessity, the UK has through the Climate Change Act become the first country in the world to adopt a legally binding target to reduce carbon emissions – by at least 26% by 2020 and by 80% by 2050. […] More efficient use of energy and other resources could save businesses and consumers in Britain billions of pounds every year. Much of this can be achieved from simple and cheap actions. The savings made could be quickly channelled into new investment.

Low Carbon Industrial Strategy: A Vision, (BERR, DECC, March 2009).

The latest available statistics[5] show that around 26% of the UK's CO_2 emissions arise from energy use in homes – equivalent to around 142 $MtCO_2$ or 38.7 MtC. The largest source of these emissions is space heating (53%) followed by hot water (19%) and electricity for appliances (16%).

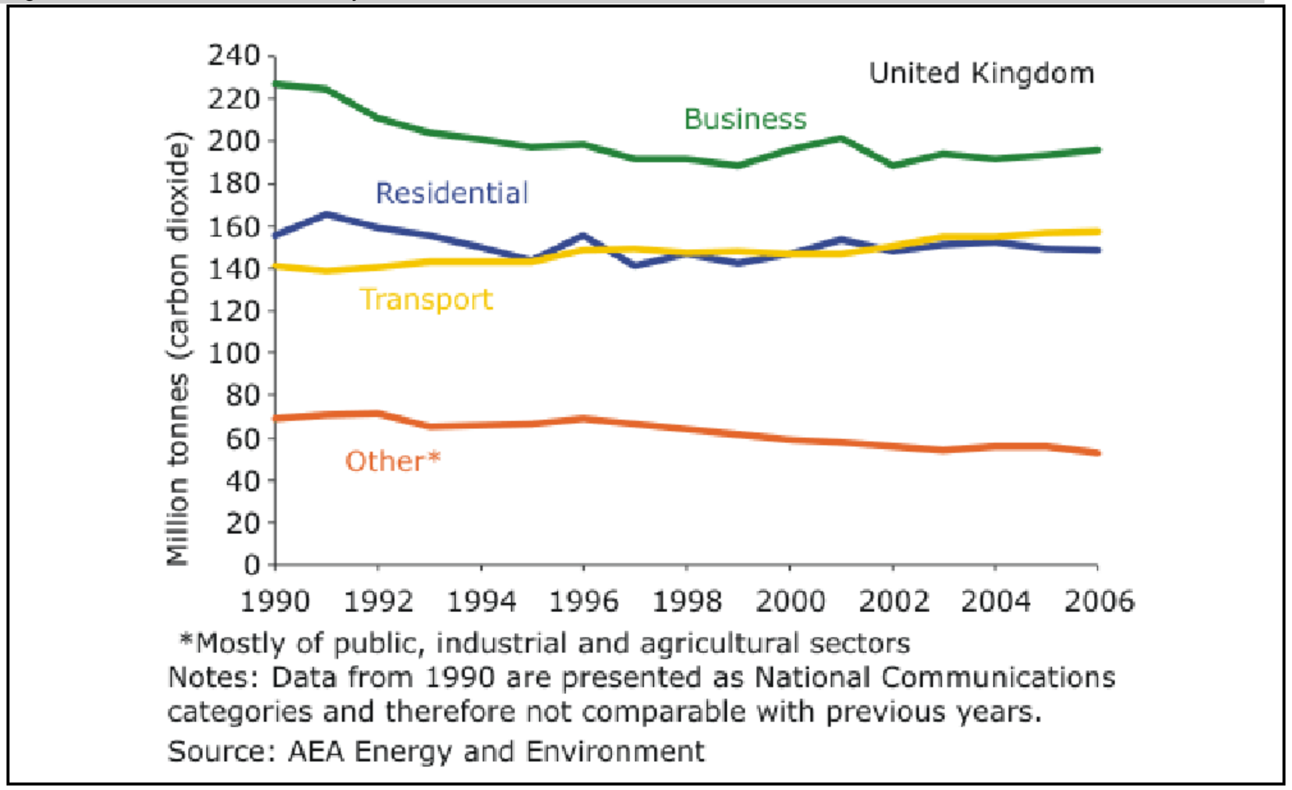
Although many technologies and measures to secure substantial savings in energy use already exist and are commonly available, carbon emissions from the UK residential sector have not reduced substantially since 1990 (Figure 1-1). Robust plans have been developed for decarbonising homes to be built in the future, yet the plans for reducing carbon emissions from the existing housing stock – expected to account for 80% of the country's housing stock in 2050[6] – are less clear. However, the government's recent consultation on its Heat and Energy Strategy (HES, 2009) goes a long way further than has previously been stated by government in outlining a path for the future.

[4] The Stern Review (2006) proposed that an investment of 1% of global GDP per year is required in order to avoid the worst effects of climate change, and that failure to do so could risk global GDP being reduced by up to 20%.

[5] DECC (26 March 2009).

[6] Boardman (2007).

Figure 1-1 : UK CO_2 emissions by end user, 1990-2006



Source: Defra SD indicators; AEA Energy and Environment

In March 2008, WWF published a report called *How Low: Achieving optimal carbon savings from the UK's existing housing stock* (referred to in this document as the *How Low* report). *How Low* found that a large-scale roll-out of energy efficiency measures which are cost-effective over their lifetime[7] could lead to a 35% reduction in carbon emissions from existing housing by 2020.

1.1.1 UK existing housing stock

The UK's housing stock was designed and built in the context of a relatively mild climate. Compared to other European countries such as Sweden or Spain with more pronounced seasonal changes in temperature, the UK's housing stock was not designed to be energy-efficient. As much as 40% of the existing housing stock was built before 1944 (EHCS, 2006); much was built rapidly in the Victorian era of industrialisation and, with cheap coal readily available, little thought was given to energy efficiency.

In terms of addressing the need to reduce energy use and carbon emissions in the housing stock, the scale of private ownership in the UK is an issue. Around 70% of homes in the UK are owner-occupied (Table 1-1), meaning that there is inevitably a piecemeal approach to upgrading the fabric of the collective building stock.

[7] Defined as the installation of any measure that recoups its upfront costs by future savings on energy bills over its lifespan.

Table 1-1: Breakdown of housing tenure by country

		Owner-occupied	Private rented	All Private	All Social	Vacant	All
England	2007	71.2%	11.6%	82.8%	17.2%	n/a	100%
Wales	2007	73.5%	10.7%	84.2%	15.8%	n/a	100%
Scotland	2007	64.9%	7.8%	72.6%	27.4%	n/a	100%
Northern Ireland	2006	66.5%	11.5%	78.0%	16.3%	5.7%	100%
TOTAL UK		**70.5%**	**11.1%**	**81.5%**	**18.3%**	n/a	**100%**

Source: English Housing Condition Survey 2007; Living in Wales Survey 2007; Scottish Housing Quality Survey 2007; Northern Ireland Housing Condition Survey 2006

In addition, the housing stock varies considerably across the UK, both between the individual countries (Table 1-2) and also between the English regions. This means that a single UK-wide approach to tackling the issue is unlikely to be optimal.

Table 1-2: Breakdown of housing type by country

		Detached	Semi- detached	Terraced	Tenement	Other	All
England	2007	17%	28%	29%	17%	9%	100%
Scotland	2007	21%	21%	22%	22%	14%	100%
Northern Ireland	2006	17%	20%	32%	8%	23%	100%
TOTAL UK		**17%**	**27%**	**28%**	**17%**	**10%**	**100%**

Source: English Housing Condition Survey 2007; Scottish Housing Quality Survey 2007; Northern Ireland Housing Condition Survey 2006; similar metrics are not reported in Living in Wales Survey 2007

1.1.2 Policy drivers

The UK government's Climate Change Act (2008) contains a legally-binding, economy-wide target to reduce CO_2 emissions by at least 80% from 1990 levels by 2050. In the 2009 budget the Chancellor committed to a 34% cut in emissions by 2020[8].

Steps for residential sector emissions cuts have been set out by the Committee on Climate Change (CCC 2008). And the National Energy Efficiency Action Plan (NEEAP; 2007) set a target to reduce emissions from the UK's residential housing stock by 31% from 1990 levels by 2020. The residential sector might need to account for a higher than average proportion of emissions savings to offset sectors of the economy where emission reductions are harder to achieve (e.g. aviation and shipping).

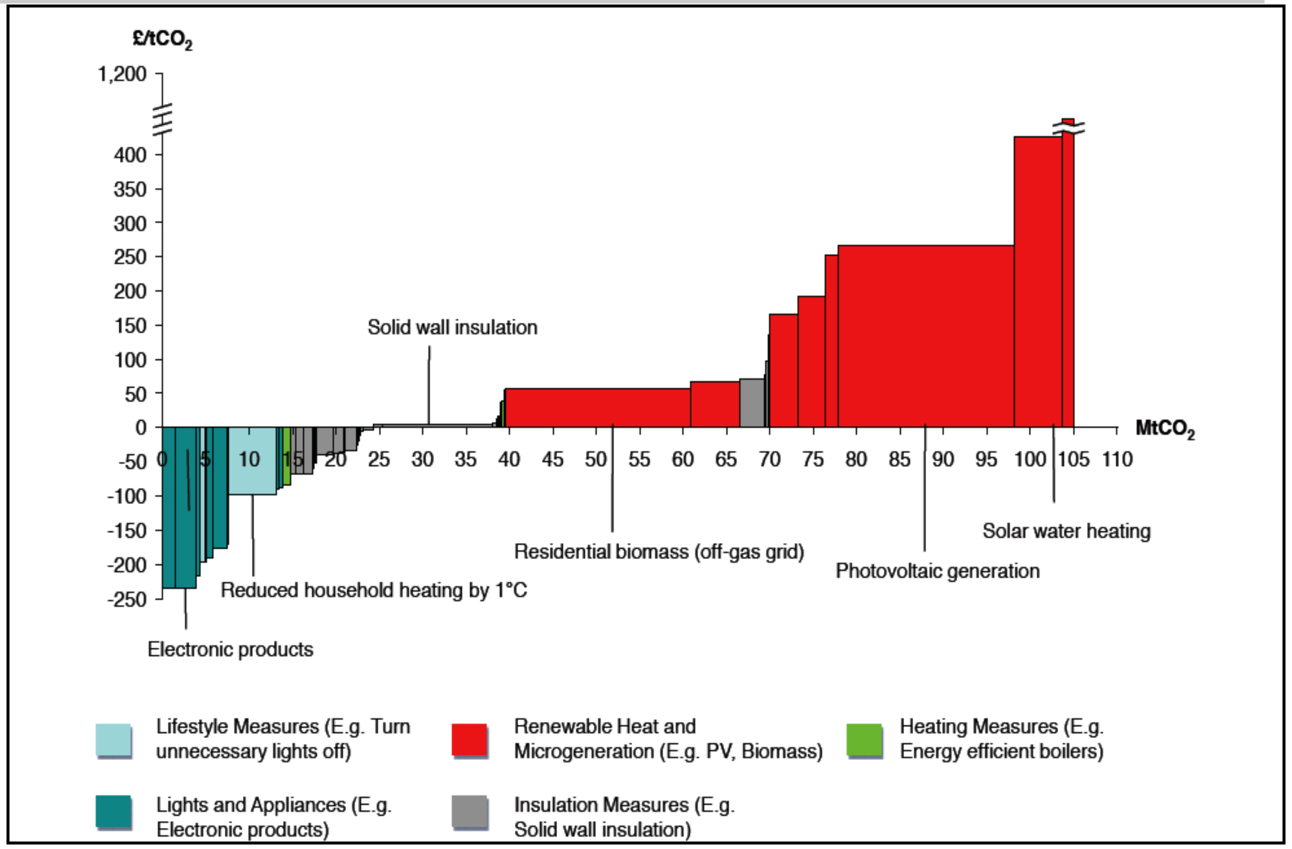
The government is now consulting on its plans for a reduction in energy end-use in the residential sector, specifically through the current consultations for the Heat and Energy Saving (HES) strategy and the Community Energy Saving Programme (CESP).

A recent report by the Committee on Climate Change (CCC, 2008) estimates that a range of technical and lifestyle measures could be put in place in the UK residential stock that would

[8] A tougher 2020 emissions target will be set if there is a "satisfactory" global agreement on climate change. The definition of a "satisfactory" agreement is unclear, as is the level of the more stringent target. However, the Committee on Climate Change (CCC, 2008) recommended a 42% target for 2020.

cumulatively achieve savings of up to 105 $MtCO_2$ in 2020, the equivalent of a 67% reduction against 1990 emissions from the UK domestic sector. Of these, some 40 $MtCO_2$ can be achieved cost-effectively (a 26% reduction). The potential measures identified are summarised in Figure 1-2.

