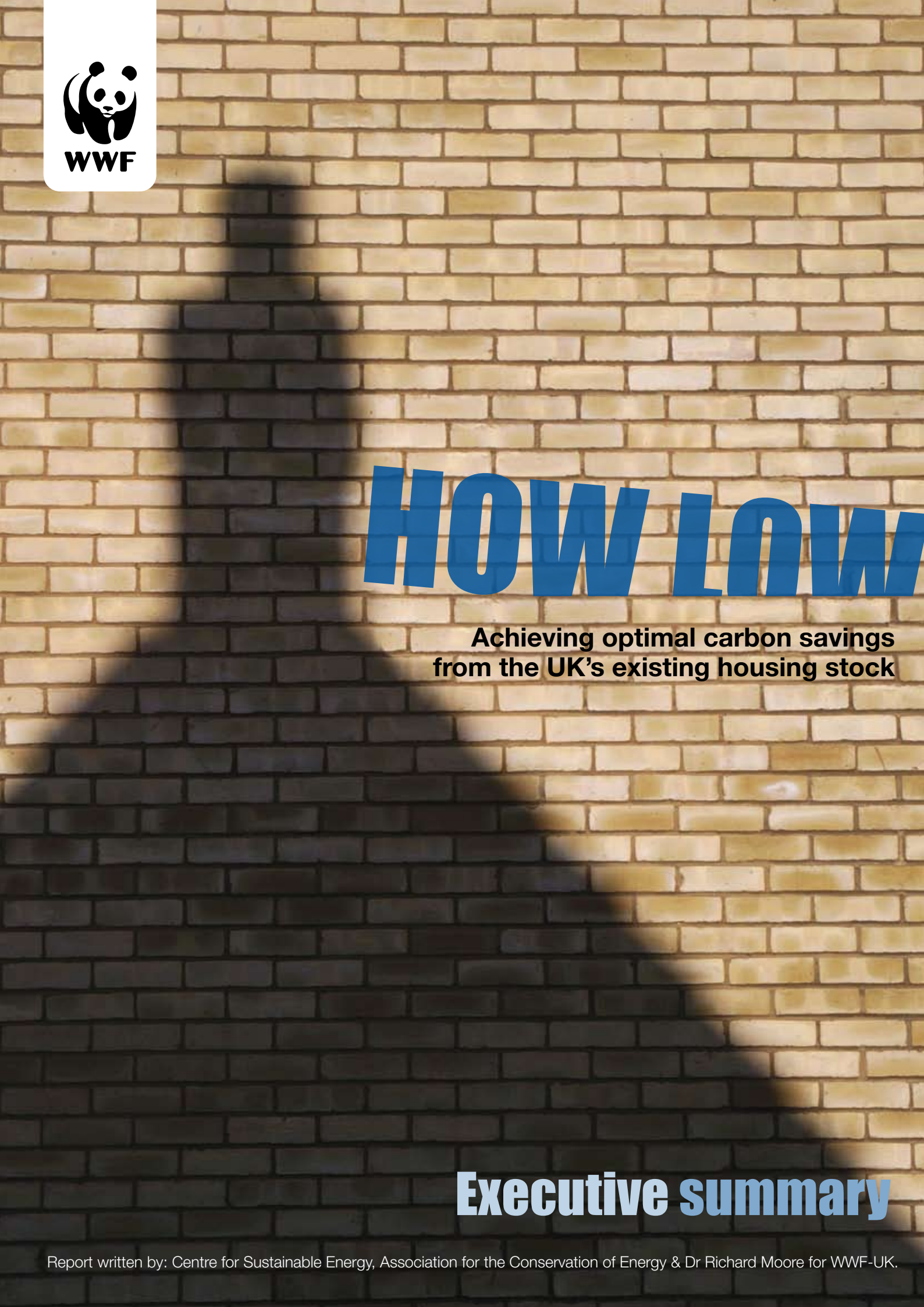


HOW LOW

Achieving optimal carbon savings from the UK's existing housing stock

Executive summary

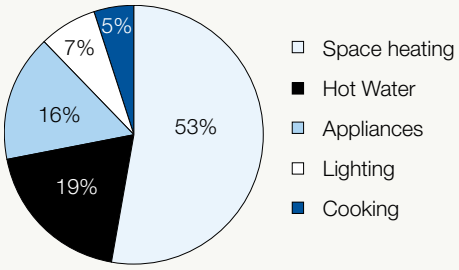
Report written by: Centre for Sustainable Energy, Association for the Conservation of Energy & Dr Richard Moore for WWF-UK.