Figure 1-2: Marginal abatement cost curve in 2020 for residential buildings at the UK level, 2008



Source: Committee on Climate Change, 2008

1.1.3 Positive economic stimulus

In addition to the CO_2 savings associated with the various measures to be put in place, as outlined above, a significant increase in the rate of take-up will stimulate employment in the construction industry for the installation and servicing of these measures.

The current economic downturn has hit the construction industry particularly hard, with around 71,000 jobs lost in the sector between November 2007 and October 2008[9]. It has been estimated that 450,000 jobs will be lost in the construction sector between 2008 and 2010[10]. Major investment in household emissions reductions will provide new contracts for house builders that are currently not building new homes, and support SMEs that install energy-efficiency and low-carbon measures.

A report carried out for the Federation of Master Builders (FMB, 2008) suggests that for building firms, product manufacturers and suppliers, a range of policy measures and financial incentives built around the Energy Performance Certificate (EPC) represents an estimated business opportunity of £3.5 billion to £6.5 billion a year.

[9] Office of National Statistics cited in: www.building.co.uk/story.asp?sectioncode=29&storycode=3127428&c=3

[10] The 2020 Group cited in: http://news.bbc.co.uk/1/hi/business/7904936.stm

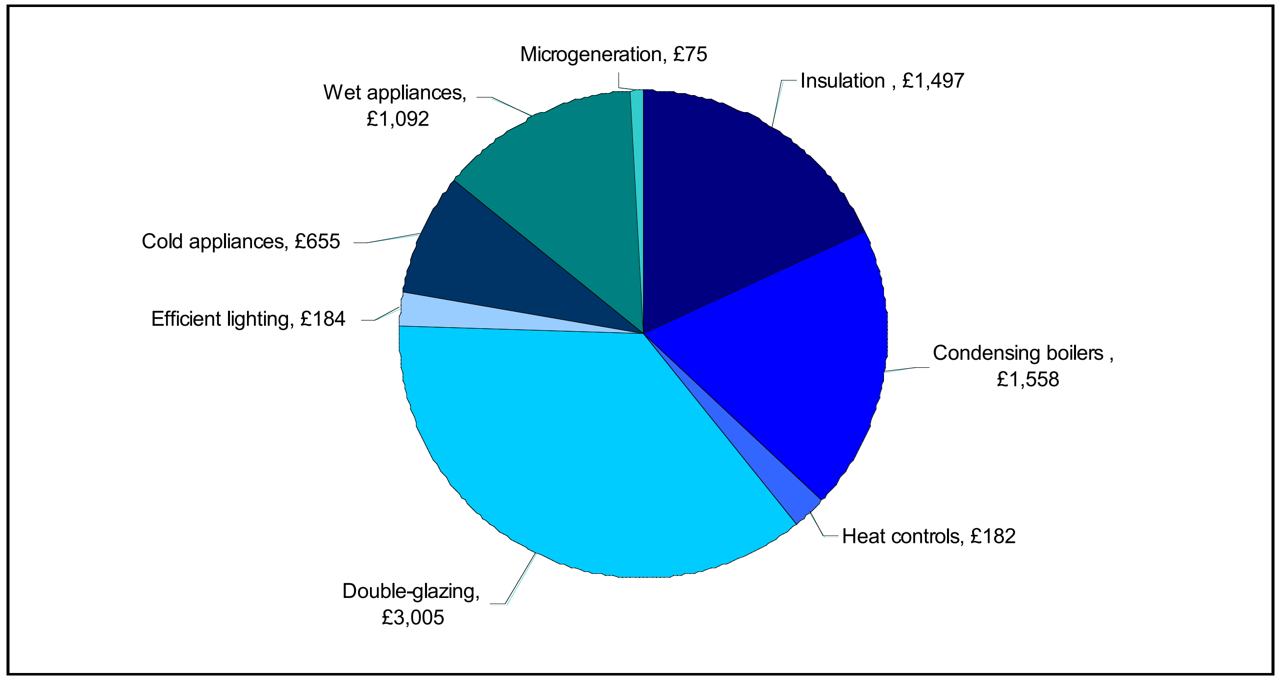
Finally, but importantly, householders themselves will save money on their fuel bills. Typical figures[11] suggest that installing a basic set of currently available measures could save up to £300 a year per household in fuel bills. In aggregate, this money could have a significant impact in the wider economy as a greater disposable income is translated into wider economic circulation[12].

A major programme of energy-efficiency retrofit could therefore be an important component of the UK government's efforts to boost the economy, providing savings to householders and creating employment opportunities in installation and throughout the supply chain.

1.1.4 The UK domestic energy-efficiency market

The total size of the UK domestic energy-efficiency market in 2007 was estimated at £8.25bn[13]. This is split roughly as in Figure 1-3:

Figure 1-3: Estimated size of domestic energy-efficiency market (2007); figures in £m per year



Source: Element Energy, Quantum Strategy & Technology (2008)

Under conservative assumptions[14], the market is expected to grow to £10bn (at 2007 prices) by 2020. The largest growth sector is expected to be microgeneration (increasing from less than £100m to around £1.2bn per year), driven by support under the Supplier Obligation and the Renewables Obligation. It could grow faster with the introduction of new policies such as Feed-in-Tariffs, due to be implemented in the UK by 2010.

[11] www.est.org.uk ; http://campaigns2.direct.gov.uk/actonco2/home/in-the-home/save-energy.html

[12] The wider programme to decarbonise the energy sector will result in an increase in energy bills, as illustrated in the UK Low Carbon Transition Plan (DECC, 2009). However these increases can be offset by installing energy efficiency measures – a large number of which are already cost-effective (WWF, 2008).

[13] Element Energy, Quantum Strategy & Technology (2008).

[14] Using the baseline scenario in Element (2008) – essentially, support under the Supplier Obligation, Renewables Obligation, Warm Front, Decent Homes and other mechanisms continued at the levels announced by 2008.

1.2 THIS REPORT

This report examines the economic benefits associated with a large-scale roll-out of energy-efficiency measures and low and zero-carbon (LZC) technologies, using the *How Low* report's Scenario 1b (Economic potential) as a base case. It discusses the direct employment created through the installation of such measures, as well as the effect such a programme could have on indirect job creation (through the manufacturing supply chain and servicing). In addition, this report explores the potential for household financial savings through reduced fuel bills, and the knock-on impact of the additional spend elsewhere in the economy.

The report is based primarily on a literature review and working with the figures developed for the *How Low* report. A rapid process of stakeholder engagement, particularly around the issues on deliverability and policy recommendations, was also undertaken. The results are embodied in this report.

The report provides an overview of expected employment benefits associated with a large-scale retrofit programme. However it does not examine in detail the net effects of jobs growth. A more detailed quantitative analysis could be developed from this work to take account of leakage (intervention/investment leads to job creation outside the UK), deadweight (jobs that would have been created without the intervention), displacement (other jobs lost, e.g. through supported retrofit activities gaining market share) or substitution (job creation in one area leads to job destruction in another) effects.

The following chapters are structured as follows:

- Chapter 2 provides a summary of the key messages and figures from the *How Low* report.
- Chapter 3 discusses the potential savings for households, both in terms of fuel savings (over the lifetime of retrofit measures) and the potential change in the market value of homes.
- Chapter 4 reviews the literature around likely employment effects linked to a large-scale retrofit programme, and briefly discusses the effect on economic output.
- Chapter 5 outlines the deliverability elements of a large-scale retrofit programme, both within the construction industry and in terms of available technologies.
- Chapter 6 discusses and expands on the policy recommendations proposed in the *How Low* report.

2 Summary of findings from the *How Low* report

2.1 SCENARIOS AND KEY ASSUMPTIONS

The *How Low* report developed several scenarios to summarise the potential for carbon emissions reductions in the residential sector. The report notes that the government at the time had intended (2007 Budget) to introduce energy-efficiency measures to enable (as far as possible) all homes to achieve their 'cost-effective energy-efficiency potential'. It argues that too narrow a definition was applied to the term 'cost-effective', and that supporting a more ambitious roll-out of a wider range of measures would not only be desirable, but also necessary in order to reduce carbon emissions to the limits set by policy.

The report highlighted key policy recommendations for the government to follow. These are summarised in Chapter 6 (Table 6-1).

The report defined the 'cost-effectiveness' of measures in two ways:

- **Market potential** (Scenario 1a) – defined by the government as including cavity wall, loft and hot water cylinder insulation, draught-proofing, efficient boilers and heating controls. The report sees this definition as limited and very restrictive.
- **Economic potential** (Scenario 1b) – defined as any measure that recoups its upfront cost by future bill savings over the lifespan of the measure. This is seen as the more pragmatic approach as it increases the number of measures deemed cost effective and therefore allows for a greater number of measures to be applied.

Both scenarios listed above were developed to 2020. Two further scenarios were developed to 2050 illustrating the **technical potential** (Scenario 2a; the application of all current measures, regardless of cost-effectiveness) and **theoretical potential** (Scenario 2b; including the development of new technologies and behavioural change), both of which included an allowance for decarbonisation of electricity.

The authors of the report were deliberately cautious in their assumptions in order to reassure readers that significant savings are achievable with concerted government action. Examples of the assumptions used include:

- The cost of carbon was not included in either scenario.
- The study assumed that solar power systems and internal/external wall insulation will not be applied to listed buildings or to homes in conservation areas.
- The report used a conservative assumption of total residential green gas supply of 10% by 2050.
- The report assumed that the carbon factor for electricity in 2050 would be 0.059kgC/kWh (this has been extrapolated from the intensity of delivered electricity in 2008-2020). However, it is now widely acknowledged that decarbonisation of electricity will be a key factor if an 80% carbon reduction is to be achieved by 2050[15].

[15] A recent report (IPPR, WWF, RSPB, 2007) concluded that a carbon factor of 0.005 kgC/kWh should be targeted by 2050.

- The report used contemporary cost figures for low and zero carbon technologies (LZCs)[16] although these are likely to fall significantly as they become more prevalent. If the Renewable Advisory Board's projected costs were taken into consideration then costs would fall by £36 billion.
- Fuel prices in 2007 were used. At the time the *How Low* report was written, the DTI projected a 21% rise in fuel prices by 2050.
- A 15-year lifetime was used in estimating energy savings for all measures. However, this is conservative for a range of technologies such as solar power systems which have an estimated lifetime of 20-30 years, or insulation with an estimated lifetime of 30+ years.

2.2 WHAT MEASURES WILL BE REQUIRED?

The report suggests a wide range of measures would be cost-effective to install. It compares the existing housing stock across the country and its energy-efficiency status (SAP ratings along with current installations of measures, e.g. insulation) with the potential measures that could be installed. Packages of measures were selected to cost-effectively upgrade the energy-efficiency of each property type.

The total number of measures required under Scenario 1b in England is presented in Table 2-1.

[16] Most of the LZC technologies considered are mature, and widely deployed across the globe (if not in the UK). For micro-CHP, which is at an early stage of deployment, estimated production costs were used.

Table 2-1: Cost-effective measures required in *How Low* Scenario 1b, England

Measure	Total measures	Measures / yr	Labour / job (days)	Installer (FTE) / yr	Ancillary staff / yr
Cavity wall insulation	3,341,437	257,034	0.4	584	389
Loft insulation	4,299,547	330,734	0.3	470	313
Draught proofing	4,814,539	370,349	0.3	631	420
External wall insulation	37,075	2,852	15	243	162
Internal wall insulation	1,489,696	114,592	6	3,907	2,602
Gas central heating & replacement	5,069,993	389,999	1.6	3,534	2,354
LPG central heating & replacement	14,804	1,139	2	13	9
Oil central heating & replacement	42,787	3,291	2	37	25
Micro-CHP	8,905,656	685,050	2	7,785	1,946
Ground source heat pumps	4,910,898	377,761	13	27,903	6,976
Air source heat pumps	10,111	778	4	15	4
Biomass boilers	10,508	808	8	37	9
Solar PV	1,193,438	91,803	4	2,086	522
Solar water heating	1,627,128	125,164	6	4,267	1,067
Wind turbine	-	-	2	-	-
Total	**35,767,617**	**2,751,355**		**51,512**	**16,796**

Source: WWF (2008)

2.3 HOW LOW CAN RESIDENTIAL EMISSIONS GO?

Data for the study was drawn from the English Housing Condition Survey (EHCS) and data on sustainable energy improvements from ACE's Fuel Prophet Model (www.fuelprophet.org)[17].

Under a scenario implementing a wide-scale roll-out using the UK government's definition of 'cost-effective' (Market potential) only a 22% reduction in carbon emissions on 1990 levels (to 33.1 MtC) is projected to be achieved by 2020, which falls short of the NEEAP targets and Climate Change Act targets.

Using the report's revised definition of 'cost-effective' (Economic potential), a 35% reduction in carbon emissions (to 27.7 MtC) can be made, which would exceed the NEEAP target, and meet the minimum requirement for the Climate Change Act targets[18] . In order to do this, significant numbers of solid wall insulation and low and zero-carbon (LZC) technologies need to be deployed, including ground source heat pumps, solar-water heating and micro-CHP.

[17] Since the *How Low* report was written, the ACE Fuel Prophet model has evolved into the T-Zero tool: www.tzero.org.uk

[18] The Climate Change Bill originally stated a range of 26-32% reduction by 2020, although this has been superseded by recommendations by the Committee on Climate Change (2008) which suggested a 2020 target of 34-42% (depending on whether an international deal is reached in Copenhagen, December 2009).

An 80% reduction by 2050 is possible under the modelled Scenario 2b, although this implies significant investment and a strong set of policies to facilitate a pathway towards Scenario 1b in 2020.

2.3.1 What are the benefits of these reductions?

The report finds that the following costs, savings and benefits arise from the scenarios:

Table 2-2: Summary of costs, savings and benefits under the *How Low* home improvement model

	Scenario 1a (2020)	Scenario 1b (2020)	Scenario 2 (2050)
Savings calculated by the model (MtC)	6.2	9.5	11.2
Total costs	£23.1 bn	£92.5 bn	£156.0 bn
Total economic benefit[19] (lower)	£80.9 bn	£108.3 bn	£111.8 bn
Total economic benefit (upper)	£84.3 bn	£113.6 bn	£118.0 bn
Net benefit (lower)	£57.8 bn	£15.9 bn	-£44.2 bn
Net benefit (upper)	£61.2 bn	£21.1 bn	-£38.0 bn

Source: WWF (2008), Table 2

2.3.2 Implications for the sustainable energy sector in the UK

In order to achieve Scenario 1b, the current installation rates fall short of the required rates for all solid wall insulation measures and renewable energy measures. The shortfall suggests a significant programme of training, investment and policy support would be needed if the required installation rates are to be achieved. These issues are covered in this report in Chapters 5 and 6.

The greatest uplift is needed in micro-combined heat and power (CHP) installation, which requires an increase of just under 685,000 installations per year. The report argues that the government must ensure that a framework is put in place to facilitate the deployment of micro-CHP across the housing sector[20].

This is an ambitious growth profile, and other studies have questioned the market readiness of micro-CHP[21]. However, should the micro-CHP market grow more slowly than this target demands[22] then the *How Low* report shows that significant savings can still be realised through widespread installation of central heating and modern, high-efficiency condensing boilers.

[19] Including fuel savings; GVA and value of carbon.

[20] Much can be learned from experience in promoting the uptake of gas condensing boilers – e.g. see ACE (2007).

[21] For example, Carbon Trust (2007) and McKinsey (2008): "Although some additional attractive options [for CHP] may exist in residential or other [small-scale] commercial settings, substantial cost reductions would be necessary to create a broader market for CHP in these applications" (p86).

[22] The market readiness of some leading micro-CHP products will be explored in the forthcoming final report from the Carbon Trust Micro CHP Technology Accelerator: http://www.carbontrust.co.uk/technology/technologyaccelerator/small_scale_chp.htm

3 Savings for households

In addition to carbon reduction, there are several other convincing reasons for upgrading the energy-efficiency of the current housing stock. These are largely defined by the government in terms of social benefit. For example, fuel poverty has risen up the agenda over the last few years, and is explicitly linked by the government[23] to three prime factors:

- the energy-efficiency status of the property
- the cost of energy
- household income.

A household is said to be in fuel poverty if it needs to spend more than 10% of income on fuel to maintain a satisfactory heating regime (usually 21°C for the main living area, and 18°C for other occupied rooms). With recent fuel-price hikes, fuel poverty is estimated to affect as many as five million households in the UK (March 2009[24]), and around one in four pensioners[25]. Britain has the highest number of avoidable deaths due to winter cold in western Europe: it is estimated that the number of excess winter deaths in 2007-08 was 27,480[26].

Increasing the energy-efficiency of households therefore has a social and health impact (through making it more affordable to heat homes), as well as an economic and environmental one. The *How Low* report focused on the environmental effects of 'cost-effective' energy efficiency, and this chapter seeks to enlarge on this to examine the potential impact on household finances through reduced spending on energy.

3.1 HOUSEHOLD SAVINGS

Installing energy-efficiency measures and LZC technologies will lead to lower fuel bills and save households money. The impact on the householders' pocket will depend on how the initial payment for the installation is financed.

The installation of energy-efficiency measures and LZC technologies will lead to financial savings for households (compared with a 'do-nothing' approach), linked directly to a reduction in household fuel bills. These savings will have particular resonance for households in the current economic climate.

Of course there is also a cost associated with the purchase and installation of these measures. Understanding (and planning for) who this cost is attributed to, and how it is distributed over time (see Chapter 4), is vital in understanding the overall impact of the installation on household finances.

The overall premise of Scenario 1b from the *How Low* model is that the measures selected for each housing type within the model all have a positive Net Present Value (NPV) over their lifetime. This implies that **there are aggregate cost savings to the householder over the lifetime of the measures selected**[27].

[23] http://www.berr.gov.uk/energy/fuel-poverty/

[24] National Energy Action.

[25] Help the Aged (2007).

[26] Office of National Statistics.

[27] The *How Low* report presents a negative saving (i.e. a net cost) to the UK for the packages considered in Scenario 1b. This is largely because **central** assumptions for fuel costs were adopted to select cost-effective energy efficiency measures, while **conservative** assumptions were used to estimate the resultant cost savings.

A 3.5% discount rate should be applied to the savings achieved in future years to give the overall NPV. This is based on the Treasury's rate for appraising public policy, and does not reflect the discount rate applied by householders when appraising energy efficiency investments.

3.2 FUEL PRICE ASSUMPTIONS

Future fuel prices are uncertain, but are expected to rise in the long term.

As depicted in Table 3-1, predicting future fuel prices is an inexact science; the range of official scenario prices for the price of a barrel of oil in 2020 varies widely. However, the general expectation is that the era of 'cheap fuel', and particularly cheap oil, is over.

Much of the UK's existing housing stock was built when fuel was relatively cheap and – with Britain's relatively mild climate – little thought was given to energy efficiency.

Table 3-1: Range of oil price assumptions (under different fossil fuel price scenarios)

$/bbl (2007 prices)	Low	Central	High	High-high
2020	45	70	95	150

Source: Updated Energy and Carbon Emissions Projections, DECC, November 2008

WWF's *How Low* report provides figures based on a conservative estimate of fuel prices (based on 2006 averages). However, the measures selected for Scenario 1b were based on those with a positive NPV over their lifetime, using a base-case (medium) scenario in the Fuel Prophet model.

Residential gas and electricity prices have seen sharp price hikes in recent years, for example rising by 65% and 44% respectively between 2002 and 2006 (Boardman, 2007).

The most recent revisions to the national energy and carbon emissions projections (November 2008) show an increase in expected future fuel prices, consistent with forecasts from the International Energy Agency and US Energy Information Administration and reflecting market tightness and higher costs of production.

Table 3-2 reproduces the retail fuel price assumptions for electricity and gas in the residential sector based on the central fossil fuel prices scenario and the central policy impact scenario.

Table 3-2: Retail fuel price assumptions (residential): Central fossil fuel prices, central policy impact

p/kWh (2007 prices)	Electricity	Gas
2005	9.1	2.4
2010	12.9	3.0
2015	12.3	3.0
2020	12.5	3.1
2025	12.7	3.2

Source: Updated Energy and Carbon Emissions Projections, DECC, November 2008

Note: These prices incorporate the costs of planned environmental policies, including energy-efficiency measures and carbon pricing under the EU ETS.

3.3 TOTAL COSTS AND LIFETIME FUEL SAVINGS

The balance of costs and lifetime savings of measures varies by country and depends critically on the assumptions made. However, the installation of a large package of energy-efficiency measures and LZC technologies could enable households to make substantial savings.

The lifetime fuel savings for the UK projected by Scenario 1b in the *How Low* model are presented in Table 3-3.

Table 3-3: Lifetime fuel savings, UK, Scenario 1b (*How Low* report, conservative assumptions)

Fuel type	Energy saved	Fuel prices, 2006	Fuel saving	Lifetime fuel saving (15 years)
	GWh	£/kWh	£m/year	£m
Gas	199,000	0.0263	5,240	78,600
Electricity	(-13,000)	0.1025	(-1,330)	(-20,000)
Solid fuel	8,760	0.0226	198	2,960
Oil and LPG	28,600	0.0345	987	14,800
Biomass	(-0.75)	0.04	0	0
All	**223,359**	--	**5,095**	**76,360**

Source: WWF (2008); adapted by SQW

It should be noted that spending on electricity (in all countries) in the existing housing stock is predicted to increase under this scenario, largely due to large-scale uptake of technologies such as ground source heat pumps.

The table above shows that lifetime fuel savings (to the householder) associated with the large-scale 'cost-effective' retrofit programme under Scenario 1b are anticipated to be in the order of £76bn. (NB: The assumptions underlying these projections are set out below.)

The aggregate lifetime savings associated with the selected measures under this set of conservative assumptions do not cover the costs of purchase and installation. We have therefore remodelled the *How Low* Scenario 1b of measures with less conservative (moderate) fuel price assumptions[28].

Table 3-4 presents the total costs and lifetime fuel savings by country, for both the original set of (conservative) assumptions and a more moderate set of assumptions based on central energy price forecasts.

From discussions with ACE, SQW has developed its own model, based on the model used in producing the *How Low* report. The model depends on the following key variables:

- average lifetime of measures (e.g. 15, 20, 30 years)
- the discount rate applied to savings (e.g. @ 3.5% p.a.)
- fuel prices (e.g. 2006 prices, 2020 prices, or an average of 2006-20 prices)
- costs for energy-efficiency measures and LZC technologies.

[28] In both instances, however, costs for energy-efficiency measures and LZC technologies have been held constant at today's prices.

Table 3-4: Scenario 1b – Total costs and lifetime fuel savings

		Conservative assumptions (see text below)		Moderate assumptions (see text below)	
	Total costs (£m)	Lifetime fuel savings (£m)	Aggregate saving to household (£m)	Lifetime fuel savings (£m)	Aggregate saving to household (£m)
England	£77,100	£69,600	(-£7,540)	£120,000	£42,400
Scotland	£8,080	£5,100	(-£2,970)	£8,700	£625
Wales and Northern Ireland	*£7,260*	*£1,640*	*(-£5,630)*	*£2,630*	*(-£4,630)*
UK	£92,500	£76,300	(-£16,100)	£131,000	£38,400

Source: WWF (2008); adapted by SQW

Note: 1. Wales and Northern Ireland have been combined in this table, as the How Low *model did not provide detail on measures used in these countries. Total costs for Scotland have been assumed using the same unit costs for measures as England.*
2. Savings were calculated assuming a 15-year lifetime for each measure under conservative assumptions, and a 23-year lifetime under moderate assumptions.

3.3.1 Conservative assumptions

In the *How Low* model, the following 'conservative' assumptions were made:

- assumed average lifetime for measures of 15 years
- no discount applied to savings
- 2006 fuel prices applied
- constant costs are assumed at today's prices for energy-efficiency measures and LZC technologies.

Overall costs for the scenario set out in the *How Low* report outweigh the aggregate saving to households over the lifetime of measures by approximately £16bn at a UK level.

3.3.2 Moderate assumptions

Our selection in the 'moderate' assumptions shown above is:

- assumed average lifetime for measures of 23 years[29]
- no discount applied to savings
- average fuel prices applied 2006-2020 (using BERR baseline projections)
- constant costs are assumed at today's prices for energy-efficiency measures and LZC technologies.

For the latter scenario, we have maintained conservative assumptions regarding the average costs of measures installed, which do not change over the time period, and we have not included a carbon cost (which would make installed measures more cost-effective).