1 Executive summary

1.1 Home energy use

Over 27% of the UK's carbon dioxide (CO_2) emissions come from the residential sector.

Figure 1: Source of these emissions by end use[1]



Many of the measures which will enable us to make the necessary deep and significant cuts in these emissions also improve the quality of our homes and will reduce energy bills. It is clearly vital to tackle this area appropriately, and as a matter of urgency.

1.2 What must be achieved?

The government's National Energy Efficiency Action Plan (NEEAP[2]) sets a target to reduce emissions from the UK's residential housing stock by 31% on 1990 levels by 2020. Further, the government's own Climate Change Bill contains a legally binding economy-wide target to reduce CO_2 emissions by at least 60% on 1990 levels by 2050.

We need a wholesale revision of the rate and efficacy with which the environmental impacts of the UK's housing stock are tackled. The government's current housing policies are overly fragmented and will not deliver the cuts in CO_2 emissions necessary to achieve its own targets[3].

This was acknowledged by Prime Minister Gordon Brown in the 2007 Budget statement which announced that the government would ensure that by 2020 all homes would meet their cost-effective energy efficiency potential. However this definition of 'cost- effective' looks only at short term payback and does not factor in any value for the cost of carbon.

1.3 Why has this study used a cut of 80%, not 60%, by 2050?

This study had used the most up-to-date 80% target for a reduction in emissions from the UK residential sector.

The overwhelming scientific consensus is that the Climate Change Bill's 60% target is inadequate to avert the worst ravages of climate change. It is essential that atmospheric greenhouse gas concentrations are stabilised at a maximum of 450 parts per million (ppm)[4] of CO_2 equivalent to avoid irreversible and extremely damaging climatic changes. This would require all developed countries to cut emissions by at least 80% from 1990 levels by 2050[5].

27% of the UK's carbon dioxide emissions come from the residential sector.

ONE PLANET FUTURE

If everyone in the world were to consume natural resources and generate carbon dioxide (CO_2) at the rate we do in the UK, we would need three planets to support us. WWF has a vision for a One Planet Future – a world where everyone lives in harmony with nature and thrives within their fair share of the Earth's natural resources. It is a vision that requires a transformation in the way we live.

1 UK Energy Efficiency Action Plan – Defra, 2007 2 (Defra 2007a); Defra's NEEAP covers energy efficiency measures, renewables and carbon emissions 3 Those targets under the National Energy Action Plan (NEEAP) or the residential sector portion of the Climate Change Bill targets. 4 International symposium of the stabilisation of greenhouse gas concentrations, Hadley Centre, 2005 5 See, for example, Höhne, Phylipsen and Moltmann (2007)

1.4 What must policy-makers do to implement this?

The study has shown that urgent government action is needed to ensure the UK meets its targets for residential carbon emissions, and to ensure it is on track for 80% cuts in the sector by 2050. The study examines the measures, market transformation and behavioural changes needed to achieve these targets. In short:

- In order to achieve the UK's 2020 targets we will need to go beyond the short payback energy efficiency measures that feature in current policies. We will need to deploy significant numbers of low and zero carbon technologies (LZC) and solid wall insulation.
- The government must act now to ensure that the 80% reduction is achieved. This requires a strong set of supporting policies and financing mechanisms that support the deployment of sustainable energy measures.

This set of policy measures should include:

1.4.1 Fiscal incentives

It is vital that the government employs a suite of economic instruments to encourage the development of more energy efficient homes (and sustainable homes more widely). The poor rate of take-up of many short payback measures highlights the lack of public understanding of, and buy-in to, their necessity. The palette of financial measures should include, but not be limited to: 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.

1.4.2 Low interest loan scheme

In Germany, borrowers are able to take out low interest loans for measures that help older properties reach new-build standards through refurbishment. On reaching this standard, the government repays 10% of the loan to the householder. This government-supported retrofit programme has been extremely successful. The UK government must explore how to indroduce such innovative financing mechanisms that support the refurbishment of existing buildings.

1.4.3 Supplier Obligation, post-2011

The government is currently consulting on the Supplier Obligation, namely if it should be an upstream trading mechanism, a downstream measures-based approach or a hybrid[6]. The government must ensure that the Supplier Obligation takes into account the shadow price of carbon which would ensure all policy decisions take due consideration of their environmental impacts. It 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.

1.1.4 Minimum standards at point of sale, 2010 to 2016

The government should ensure that a minimum standard is set and progressively tightened to transform the housing sector, by preventing the resale (or letting) of the most energy-inefficient homes. For example, with appropriate exemptions, by 2016 no property with an Energy Performance Certificate rating of E could be resold, a target that can be achieved with the most cost-effective measures for the majority of properties.

1.4.5 Reform the energy market

Feed-in tariffs are a recognised method of encouraging the installation of electricity from micro-generation in countries such as Germany and Spain. They ensure that the householder can get a fixed and substantial price for electricity they generate and feed in to the National Grid. The government should ensure that the public are guaranteed that this price reflects the true cost of installing the equipment.

1.4.6 Evaluate personal carbon trading (PCT) or carbon taxes, 2013 to 2015 onwards

UK residential emissions have not decreased since 1990. Our relationship with energy use and personal understanding of carbon emissions needs to evolve if we are to meet our 2020 and 2050 targets. The government must open the debate to include a wide range of potential policy measures, including personal carbon trading and carbon taxes. It must ensure that the social implications of both trading and taxation approaches are fully understood – i.e. who stands to lose and gain.

6 In a hybrid system, emissions would be capped and tradable among suppliers, with a seperate measures-based social obligation for low income households.

However, there are significant barriers to introducing PCT, and it could not be onstream for several years. As it is imperative to act now, any debate on these mechanisms must be in parallel with the other recommended actions. Particularly important is to consider how PCT might interact with other measures so as to understand the most effective way forward. For example, emissions can't be capped upstream and downstream simultaneously, it is therefore important that any overlap between the supplier obligation and PCT is planned carefully.

1.5 What has been explored?

The project team has considered what the "cost-effective" savings from the UK residential sector are. The carbon savings have been modelled for the implementation of two cost-effective scenarios to 2020. These scenarios are:

- **1a** the **market potential**, as defined by the government's limited definition of cost-effective[7]; and
- **1b** the **economic potential**, as defined by any measures that recoup their upfront costs by future bill savings over their lifespan[8].

The latter approach, which is the report team's recommended and pragmatic approach, significantly increases the number of measures deemed cost-effective, resulting in more measures being applied and increased carbon and financial savings.

The project team has not included a cost of carbon in either of these models as this will be released as an associated piece of work. However it is noted that even using a relatively low cost of carbon will significantly increase the number of measures considered 'cost effective.' This is just one of the ways in which the project team has been deliberately cautious in its assumptions. The 2050 scenarios, 2a and 2b, have examined what can be achieved if all available measures are applied to the residential sector, regardless of whether they achieve net financial payback. Considering the scale of the challenge, it is likely that almost everything possible will be needed to achieve 80% cuts. Scenario 2b includes stronger assumptions about the additional reduction in carbon emissions achievable from things other than measures applied to the property itself. These include a greater decarbonisation of the energy supply and more efficient appliances.

In order to achieve the UK's 2020 targets we will need to go far beyond the short payback energy efficiency measures that feature in current policies

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7 This was defined solely as including: cavity wall, loft and hot water cylinder insulation, draught proofing, efficient boilers and heating controls. 8 The Treasury's own discount rate of 3.5% was used to determine this.

1.6 How (and why) this report uses conservative assumptions

The study has made a number of conservative assumptions about the technologies that have been applied and the magnitude of savings generated. This approach should reassure readers that the savings we present are achievable with concerted government action. Furthermore, the costs of the measures required and the magnitude of the savings generated represent the pessimistic scenario. The measures associated with scenarios 2a and 2b more than pay for themselves if projected system costs are used and the full payback is included – i.e. Gross Value Added (GVA)[9], lifetime fuel savings and value of carbon.

The following is a short description of the main conservative assumptions made in this report. See Annex VI for more detail.

We need to deploy significant numbers of low and zero carbon technologies (LZC) and solid wall insulation.