[29] This represents the weighted average (by number of measures) lifetime of the measures installed.

Using our more moderate assumptions, aggregate savings to households over the lifetime of measures outweigh the overall costs of installing the measures by approximately £38bn at a UK level, or £1.64bn per year.

This seems reasonable, compared with other reports. For example, the *Home Truths* report (Boardman, 2007) develops a strategy that implies permanent energy savings from UK homes could be worth £12.3 billion a year by 2050.

3.4 WHO PAYS?

The question of who pays for the installation of the measures is important in looking at the financial savings to the householder. In practice, it is likely to come from a combination of three sources:

- **Public sector organisations** pay: of course, payment from public sources will, other things being equal, result in higher taxation, and so indirectly UK businesses and the general public will pay.
- **Energy companies** pay: this is the model that has been increasingly adopted through the Energy Efficiency Commitment (EEC) and its predecessors, and now the Carbon Emissions Reduction Target (CERT), and will continue through another form of Supplier Obligation. However, assuming energy suppliers pass on the costs incurred to their customers, ultimately this leads to higher unit costs for fuel and therefore indirectly UK businesses and the general public will pay.
- **Householders** pay: This is the non-interventionist route; householders who will realise the financial gains of energy savings invest in the energy-efficiency measures and LZC technologies themselves.

In modelling household savings, we have assumed that the full cost is borne (directly or indirectly) by householders. We have also assumed that a mechanism is in place to spread the cost of the measures over their lifetime (see Chapter 6).

In practice, depending on the timing of installation, some of the measures to be installed could effectively be installed at low or no-cost compared with the alternative. For example, a large number of boilers will need to be replaced on a rolling basis (the standard rate of replacement across the UK is approximately 1.5 million boilers a year). This effect has not been incorporated in the model.

3.5 REBOUND EFFECT

The model described above does not account for a rebound effect linked to the lowering of energy spend at a household level. The literature[30] identifies three types of potential rebound effect, as outlined below.

- Direct rebound effect: increased fuel efficiency lowers the cost of consumption, and hence increases the consumption of fuel (and hence CO_2 emissions). For example, because gas bills are lower, some customers may feel able to leave their heating on for longer, removing some of the positive impact achieved from energy-efficiency measures.

[30] For a comprehensive review, see UKERC (2007).

- Indirect rebound effect: decreased household spend on fuel enables increased household consumption of other goods and services, increasing the CO_2 emissions embodied in those goods and services.
- Economy-wide effects: new technology creates new production possibilities and increases economic growth, with potential consequences for increased energy use and CO_2 emissions.

The rebound effect is difficult to account for, but its impact should not be neglected. The potential effects can, however, be moderated by a concerted and widespread programme of education and awareness-raising alongside other marketing and publicity for retrofitting technologies and measures.

The existence of the rebound effect also enhances the importance of reducing emissions across all sectors of the economy, since the impact of savings in one area could be offset by a consequential increase of consumption in another.

3.6 POTENTIAL CHANGE IN MARKET VALUE OF HOMES

Little hard evidence exists of uplift in value of homes linked to energy-efficiency improvements, although there are studies indicating that some house purchasers are willing to pay a premium for low-carbon houses.

Sponge, a network of professionals in sustainable development and the built environment, concluded in 2005[31] that it was yet to be proven that there is market demand for more sustainable homes, but also that "homebuyers do not fully understand the choices available to them in relation to sustainability features". A subsequent telephone survey of 500 homeowners[32] found clear **evidence of consumer demand for high performance environmentally-friendly homes**. It found that while there was a general willingness to adopt sustainable lifestyles in their dwelling (e.g. four out of five believe that sustainable homes can help combat climate change), the general **lack of information is seen as a key barrier** in driving demand for sustainable homes, with 70% of homeowners claiming to know little or nothing at all about sustainable homes.

Recent research from Canberra[33], which in 1999 became the first jurisdiction in Australia to introduce mandatory energy disclosure for all houses on the market, found that a statistically significant relationship exists between the Energy Efficiency Rating (EER) of a house and sale price (using data from 2005/2006). For example, the study found that:

> *If the energy performance of a house improves by 1 star level, on average, its market value will increase by about 3% (2.5 in 2005 and 3.8 in 2006). Therefore, if a property owner installs R4 ceiling insulation at an approximate cost of AUD$1,200 they will, on average, improve the energy performance of a poorly insulated home by at least 1 star. This means that a detached house sold in 2005 for AUD$365,000 could fetch an additional AUD$8,979 with only a 1 star improvement in energy rating.*

While climatic variation is significantly greater in Canberra than in the UK, this is an encouraging initial indication of a positive relationship between energy efficiency and sale price, and reinforces the argument for the Energy Performance Certificate to be given a higher profile in home transactions.

[31] Upstream for Sponge Network (2005).
[32] Ipsos MORI survey for Sponge Network (2006).
[33] DEWHA (2008).

3.6.1 Evidence from non-domestic buildings

Recent research[34] commissioned by RICS (Royal Institution of Chartered Surveyors) found that office buildings in the US with a high Energy Star rating are attracting rental premiums of 3% more per square foot compared with non-green buildings of the same size, location and function. In addition, when looking at effective rents (the true rent of a property, considering rental concessions, spread over the life of the lease) the premium is higher still, above 6%.

The research also examined the impact on the selling prices of green buildings, and found that the premium was in the order of 16%.

[34] RICS (2009).

4 Employment effects

4.1 INTRODUCTION

In this study, we have focused our attention on the impacts that installing/retrofitting energy-efficient measures have on employment (measured in labour years). We also briefly discuss the effects on output (the impact on Gross Value Added, GVA), although the positive benefit identified is limited to the direct effect associated with the installation of energy-efficiency measures.

Usually the full impact on these economic variables is calculated from three components[35]:

- The **direct impact** – this is the immediate effect after the change in final demand. For this study, this represents the impact on the firms directly *installing* the energy-efficiency measures, in addition to ancillary jobs such as administration, management, technical support and monitoring.
- The **indirect impact** – the demand for inputs to produce the additional output will in turn cause additional demand for the products used to form those inputs. For this study, this represents the impact on the supply chain associated with the installation of measures including the *manufacture and servicing* of the energy-efficiency measures.
- The **induced impact** – when output is increased there is an increase in compensation of employees and other incomes, which may cause further spending and, in turn, further changes in final demand. For this study, only the impact from the *shift in household expenditure* (of money freed up by less expenditure on energy following the installation of energy-efficiency measures) is considered.

The latter is of particular interest, as we anticipate that money saved through energy-efficiency measures will lead to a shift in expenditure from a capital-intensive product (energy) to a more labour-intensive product (general goods and services); see Table 4-2.

The most consistent way of analysing the potential impact of large-scale retrofit is to examine the effect of previous similar programmes. However, due to the availability of comparable data, the estimates for each of these components come from different sources. Separate discussions on each of the components can be found below.

4.1.1 Headline findings

Table 4-1 provides a summary of our headline findings of the impact that previous energy-efficiency policies and programmes have had on employment and GVA in England. The detailed figures available from the model used in the *How Low* report only allow for extrapolation in England; further modelling would be required to provide robust figures for other UK countries.

[35] These distinctions are made by the ONS in its analysis of UK Input-Output tables.

Table 4-1 Summary of employment and output impacts of domestic carbon mitigation measures (England)

	Employment impact	GVA (£)
Direct	+ 11.5 (total FTE per £1m invested) Overall expected impact of *How Low* Scenario 1b (England): 68,300 FTE staff per year	£22.8bn
Indirect	+ 1.5 :1 (ratio to total direct employment) Overall expected impact of *How Low* Scenario 1b (England): 102,500 FTE staff per year	-3.5 to zero (ratio of total indirect and induced impacts compared to direct)
Induced	+ 32.0 (total FTE per £1m saved on energy) Overall expected impact of *How Low* Scenario 1b (England): 58,100 FTE staff per year	

Sources: *SQW, WWF (2008), ACE (2000), Committee on Climate Change (2008)*

Notes: 1. Figures for the direct employment impact are from Scenario 1b in the WWF's How Low *report.*
2. The figures for the indirect and induced impact show the average across the programmes considered in the studies used in this project over 15 years.

The most striking conclusion is that energy-efficiency measures have significantly more impact on employment than output. This is confirmed by numerous studies, including macro-economic modelling conducted for the European Commission under the SAVE Employment programme[36]. This is in part because the installation of energy-efficiency measures is labour-intensive, albeit relatively low-skilled.

The largest number of jobs are anticipated through the *indirect* impact associated with the retrofit programme, i.e. the manufacturing and servicing of the energy-efficiency measures. However, the ability to fulfil this potential within the UK will depend on investment in, and support of, domestic companies manufacturing energy-efficiency and LZC technologies. The rate of leakage (the proportion of job creation outside the UK associated with the intervention) did not form part of this research.

Potentially, the *induced* impact on employment (caused by greater household spending in the wider economy following energy savings due to energy-efficiency measures) is also significant. In one example, the induced impact accounted for more than 97% of total estimated employment generated by a predecessor of the government's Certified Emissions Reduction Target (CERT)[37]. This is because, on average, the energy sector generates far fewer jobs per unit of output compared to the average number of jobs generated by the economy as a whole (see Table 4-2).

However, it should be noted (as outlined in Chapter 3), that this will in itself have impacts on carbon emissions through additional spending in the wider economy, via the 'indirect rebound effect'.

[36] Capros P, Paroussos L & Stroblos N (1999).

[37] A study by Jeeninga et al (1999) estimated that the expenditure of the money freed up from the energy savings from the Energy Efficiency Standards of Performance (SoP) was responsible for generating 12,000 labour years (over 15 years) compared with the total 12,260 labour years directly generated by scheme.

Table 4-2 Jobs generated by spending on the energy sector and the wider economy, 2007

Sector	Total output (£ millions)	Total employment (number of jobs, thousands)	Labour intensity (Jobs per £1m output)
Energy	73,200	137	1.87
Total economy	1,400,000	31,500	22.5

Sources: *ONS (2008), BERR (2008)*

Notes: 1. Total output for the energy sector and total GVA for the total economy is presented. Output for energy is for electricity, gas and water supply.
2. Employment figures for the energy sector are taken from estimates found in BERR's 'UK Energy in Brief July 2008'.

The potential for job creation and security through energy-efficiency measures is particularly important in the current economic climate. Around 71,000 jobs in the construction industry were lost between November 2007 and October 2008[38]. It has been estimated that 450,000 jobs will be lost in the construction sector between 2008 and 2010[39]. The wider case for a 'Green Fiscal Stimulus' to counter the recession has been advanced by a number of commentators, including Stern (2009).

4.1.2 The importance of policy design

In previous programmes, the indirect impact on employment has been almost double the direct impact. However, this can vary considerably depending on policy design. For example, the estimated indirect impact on employment from grant schemes to install energy-efficiency measures in low-income households (Home Energy Efficiency Scheme – HEES) was almost double the direct impact. However, the indirect impact from subsidising the installation of energy-efficiency measures in a wider range of households (the Energy Efficiency Standards of Performance – SoP), was estimated to be half of the direct impact (see Table 4-4).

One possible explanation for this large difference is that energy suppliers, who were responsible for coordinating the installation of measures under the SoP, were able to exploit significant economies of scale that households which had measures installed under the HEES (coordinated by the individual households themselves) were not able to exploit.

Changing the **source** of funding can also significantly alter the scale of net employment generated by the installation of energy-efficiency measures. For example, changing the source of funding away from 100% government funding to a general funding source (private and public) was estimated to increase the employment impact for one of the programmes reviewed by more than six-fold[40]. This estimate depends on the assumption that government money spent on the energy-efficiency scheme would otherwise have been spent on wider government programmes, which are in general much more effective at generating jobs than private expenditure[41].

Changing the recipient of energy-efficiency measures can also have a significant impact on the employment impact. For example the HEES programme, which targeted low-income

[38] Office of National Statistics cited in: www.building.co.uk/story.asp?sectioncode=29&storycode=3127428&c=3

[39] The 2020 Group cited in: http://news.bbc.co.uk/1/hi/business/7904936.stm

[40] Jeeninga et al (1999) estimated that if the HEES had been funded out of the general consumption (government and private sector), then it could generate 23,300 labour years (over 15 years) whereas it is estimated to have generated 3,800 labour years when the funds for this programme came entirely from the government.

[41] Note that the generation of increased employment is not a benefit *per se*: for example, employing twice the number of public servants to do the same amount of work would not generally be regarded as beneficial.

households exclusively, is estimated to have increased the amount of employment generated through the switch in household expenditure (related to energy savings) by more than 3½ times compared with the SoP programme, which targeted a wider range of households (see Table 4-5). This is likely to be because poorer households tend to spend a higher percentage of any additional income (or in this case avoided expenditure on energy) to cover their basic living needs.

4.2 EMPLOYMENT

4.2.1 The direct impact

In England, the direct impact on employment of *How Low* Scenario 1b would be 68,300 FTE staff per year to 2020. Just over half are required to install ground source heat pumps.

The estimates of the direct impact on employment of implementing a large-scale retrofit programme across the UK (assumed to be installers of energy-efficiency and LZC measures and associated ancillary staff) are provided by the model used in WWF's *How Low* report.

In England, under Scenario 1b, a total of 68,300 FTE staff will be required per year to 2020. This consists of:

- 51,500 installers[42], and
- 16,800 ancillary staff (administration, management, technical support/monitoring etc).

Just over half of these additional employees (34,900) are required to install (and administer the installation of) ground source heat pumps, which represents one of the most labour-intensive measures installed (at an average of 13 days per installation).

The total cost of implementing Scenario 1b in England is £77.1 billion. This means that 11.5 FTE jobs (over the entirety of time considered, rather than per year) are generated for every £1 million pounds invested in energy efficiency measures in Scenario 1b.

4.2.2 The indirect impact

In England, the indirect impact on employment of *How Low* Scenario 1b is anticipated to be around 102,000 FTE staff per year to 2020[43].

The estimates of the indirect impact on employment used in this study are largely based on those contained in the Association for the Conservation of Energy (ACE) report *Energy efficiency and jobs: UK issues and case studies*. For this study, the indirect impact is interpreted as the impact on the supply chain associated with the installation of measures: primarily the manufacture and servicing of the energy-efficiency measures. The estimates in the ACE report are based on those made by others such as the National Audit Office.

The ACE report considered the impact of policies (listed in Table 4-3) rather than individual technologies. These policies match well with the policies the UK government is currently pursuing and/or has signalled that it wishes to use to deliver the installation of energy-efficiency measures in households.

[42] This compares with an estimation in the government's Heat and Energy Saving strategy consultation document of 34,000 jobs in England and Wales installing and maintaining whole-house packages.

[43] The estimate varies widely due to the large variation in the ratio of the amount of indirect jobs created compared with the number of direct jobs created by each scheme.

Table 4-3 Energy-efficiency policies considered by the SAVE study

Policy considered in SAVE study	Policy description	Equivalent current policy
Home Energy Efficiency Scheme (HEES)	Grant scheme for low-income households	Warm Front and Decent Homes programme
Energy Efficiency Standards of Performance (SoP)	Aimed mainly at low-income households, run by electricity utilities and financed by a levy on all domestic (and small business) consumers. Estimates in this study only relate to insulation measures	CERT (and possibly Supplier Obligation for the future)
Fridgesavers programme	Actually part of SoP, but grants for replacing fridges	Grants for large domestic appliances
Heatwise	Training scheme for installers for heating system	
Building regulations, 1995		Building regulations, 2005

Sources: SQW, Jeeninga et al (1999), Impetus Consulting

Table 4-4 Indirect employment from energy-efficiency policies

Policy considered in SAVE study	Amount invested, £ millions	Indirect jobs generated: per £ million invested (labour years)	Indirect jobs generated: Ratio to number of direct jobs created
Home Energy Efficiency Scheme (HEES)	359	46	1.9
Energy Efficiency Standards of Performance (SoP)	138	6	0.5
Fridgesavers programme	6	1	0.1
Heatwise	5	0	0.0
Building regulations, 1995	99	11	0.6
Total/Average	607	31	1.5

Source: SQW, ACE(2000)

Notes: 1. Amount invested over the entirety of the programme.
2. Indirect jobs are defined as those generated in manufacturers and others in the supply chain associated with the installation of energy-efficiency measures, including those that ensure compliance and issue ratings.
3. Estimate of the number of indirect jobs based on information in the ACE report. For some of the programmes this report only presented the number of jobs generated in one year of the programme. To produce estimates of labour years, the multiplier of number of direct jobs to total amount of direct labour years was used.

The amount of indirect employment generated by energy-efficiency programmes is (on average) about double that of the direct employment generated (see Table 4-4 above). However, there is a large variation in the ratio of the amount of indirect jobs created compared with the amount of direct jobs created by each scheme. The most striking difference is found by comparing the indirect employment generated by the Home Energy Efficiency Scheme (HEES) (46 labour years per £m invested) with the Energy Efficiency Standards of Performance (SoP) (17 labour years), considering that both schemes installed the same type of energy efficiency measures.

years), considering that both schemes installed the same type of energy efficiency measures.

One possible explanation for the difference is that measures installed under the SoP were coordinated by the energy suppliers and therefore they were able to exploit significant economies of scale and use labour very efficiently, whereas under the HEES, households themselves had to organise the installation and therefore were unable to get the full potential gains in labour efficiency. This may have had implications for installation, but also through the supply chain, by, for example, the placement of bulk orders under the SoP.

Given the scale and type of programmes, it is reasonable to assume these two programmes form the bounds of a likely indirect employment impact (i.e. of between 0.5 and 1.9 times the scale of direct employment). In England therefore, this provides us with upper and lower bounds respectively of 130,000 FTE per year and 34,200 FTE per year. The average ratio for these programmes was 1.5 indirect jobs per direct job created, and we have taken this figure as a reasonable potential, particularly if policies continue to be supportive of the development of the manufacture of energy-efficient and LZC products and the supply chain. This would imply an indirect impact of 102,000 FTE jobs per year.

4.2.3 The impact from money freed up by energy savings (the induced impact)

In England, the induced impact on employment of *How Low* Scenario 1b is anticipated to be 58,000 to 2020.

The estimates of the induced impact on employment used in this study are largely based on those contained in the Association for the Conservation of Energy (ACE) report *Energy efficiency and jobs: UK issues and case studies*, which in turn are based on estimates derived in a study commissioned by the European Commission under the SAVE Employment project[44].

In the ACE and SAVE studies, the induced impact considers the impact on employment brought about by additional household expenditure on goods and services, which in turn has been brought about by a decrease in expenditure on household energy.

In summary, the following methodology is used to derive the estimate of impact on employment (further details can be found in Annex C):

- Firstly, econometric methods are used to form saving and expenditure functions for the UK households using national accounting data. The expenditure functions estimate the increase in consumption of various products from selected drivers, for example the rise in income.
- Secondly, the resulting estimates on expenditure by category are related to the output side of the economy through input-output relationships. In the SAVE study, the 123 product categories in the UK Input-Output accounts are aggregated to the seven expenditure categories used in the study.
- Finally, the impact on employment from the increased expenditure on products is estimated by use of ‘labour coefficients’, derived from national account data. These labour coefficients state the increased use of various types of labour with the increased demand for particular products.

[44] Jeeninga, H, et al, (1999)

The studies present separate estimates of total impact on employment from the:

- initial investment required to install the energy-efficiency measures
- money freed up from the energy savings generated by the measures
- impact of government expenditure through the use of grant funds.

While, in our view, the induced impact will be present in all of these, only the induced impact from the energy savings is discussed below. This is because the latter accounts for the majority of the induced impact, and because it is difficult to identify separately the induced impact in the other elements.

Inevitably, there are questions on the relevance of using historical data (as in the SAVE study) to evaluate the impact of future measures, particularly when there is a significant difference in:

- the market conditions operating in the historical data and that operating in the future
- the scale of future action anticipated compared with that which has happened in the past.

Nonetheless, these studies provide a useful guide as to the quantum of employment expected to be generated from future, similar, policies.

Table 4-5 shows estimates from the ACE study on the long-term impact (over 15 years) on employment (measured as FTE per year) from money freed up by energy savings from installation of the energy-efficiency measures for each of the policy measures it considered. On average, the schemes considered generated 32 FTEs per year per £1 million saved in energy expenditure.

Table 4-5 Induced employment from expenditure freed up by savings from energy-efficiency policies

Policy considered in SAVE study	Amount saved, £ millions saved per year	Induced jobs generated by per £ million saved (FTE per year)
Home Energy Efficiency Scheme (HEES)	21.2	69
Energy Efficiency Standards of Performance (SoP)	42.0	19
Fridgesavers programme	1.1	28
Heatwise	0.1	31
Building regulations, 1995	21.3	22
Total/Average	85.8	32

Source: SQW, ACE (2000)

Note: The time period considered in this study was 15 years.

Estimates from the ACE study concluded that the money freed by energy savings generated by insulation measures installed under the HEES generated the most jobs, 69 FTEs per year per £1 million saved, of all the policies considered by the SAVE study. In contrast, energy saved from measures installed under SoP generated the least amount of jobs, 19 FTEs per year per £1 million saved. The other programmes considered generated between 22 and 31 FTEs per year per £1 million saved.

It is not clear why there is a difference in the estimates for the impact of insulation installed under the SoP and measures installed under the HEES, given that both schemes installed the same type of energy-efficiency measures. One possible explanation for the difference is that measures installed under the HEES were exclusively targeted at low-income households, who are much more likely to spend a greater amount of the money saved compared with the wider range of households that were eligible for measures from the SoP.

We have therefore assumed that a reasonable estimate of induced employment is 32 FTE jobs per year per £1m saved. Linked to an expected £42,400 million saving in England across the lifetime of the measures (see Chapter 3), or £1,820 million per year, this means an estimated 58,100 jobs (FTE/year) could be created in England from the induced impact of household expenditure.

4.2.4 The impact on employment by changing the source of funding of energy-efficiency measures

The SAVE employment study analysed the impact on employment by changing the source of funding for the HEES. The results implied that switching away from purely government funding (the HEES distributed grants to low-income households to install the energy efficiency) to a mix of funding that matched the pattern of expenditure witnessed in the economy as a whole (i.e. government and private), would increase the amount of employment generated by six times or more. This estimate assumes that any government funding for energy-efficiency measures must mean a cut in other government programmes (as total government spending and the level of public debt are held constant in the study), which are generally more effective at generating employment than energy-efficiency schemes.

4.2.5 The impact on employment by changing the recipients of funding

Changing the target recipient of energy-efficiency measures also significantly changes the employment impact. Targeting low-income households exclusively (as is the case of the HEES) is assumed to be one factor in the increase in the amount of employment generated from expenditure of the energy savings, following the installation of energy-efficiency measures. In the case of HEES, this effect was more than 3½ times the induced employment compared with the case when measures are installed in a wider range of households (as under the SoP). This is likely to be because households tend to spend a higher percentage of any additional income they have the poorer they are.

4.3 GVA

4.3.1 The direct impact

The direct impact on GVA is drawn from the model used in WWF's *How Low* report. Under Scenario 1b, the number of measures required across the UK by 2020 costs £92.5 billion and gives rise to an associated rise in GVA of £27.3 billion.

The equivalent figures for England under Scenario 1b are: a cost of £77.1 billion giving rise to an associated GVA of £22.9 billion.

In both cases, the associated GVA is approximately 30% of the overall cost of the programme of implementation.

4.3.2 Indirect and induced impact

There is a limited amount of literature available which studies the wider (indirect and induced) impact on output from energy-efficiency measures. The most recent studies on the UK were conducted for the Committee on Climate Change (CCC), for its first set of recommendations on the carbon emissions target for 2020 and carbon budgets for the intervening period. These studies looked at the impact for all the measures that the CCC considered, including energy-efficiency measures, for meeting its recommendations for the 2020 emissions target. For this reason, the results are not directly applicable to the consideration of energy-efficiency policies alone. Nonetheless they provide a useful insight.

One of the studies (by Cambridge Econometrics) for the CCC concluded that indirect and induced impacts on output could cause the direct costs to multiply by more than three-fold; the direct costs of 0.25% of GDP[45] could be multiplied to 0.82% of GDP once indirect and induced impacts are taken into account. However, another study (conducted on a revised version of the HMRC model) concluded that the indirect and induced impacts on output were effectively zero.

The differences in the outcomes from the two CCC projects relate to the different approaches taken in the two studies. For example, the Cambridge Econometrics model does not necessarily model the full use of resources, whereas the HMRC model does. Therefore the outcomes from Cambridge Econometrics can be viewed as including the transitional effects (i.e. in the interim period between the current state and the new) stimulated by the adoption of climate change mitigation policy.