1.6.1 Discount rates and cost of carbon

Scenario 1b represents a cost-effective scenario based upon a Treasury (real) 3.5% discount rate for the savings achieved. The study could have alternatively looked at those measures deemed cost-effective when the cost of carbon has been added. This definition of cost-effective would be even more holistic than that used for scenario 1b, and even more measures would have been available.

1.6.2 Areas of Outstanding Natural Beauty

The *How low?* study has assumed that solar power systems and internal/external wall insulation will not be applied systematically to listed buildings or to homes in conservation areas.

1.6.3 Green gas percentage

The study has considered methods of future decarbonisation of energy supply. The report team has made a conservative assumption of a total residential green gas supply of 10% by 2050.

1.6.4 Decarbonisation of electricity

The report team has linearly extrapolated the projected carbon intensity of delivered electricity (2008-20) to estimate a 2050 carbon factor of 0.059kgC/kWh. The recent IPPR, RSPB and WWF[10] study – *80% Challenge* – to identify whether it would be possible to reduce the UK's carbon emissions by 80% of 1990 levels by 2050 identified decarbonised electricity as a key measure – i.e. a carbon factor of 0.005kgC/kWh. This study has not assumed as high a level of decarbonisation as the *80% Challenge* report, which serves to highlight that there is room to manoeuvre and go beyond an 80% cut in the residential sector.

1.6.5 Measures costs – mass marketing LZC technologies

The report team has used a cost based on today's prices for insulation and LZC technologies, which are likely to fall significantly between now and 2050. The Renewables Advisory Board examined the projected cost of LZC technologies from 2007 to 2025. If the cost reductions predicted are applied to scenario 2, to 2050, costs fall by £36 billion which would mean that they achieve a net positive economic position.

1.6.6 Fuel prices

This represents a conservative estimate of the actual savings achieved, as the fuel prices are based on 2007 averages. Whereas DTI baseline projections for fuel prices by 2020 demonstrate an average price rise of 21%.

1.6.7 Measures lifetimes – 15 years

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

1.7 How low can residential emissions go?

The government's definition of cost-effectiveness, is overly restrictive and as a result only achieves emissions reductions of 22% from 1990 levels. As shown in Scenario 1a, this falls short of both the National Energy Efficiency Action Plan (NEEAP) and Climate Change Bill targets (apportioned to a household sectoral target for these purposes). This demonstrates that a more holistic view of cost-effectiveness must be considered if we are to meet our 2020 residential carbon emission targets.

9 Gross Value Added represents value to the UK economy or money in the pockets of British workers and businesses. 10 www.wwf.org.uk/filelibrary/pdf/80percent_report.pdf

Our alternative definition of cost-effective – scenario 1b – could reduce UK residential emissions by a further 7%, which exceeds both the Climate Change Bill targets and those for 2020 from the NEEAP. The scenario requires the deployment of significant numbers of solid wall insulation and low and zero carbon (LZC) technologies, for which adequate provision is not made under current implementation or funding policies. Implementing these measures by 2020 will require the government to support a step change in the capacity to install them. For example, implementing scenario 1b would require in the region of 125,000 solar water heating systems to be installed each year, a tenfold increase on current activity.

Concurrently, the government will need to implement the above range of supporting fiscal and behavioural change policies to educate and provide incentives for householders to take action. Householders need to have a better understanding of their own energy use and carbon emissions and a vested interest in taking those measures.

It is noted again that scenario 1b does not include a cost of carbon which would make even more measures cost effective by 2020.

The 80% reduction in residential emissions by 2050 is achievable under scenario 2b. This requires: the implementation of the sustainable energy improvements to homes described in 1b; an uplift in the energy efficiency of household appliances; a reduction in the carbon content in electricity through improved generating efficiencies and increased large scale renewable energy generation; the use of green gas from waste or other organic matter; and a 20% improvement in people's behaviour to further reduce home energy use. In order to implement scenario 2b by 2050, we will need to first implement scenario 1b. Given the urgency of the issue, we suggest that the government implements a strong set of policies now to facilitate this by 2020.