A large-scale retrofit programme will lead to a redistribution of economic activity with knock-on effects (including winners and losers) throughout the economy. However, while the CCC findings cannot be applied directly to this study, they do suggest that the overall impact of an energy-efficiency programme on GDP, though difficult to estimate with any precision, is likely to be positive in the long term.

[45] NB: GVA, unlike GDP, ignores taxes and subsidies.

5 Deliverability

A significant opportunity exists for cost-effective energy saving measures to be rolled out across the UK.

The deliverability of a large-scale retrofit programme will be vastly improved if it is tied to key delivery points. These include:

- Point of sale: which could include fuller use of the Energy Performance Certificate (EPC) to enforce uplift in standards.
- Planned renovation work: Over £23 billion per year is spent on repair, maintenance and improvement (RMI) works to existing housing (ONS, 2009), representing a significant 'missed opportunity' in terms of low-carbon refurbishment (FMB, 2008).

For both householders and construction workers, cost-efficiencies will be achieved if many of the measures can be installed at the same time (which will also reduce overall negative impact on householder lifestyles, for example through stress linked to building works). In particular, using the opportunity of renovation work, such as removing a wall or installing scaffolding to repair/extend the roof, to install retrofit energy-efficiency measures or LZC technologies has the potential to save much of the infrastructure cost associated with installation.

5.1 CONSTRUCTION INDUSTRY

The recession has significantly impacted on the construction industry. A large-scale programme of retrofit could provide an important boost to the repair and maintenance sub-sector, which is particularly affected. A whole-house approach would be most effective, but this will require skills development and training. Any retrofit programme must be designed for ready engagement from within the industry, and therefore be cognisant of the key elements of 'buildability'.

The economic downturn of 2008/09 has not been good to the construction sector. The volume of construction output from first quarter 2008 to first quarter 2009 fell by 6% compared with the previous 12-month period, and in the first quarter of 2009 was 9% lower compared with the fourth quarter of 2008 (ONS, 2009). New housing construction work fell by 10% over the same period, and (despite some commentary suggesting that the RMI market may benefit as householders switch their investment to upgrading their existing housing, rather than moving), RMI work also fell by 9% (*ibid*).

Nonetheless, for the construction industry, the retrofit agenda presents significant growth potential as shown in the figures above and in the preceding chapters.

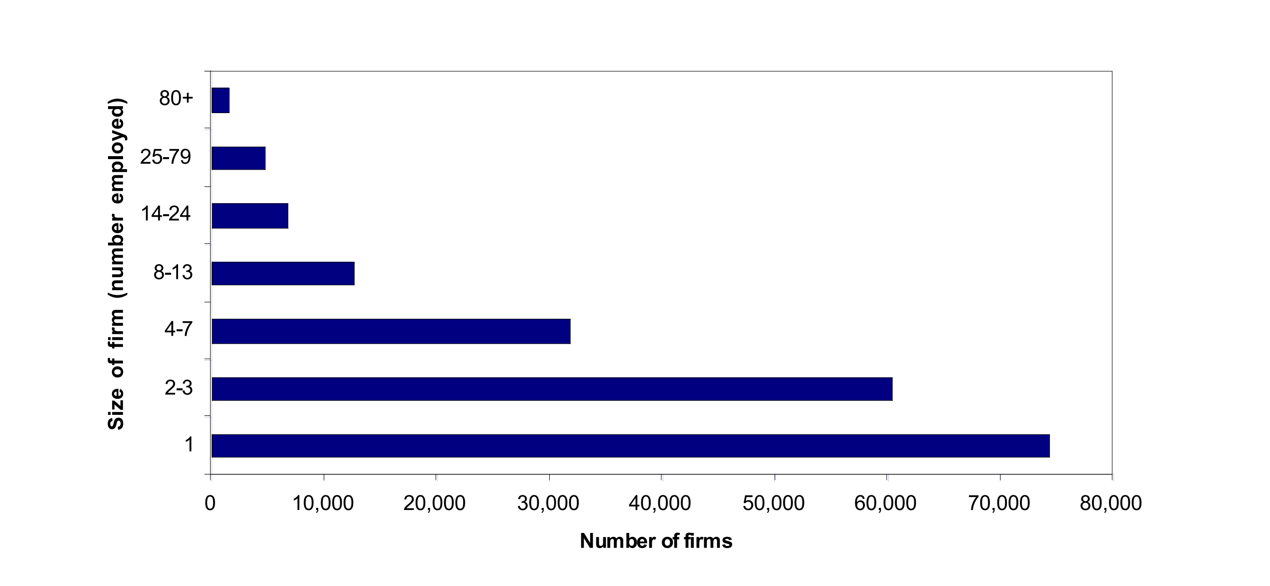
5.1.1 A whole-home approach

In addition to the gain in cost-efficiency of carrying out a range of retrofit simultaneously (as outlined above), the disruption is significantly reduced if the low-carbon work can be scheduled to happen at the same time as other work. Measures will also be *more effective* if carried out in an integrated fashion, using a 'whole-home' approach. For example insulation will be most effective if draught-proofing is carried out at the same time, and there is no point in installing large-scale technologies such as ground source heat pumps until a house is fully insulated, thus requiring a lower heat load.

A whole-home approach also allows for good integration of different energy systems with improved building fabric and the installation (and explanation to the householder) of new control systems. Failure to integrate these different elements will almost certainly lead to poor real-life performance and much higher CO_2 emissions than expected.

The move towards a whole-house approach to energy efficiency is not however supported by the structure of the supply chain, where individual tasks are managed by separate suppliers. The construction industry is made up of a large number of small firms (Figure 5-1), and this is particularly true of the RMI market. This structure presents a positive story for the industry as the positive economic impact of a stimulus will be spread widely among a large number of businesses.

Figure 5-1 : Size distribution (by number of employees) of construction firms, GB, 2007 (3rd quarter)



Source: BERR (Department for Business, Enterprise and Regulatory Reform), 2008 (Table 3.1)

However, it also raises serious difficulties in terms of engagement across the sector. Inevitably skills, knowledge, interest and experience will vary widely in this context, whereas the scale of intervention described requires a relatively rapid and widespread engagement from across the industry.

> *Key to managing this transition is to engage more fully with the construction industry, specifically the SME firms who are already involved in housing repair, maintenance and improvement works. If the opportunities for low-carbon refurbishment are to be exploited fully, this kind of renovation needs to be on offer every time a building tradesperson is asked to quote for work. (FMB, 2008)*

5.1.2 Buildability

In practice this means taking account of established custom and practice among the construction industry. Builders like to 'work with what they know', to avoid the risk of things going wrong, to be able to carry out the job effectively and efficiently, and to minimise the chance of being called back to deal with complaints. Key elements of 'buildability' have therefore been set out by the FMB (2008) as products and methods which are:

- **Practical** – relatively simple and quick to implement
- **Replicable** – refurbishment packages that can be installed many times over by the general population of installers
- **Affordable** – within reach of a viable market
- **Reliable** – products and systems need to work well and be robust; in particular contractors have to be confident of their ability to achieve satisfactory results for the customer
- **Sellable** – costs and benefits should be easy to understand for householder and installer
- **Available** – i.e. not specialist products which take weeks to order
- **Guarantee-able** – installers will abandon products which lead to repeated call-backs
- **Profitable** – firms need to be able to make a living from it.

Any retrofit programme should be cognisant of these elements of 'buildability'.

5.1.3 Short-to-medium term employment levels in the construction industry

The construction industry is made up of 187,000 companies (BERR) and is estimated to employ 2,241,430 individuals (Construction Skills Network, 2009). When civil engineers, architects, surveyors and other construction professionals and technical staff are included, this figure increases to 2,535,490[46]. Many of these are skilled and semi-skilled trades with relevant skills for the retrofit agenda (see Figure 5-2).

Estimates of job loss in the construction industry over the period of the recession range from 300,000 jobs (RICS prediction[47]) to 450,000 jobs (the 2020 Group[48]), i.e. up to 20% of the workforce. The expectation however is that the worst of the recession will be over by late 2010, and with an expansion of the economy, facilitated by an easing of credit conditions, the construction market is expected to bounce back fairly quickly with construction output starting to rise again from 2011, reaching 3% in real terms by 2013 (Construction Skills Network, 2009).

Thus, despite the recession, employment in the construction sector is projected to rise in the medium term, and is projected to employ around 2.6m people in 2013. For the sector as a whole, the annual recruitment requirement (ARR[49]) is anticipated to be in the region of 37,000 in the period 2009-2013 (not including new entrant trainees), with 16% of this requirement in London.

This is an important finding, because it cannot therefore be argued that a large-scale retrofit programme will contribute towards filling an overall gap in construction sector employment left by the economic downturn. Nonetheless, there will be 'slack' in the market in specific areas of the construction sector and, despite positive projections for the sector as a whole (largely driven by continuing infrastructure investment), **output in housing repair and maintenance – the most relevant sub-sector for retrofit – is likely to decline over the period (2009-2013) as disposable incomes fall and consumers cut back on non-essential work** (*ibid.*)[50].

[46] Geographically, the largest region in terms of employment is the south-east which accounts for over 15% of all construction employment.

[47] Pers. comm. Berry.

[48] Cited in: http://news.bbc.co.uk/1/hi/business/7904936.stm

[49] The ARR takes overall demand into account, as well as net flows of labour between regions and nations.

[50] However, this varies significantly by region and nation, with Wales for example expecting to see growth in housing R&M output of 8% between 2009 and 2013, the highest rate of growth in the UK.

The Construction Skills Network anticipates that public sector spending in repair and maintenance may be maintained in the short term, despite a wider tightening of programmes and budgets, due to the level of employment it supports. However, ongoing repair and upgrading work on public-sector housing through the Decent Homes for All programme in England, and the Welsh and Scottish Housing Quality Standard Schemes, are likely to be more than cancelled out by the reduction in private housing RMI, which accounts for 65% of the sub-sector.

Policy to support the rapid roll-out of retrofit measures on a large scale will therefore be most helpful for overall employment creation and retention in the immediate short term, but will continue to be of specific importance for saving jobs in the repair and maintenance sub-sector, which is dominated by SMEs, into the medium term. If rapid enough, this policy incentive could help many thousands of SMEs to remain solvent in these challenging economic times.

Overall construction sector expansion in the medium term implies that some serious recruitment will be required if a large-scale retrofit programme similar to that of Scenario 1b were to be put in place (although it will also help to safeguard jobs at risk in the sector; particularly in R&M as discussed above). Of the 37,000 jobs in the ARR predicted for the construction industry in the UK as a whole, just under 30,000 (29,840) are projected for England. This, however, is just 58% of the (additional) annual projected employment linked to the additional installation of retrofit measures in England alone (51,512) under *How Low* Scenario 1b. So, **the implementation of an ambitious national programme of retrofit will require a significant recruitment drive on top of those projected by industry**.

5.1.4 Local jobs?

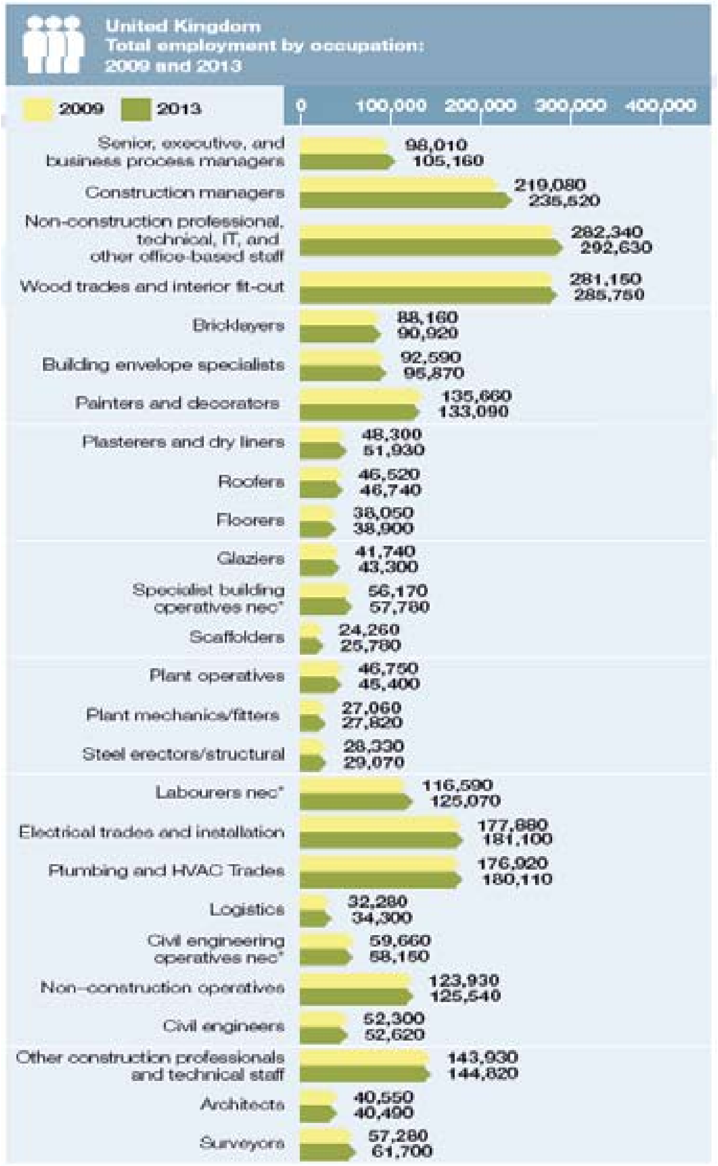
Stimulation of employment is likely to also have a positive social impact. In terms of job creation, registered social landlords (RSLs) have often led by example – concentrating their retrofit work in deprived areas, providing 'regeneration through job creation'.

However, the current system of national contracts being awarded by major investors in retrofit – particularly energy companies through the CERT scheme – means that installation jobs may not be carried out by local contractors. As part of this research, examples were reported of contractors travelling several hundred miles to install energy-efficiency measures. From a sustainability point of view this is clearly not an efficient way of operating, but may be difficult to legislate against. Measures such as minimum percentages of installation jobs to be awarded locally could be written into contracts[51]; in the short term this may mean the CERT scheme has the ability to kick-start a more evenly spread upskilling of the workforce in preparation for a large-scale roll-out of retrofit measures (see next section).

In the long term, as the market for energy efficiency and LZC technologies matures, local demand is likely to be increasingly met by small, local businesses – as is the case in the current RMI market.

[51] Assuming this could be achieved without violating employment and competition law.

Figure 5-2: UK construction sector: projected total employment by occupation (2009 and 2013)



Source: Construction Skills Network, 2009

5.2 SKILLS

Many of the required retrofit skills need small amounts of training, with relatively short training courses. Some of this will be provided by manufacturers and/or paid for by the construction industry itself through a training levy. A thorough understanding of building dynamics will become increasingly important, and sufficient training provided, to ensure that enough project managers are available with a solid understanding of the 'whole-building' approach. S/NVQs will need to continue to develop to reflect the importance of the retrofit agenda.

A range of measures was proposed in the *How Low* report's Scenario 1b (see Table 2-1). This has implications for the specific skill requirements associated with the direct employment creation, i.e. for the installation of these measures.

The bulk of the installation (direct) jobs are relatively straightforward for builders with generic building skills. For example, a plasterer can – in principle – be easily trained how to fit internal solid wall insulation, and an experienced plumber can fit new types of boiler.

Most of these skills can be taught with relatively short training courses of up to a week for those with good building skills, along with courses of Continuous Professional Development.

However, the specialisation and division of responsibility between different building trades – supported by custom, long practice and reasonable concerns over risk and liability – can make changes that appear simple in principle difficult to effect in practice.

Furthermore, there is a fundamental challenge when it comes to underpinning knowledge. A new set of technical certificates will become necessary to ensure that builders of all trades and at all levels understand the importance of energy efficiency, and how different building jobs can work together (or, conversely, against one another) in its achievement. For example, in fitting internal wall insulation, it is important for builders to have an understanding of thermal bridging, where vapour membranes need to go, what happens with ventilation, etc. Similarly, good work in solid wall insulation can be rendered less effective by drilling holes for electrical wiring or plumbing, which can have a subsequent effect on air-tightness.

The availability of skilled people to project-manage the process is key to success (FMB, 2008) – people who understand the full energy impacts of a renovation/retrofit programme on a building as a whole as well as other aspects of project management such as optimal ordering of works on-site and the integration of energy-efficiency measures with energy supply technologies (FMB, 2008).

The Sector Skills Councils are already gearing up for increasing retrofit activity: National Occupational Standards (NOS) have recently been set by Summit Skills for training on the installation of LZC technologies, which will in turn lay the foundations for the development of S/NVQs[52]. Killip (FMB, 2008) argues that innovation in skills training starts with short courses, which in turn are an important first step in mainstreaming the capacity to deliver new services.

S/NVQs will need to continue to develop to reflect the importance of the retrofit and low-carbon agenda, and new qualifications may in time be needed. However, it appears that in the short term, until a clearer direction is given from government which will in turn stimulate demand for retrofit measures, short courses and add-on modules for S/NVQs are likely to fill the demand for upskilling of industry professionals in most areas of retrofit. It is unlikely that training providers and awarding bodies will develop new S/NVQs until sufficient uptake can be expected to make the courses viable to test and award certificates. There is no point in training people if there are no jobs to go to.

Our consultees generally felt that in the medium term the industry will be able to respond to an increase in demand for new skills. Indeed, the construction industry itself may be expected to foot the bill for an increase in training of industry employees: the current training programme coordinated by ConstructionSkills is substantially funded through an industry levy, and then administered back to individual firms as training grants. Recently it has been reported that ConstructionSkills intends to cut its training grants; this is clearly not helpful in terms of developing skills and confidence for the long term.

An alternative area of training for certain types of measure is that of courses run by manufacturers of retrofit products, for construction workers to become 'approved installers' linked to specific technologies. Looking forward, it will be important for the Sector Skills Councils to work closely with these manufacturers and ensure that the training aligns with the NOS and NVQs. Better regulation of 'approvals' of particular courses by energy companies may also be required.

5.3 A RANGE OF MEASURES

The *How Low* report proposed a range of retrofit measures, covering energy-efficiency improvements and LZC technologies for small-scale energy generation. Inevitably there are some measures for which rolling-out on a large scale is more readily achievable than others.

Some of the technologies proposed are more 'market-ready' than others, and will inevitably vary in terms of current deliverability on the scale proposed (for example micro-CHP). Nonetheless, the broad scale of programme outlined, involving the installation of a wide range of technologies and measures, suggests a significant level of employment impact.

5.3.1 Timing

The UK has already achieved a good deal in tackling energy efficiency with programmes such as Decent Homes, Warm Front and CERT (and its predecessors). Over two-thirds of the available housing stock has already been captured with basic cavity wall and loft insulation and other 'quick win' measures. From 2015 onwards, the 'long wins' will have to take precedence, including solid wall insulation, dealing with listed buildings, etc.

With about one in five buildings in England (21.7%) and up to a third of buildings in Wales built before 1919, a different range of measures will be required to those taken so far. Solid wall insulation in particular will be increasingly important. Yet these will be more costly and less desirable – on the whole – to put in place than cavity wall or loft insulation.

[52] Scottish and National Vocational Qualifications

6 Policy recommendations

The research team has made a brief overview of the policy recommendations in the *How Low* report and other key recent literature on the retrofitting agenda. In this chapter, we highlight some of the key policy recommendations related to the agenda, particularly focusing on those related to deliverability and economic/employment impact.

6.1 GENERAL INDICATIONS FOR GOOD POLICY DEVELOPMENT

Future policy development for retrofit needs to be guided by two basic objectives:

1. creating confidence in future public sector support for the retrofit agenda (long-term certainty will encourage investment and innovation)[53], and
2. moving the low-carbon retrofit market away from a reliance on grants (i.e. developing incentives for householder action and engaging with the mainstream RMI construction sector).

A strong set of policies will take several years to develop and implement. The government must not take a short-term view in policy-making; it must instead actively plan for and develop the policies needed for stimulating the retrofit market to 2020 and beyond.

Longer term, the goal must be to develop a situation whereby the only materials, and the only installers, available are 'retrofit approved'. To reach this point, the government will need to work closely with supply chains and builders merchants[54], as well as with Sector Skills Councils (SSCs) and construction industry representative bodies.

6.2 STIMULATION OF MARKET DEMAND

The previous chapter has shown that a large-scale retrofit programme is feasible and deliverable. However, the scale of home-ownership across the UK, coupled with large numbers of SME installation operators, means that delivery will not be easy. From across our consultations, there was one over-riding consistent message: **creating/stimulating market demand for retrofit measures is an essential first step**. The building industry may be disparate and slow-moving, but it will respond readily to a significant growth in client demand.

The key question is how to create demand for low-carbon housing. A range of policy options are considered below.

[53] SQW Consulting (2007).

[54] Retrofit materials are typically not straightforward to find. The government should work with major builders merchants and DIY stores to ensure that retrofit materials are both readily and widely available, and promoted to customers as the best available option wherever possible.

6.2.1 *How Low* recommendations

The *How Low* report included a suite of recommendations, which are summarised in Table 6-1. The purpose of the report is not to repeat these. This report adds to and enlarges on some of these recommendations below.

Table 6-1: Policy recommendations from the *How Low* report

Recommendation	Description
Fiscal incentives	A range of financial measures should be adopted and include: a stamp duty rebate on energy-efficiency improvements made within a year of moving into a property: a national council tax rebate scheme; and cutting VAT on the refurbishment of existing properties.
Low Interest Loan scheme	To support the refurbishment of existing buildings (Germany was cited as an example, where the government repays 10% of a loan to the householder once properties reach new building standards).
Supplier Obligation	The government must ensure that the Supplier Obligation takes into account the shadow price of carbon, and must also support the deployment of both solid wall insulation and LZC technologies, which are not provided for under the current mechanisms in significant numbers.
Minimum standards at point of sale (2010-2016)	To ensure minimum standards in the housing sector the government should prevent the resale or letting of energy-inefficient homes. The report suggests a stepped process, based on the Energy Performance Certificate rating, to be progressively tightened over time.
Reform the energy market	Feed-in tariffs should be introduced to encourage installation of micro-generation capacity to ensure that the householder can count on a fixed (substantial) price for electricity that they feed into the National Grid.
Evaluate personal carbon trading (PCT) or carbon taxes (2013 to 2015 onward)	Government should open up debate on personal carbon trading and carbon taxes as well as the social implications of these. While it is recognised that significant barriers to introducing PCT exist, it is important to consider how PCT might interact with other measures at this stage to inform the most effective way forward.

Source: WWF (2008)

6.2.2 Standards-based approach

The literature and our consultations suggest that in the medium term the best solution will be to develop a standards-based approach, such as that outlined in Table 6-1, and let industry decide how best to reach those standards. Successful international examples of energy-efficiency standards include the Minergie (Switzerland) and PassivHaus (Germany) standards.

In the past, the only minimum standard in energy efficiency applied to the existing housing stock has been Decent Homes, although the energy-efficiency standard is described as ‘unambitious’ (FMB, 2008). Other energy-efficiency standards only exist for new houses.

A standards-based approach raises the issue of timing. Policy must consider how to take advantage of key intervention points to enforce minimum standards, including:

1. major renovations (e.g. through developing ‘building regulations’ for ‘consequential works’; see FMB, 2008)

2. point of sale (e.g. raising the profile of Energy Performance Certificates as part of the Home Information Pack to establish minimum standards at point of sale. The *How Low* report suggests that a minimum rating of D would be feasible by 2016).

For both of these approaches, it will be important to set a timescale and policy framework for establishing mandatory refurbishment work. Financial incentives may be important in the early years to allow for a premium related to ‘early movers’ (lack of/under-developed market) and, more broadly, to cover learning.

Local Authorities could be asked to create an address-specific database on the energy-efficiency of households based on Energy Performance Certificates, Energy Efficiency Commitment, building regulations, Warm Front, and other sources (Boardman, 2007).

In the shorter term, it might be simpler to bring in minimum energy-efficiency standards for privately-rented houses (SDC, 2006).

6.2.3 Retrofit in public sector housing

One potential opportunity to stimulate market demand is to use the extensive refurbishment budgets of large-scale public sector and quasi-public sector housing owners to drive forward and advance the market for retrofit technologies, including a wide range of resource-efficiency objectives (SDC, 2006). Between them, the NHS, MOD and universities and schools, along with social landlords and other local bodies, have purchasing power of between £5 billion and £10 billion a year (pers. comm. Kelly).

With 35% of housing RMI output in public-sector housing (ONS, 2009), this represents an important early opportunity, although clearly this must pave the way for wider uptake in the private housing market.

Stimulation of the market in this way will enable the development of skills, honing of techniques and awareness/understanding of materials to be developed, creating a market ready for delivery to the private sector.

6.2.4 Public information

Psychology and behaviour change is also important. Energy efficiency may appear to be a difficult message to promote, but major public campaigns (often politically difficult in the short term) already have a history of long-term success in the UK, with varying degrees of legal enforcement, including seatbelts, unprotected sex and – most recently – smoking.

The Energy Saving Trust (EST) is a main source of information. Current guidance in terms of prioritisation of home improvement measures are outlined in Figure 6-1, below, and the EST website also provides a full list of more simple DIY measures. The profile of these messages should be raised, for example through an increased marketing budget, and targeted specifically at those approaching one of the two intervention points outlined earlier in this chapter. The EST is currently developing independent packs of information and factsheets for householders. This is a positive move and careful thought should be given to how these can be distributed systematically by those in the RMI sector of the construction industry.

Figure 6-2: EST advice on home improvement

- **Insulate your home** – with grants and offers available through all energy suppliers, loft and cavity wall insulation cost around £250 each. Together they could save you around £365 every year.
- **Install an efficient heating system** – replacing an old inefficient boiler with a condensing boiler and a full set of heating controls could save up to £300 per year on your heating and hot water bills.
- **Replace single-glazed windows** with Energy Saving Recommended double glazing – your home will be warmer, quieter and more energy efficient, and you could save around £140 per year.
- **Switch to Energy Saving Recommended appliances** – if you're planning on plumbing in a new dishwasher or washing machine, choosing an energy-saving model could save you up to £23 per year.

Source: www.energysavingtrust.org.uk

The Heat and Energy Saving (HES) strategy consultation document (DECC, 2008) also emphasises the importance of communication, suggesting the need for comprehensive advice to be made available to help people make changes to save energy and money.

Better and more consistent information, along with the roll-out of smart meters making energy use in the home more 'visible' will further stimulate the demand for energy-efficiency measures, LZC technologies and a stronger market for low-carbon homes. The SDC (2006) recommended that "communication and provision of advice is brought together into a 'one-stop shop' to raise householder awareness on resource efficiency issues and solutions".

The government should also consider how to use existing policies, such as developing guidelines for use of the current CERT to include an element of stimulating a reduction in household energy demand. This is particularly important to combat the potential rebound effect of reducing energy costs to households.

6.2.5 Other potential policy measures

The literature, supported by our consultations, suggests a wide range of other potential policy measures. These include:

- The discretionary abolition of 50% council tax exemption for second homes (ERM Economics and ERM Planning, 2002).
- Tougher minimum standards on energy consumption of major energy usage equipment and appliances, and the introduction of a green retailer code for electric retailers (Boardman, 2007).
- Introducing a renewable energy heat law which stipulates that a minimum proportion of space and water heating must be produced by renewable sources (Boardman, 2007). Powers in the Energy Act 2008 allow the setting up of a Renewable Heat Incentive (RHI), proposals for which are set out in the Renewable Energy Strategy (DECC, 2009).
- Working with mortgage valuers to build the EPC rating more formally, and more visibly, into the mortgage rating system. Mortgage valuation processes are complex, but already reflect factors such as 'proximity to a park' and 'quality of the local environment'.

Probably the most important stage to get right in the short term is to **'unlock' the issue of upfront finance** for installing retrofit measures, which often poses the greatest single barrier to their uptake. In this sense it is a true market failure; there may be a number of potential policy solutions or mechanisms to spread the cost of measures over their lifetime (as assumed in chapter 3). Pay As You Save mechanisms could be administered through, for example, electricity District Network Operators (DNOs) or through the council tax mechanism. Knauf Insulation has developed suggestions for a 'zero cost upfront' approach in its paper 'From pre-pay to pre-save'[55], with a repayment mechanism linked to the property rather than the owner at the time of installation. This has recently been given additional impetus by its selection as one of 19 'Breakthrough Ideas for the 21st Century' being taken forward by the UK Sustainable Development Commission (SDC, 2009).

Another 'Breakthrough' idea is to roll out a large-scale retrofit programme for Manchester, and another would see all Local Authorities developing a Low-Carbon Zone, ensuring large-scale retrofit programmes are rolled out locally across the UK, covering at least 50% of all households in fuel poverty in that area. The prominence of retrofit in the 19 breakthrough ideas indicates the scale of importance being attached by the government's independent watchdog on sustainability.

6.3 DEVELOP THE ABILITY OF THE SECTOR TO RESPOND

On the whole, the consultations suggested that the building industry will respond fairly readily to a significant growth in market demand. However, there are some measures which government policy could support to facilitate this response. The HES consultation strategy suggests for example the introduction of a voluntary code of practice for the building trade on energy efficiency and low-carbon technology.

6.3.1 Engaging with industry

The construction industry – and in particular the RMI sector – is characterised by a high proportion of SMEs. One particular issue therefore involves the dispersed nature of the sector, in terms of how to engage the industry workforce. One option is to use trade bodies like the FMB to disperse messaging, although its membership is limited to around 12,000 construction companies (there are a number of trade associations operating in the sector, and many operators are members of none). Another would be to work in partnership with the major builders' merchants, such as Jewsons and Travis Perkins, to ensure that stock levels reflect the priority attached to retrofit materials and to encourage the provision of accessible information in a range of formats to encourage builders to find out more about retrofit options.

6.3.2 Skills development

The *Building a Greener Britain* report (FMB, 2008) adds a skills dimension to the *How Low* report, by suggesting that the building sector needs to develop capacity in 'buildability'. The FMB raises the importance of developing the appropriate skill-set that is required for low-carbon refurbishment. Multi-skilling will be required, including skills such as project management, demand reduction and energy-supply technologies.

[55] See: www.ukgbc.org/site/document/download/?document_id=488

It also raises the importance of a communications strategy that promotes retrofitting – with, for example, award schemes as incentives for businesses in the building industry to innovate and to increase awareness.

The report raises the need to make low-carbon refurbishment a mainstream norm. It makes the following suggestions to make this a reality:

- Training skills and standards for retrofit should be developed and merged into existing frameworks. ConstructionSkills should coordinate a review of existing training and develop a strategy for training development.
- Training (existing and future) will have to consider the need for construction workers to be able to respond to any future minimum energy-performance standards, including a thorough understanding of whole-house energy and energy-loss dynamics. The report suggests the Department of Communities and Local Government coordinates a study tour of relevant European countries for key UK stakeholders to learn about refurbishment to high energy-performance standards.
- A concerted programme of support for innovation, including the use of regional innovation networks to help foster retrofitting innovation.
- All of the above will require a full and robust communications strategy, aimed primarily at the construction industry, recognising that the industry consists of a large number of small firms.

While it will be necessary to influence and change the way that SME tradespeople work, the process of change is more likely to work if it is carried out in ways that fit with customary approaches and standard ways of working. The construction industry can be both conservative and reliant on what is already known (e.g. using materials and techniques they know they can trust in order to reduce risks and keep the client happy).

In the short-term, short courses for upskilling existing tradespeople to be aware of retrofit measures and technologies (so they are offered – or even suggested – to householders as an option), and how they work (to instil confidence in taking on installation jobs) will be important.

The Federation of Master Builders has a membership of around 12,000 construction SMEs; with its regional structure it may readily be able to coordinate appropriate training for SMEs at a national scale (although it is only one of a number of relevant trade bodies).

6.3.3 Recruitment

It is important to note that there are particular measures which have a much greater employment requirement for installation than others. Most notably, this applies to ground source heat pumps: in Scenario 1b of the *How Low* report, such installations require around 28,000 new FTE jobs a year in England alone. In practice, this workforce is likely to consist of a range of existing construction trades, including engineers and plumbers. If this scale of retrofit were to take place, a significant recruitment drive would be required in these professions in particular[56].

[56] This recruitment drive would need to be accompanied by a suitable accreditation programme, to provide quality assurance.

Annex A: List of consultees

David Adams, Knauf Insulation

Brian Berry, Federation of Master Builders

Lizzie Chatterjee, Sustainable Development Commission

Alastair Collin, Future Skills Unit, ConstructionSkills

Karl Cunion, Department for Communities and Local Government (CLG)

Professor Michael Kelly, Chief Scientist CLG

Gavin Killip, Environmental Change Institute, Oxford University

Russell Smith, Parity Projects

Jo Wheeler, UK Green Building Council

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Annex C: SAVE employment study

For the induced impact on employment, we have used estimates derived from the study *Employment Impacts of Energy Conservation Schemes in the Residential Sector* (Jeeninga, 1999)[57] which was commissioned by the European Commission as part of the SAVE employment project. The study uses data up to 1998 for UK expenditure and UK input-output data up to 1996.

In summary, the SAVE study uses the following methodology to derive the estimate of impact on employment:

- First, econometric methods are used to form saving and expenditure functions for the UK households using national accounting data. The expenditure functions estimate the increase in consumption of various products from selected drivers, for example the rise in income.
- Second, the resulting estimates on expenditure by category are related to the output side of the economy through input-output relationships. In the SAVE study, the 123 product categories in the UK Input-Output accounts are aggregated to the seven expenditure categories used in the study (see Table C-1).
- Finally, the impact on employment from the increased expenditure on products is estimated by use of 'labour coefficients' (see Table C-2), which were derived in this study using national account data. These labour coefficients state that there will be rises in various types of labour with the increased demand for particular products.

Table C-1: Consumption categories considered in the SAVE study

Consumption categories considered in the SAVE study	**Categories available in the data**
Food	Food, drink and tobacco
Housing	Rent (including imputed rent), and water and sewage
Clothing	Clothing and footwear
Energy	Electricity, gas, coal and other fuels
Transport	Vehicles, petrol and engine oil, motor vehicle running costs, and travel and communications
Services	Vehicles, petrol and engine oil, motor vehicle running costs, and travel and communications
Other	Other durables, and other goods

Sources: Jeeninga (1999)

Note: Data used was Consumer Trends, Office for National Statistics, The Stationery Office, London (1998).

[57] Jeeninga, H, et al (1999).

Table C-2: Labour coefficients for the UK used in the SAVE study

	Sector	ISIC code (1992)	Labour coefficients (1996) Male full time	Male part time	Female full time	Female part time
1	Agriculture; forestry and fishing	1, 2, 5	0.00614	0.00125	0.00124	0.00102
2	Extraction-oil and gas	11, 12	0.00087	0.00001	0.00015	0.00002
3	Other mining and quarrying	10, 13, 14	0.00194	0.00001	0.00025	0.00003
4	Solid and nuclear fuels; oil refining	23	0.00095	0.00000	0.00016	0.00002
5	Chemicals, man-made fibres	24	0.00573	0.00006	0.00219	0.00032
6	Other non-metallic minerals	25, 26	0.00936	0.00014	0.00248	0.00052
7	Metals and metal products	27 – 33	0.03863	0.00048	0.00910	0.00164
8	Transport equipment	34, 35	0.01106	0.00009	0.00129	0.00016
9	Food, beverages, tobacco	15,16	0.00895	0.00033	0.00374	0.00156
10	Textile and leather products	17, 18, 19	0.00502	0.00019	0.00578	0.00105
11	Pulp, paper printing and publishing	21, 22	0.00926	0.00035	0.00469	0.00125
12	Other manufacturing	20, 36, 37	0.00649	0.00020	0.00196	0.00058
13	Energy and water	40, 41	0.00363	0.00003	0.00093	0.00019
14	Construction	45	0.02237	0.00035	0.00299	0.00112
15	Motor vehicles sales and repairs	50	0.01320	0.00080	0.00268	0.00126
16	Wholesale trade	51	0.02121	0.00143	0.00671	0.00259
17	Retail trade	52	0.01541	0.00818	0.01710	0.03482
18	Hotels and restaurants	55	0.00791	0.00621	0.00942	0.01942
19	All transport	60 – 63	0.02035	0.00103	0.00583	0.00162
20	Post and telecommunications	64	0.01028	0.00092	0.00248	0.00110
21	Financial intermediation	65, 66, 67	0.01408	0.00034	0.01393	0.00415
22	Real estate, renting, business activities	70, 71	0.00606	0.00072	0.00408	0.00223
23	Services	72 →	0.09177	0.01960	0.09942	0.09560

Source: Jeeninga (1999)

The SAVE study presents separate estimates on the total impact on employment from the:

- initial investment required to install energy-efficiency measures
- money freed up from the energy savings generated by the measures
- impact from the use of grants funded by government expenditure.

Notes

Notes

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

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