1.8 What are the benefits?

Table 2 summarises the carbon savings associated with all the measures applied to individual properties, their cost and overall economic benefit. The savings are conservative as they do not include those associated with improved appliance efficiency, behavioural changes and upstream changes to the energy mix of fuels. Scenario 1a would generate over £3 of fuel savings for every £1 spent on home improvements. The total economic benefit if scenario 1b was implemented by 2020 also outweighs the projected cost. These measures will also provide considerable benefit to the 3.5 million fuel-poor households in the UK[11], thus helping the UK government to achieve its statutory target to eradicate fuel poverty where practicably possible in all homes by 2016.

For scenarios 2a and 2b, implemented to 2050, the total benefit is less than the investment cost, but this takes the very conservative position that LZC technologies will not fall in price. However, if the predicted cost of LZC technologies falls, in line with the Renewables Advisory Board (RAB) projections the economic benefit therefore matches the investment made even without ascribing a cost of carbon. The cost of £2.6-£3.5 billion per year required to deliver the residential sector measures in scenario 2b is minimal compared to the cost of doing nothing. The Stern Review[12] estimated the cost to the economy of mitigating the harmful impacts of climate change to be 10 times that of acting now.

Table 1: Summary of emissions reductions for all scenarios

Year		2020 (MtC)	% reduction		2050 (MtC)	% reduction
Government targets	NEEAP	29.3	**31%**	Climate Change Bill	8.5*	**60%**
Market potential (Scenario 1a)		33.1	**22%**			
Economic potential (Scenario 1b)		27.7	**35%**			
Technical potential (Scenario 2a)					11.9	**72%**
Theoretical potential (Scenario 2b)					8.5	**80%**

*Although the Climate Change Bill does not contain sectoral targets, this has been apportioned to the residential sector.

11 EEPtH, *The impact of fuel price risees in the managed housing sector,* CSE, ACE and Dr Richard Moore 2007. 12 www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm

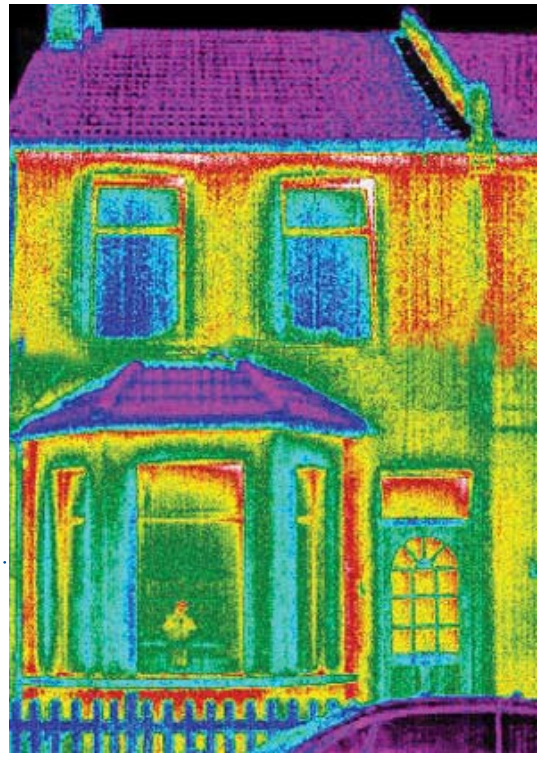
Table 2: Summary of measures costs, savings and benefits under the home improvement model

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

* All figures in billions

** This table only considers savings and costs under the model, without considering the wider improvements around decarbonisation of energy supply, appliance efficiency and behaviour change. Therefore scenarios 2a and 2b are the same.

The Stern review estimated the cost to the economy of mitigating the harmful impacts of climate change to be 10 times that of acting now.



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1.9 What are the implications for the sustainable energy sector in the UK?

The study has concentrated on the capacity to deliver sustainable energy measures to homes between 2007 and 2020, as the government's support mechanism and intentions beyond this date are entirely unknown. In order to achieve our UK 2020 NEEAP targets we will need to implement scenario 1b.

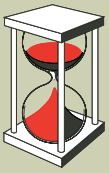
Current installation rates fall short of the required rates for all solid wall insulation measures and renewable energy measures. The shortfall suggests a significant programme of training, investment and policy support would be needed if the required installation rates are to be achieved.

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. Micro-CHP is a near-market-ready technology and the government must ensure that a framework is put in place to facilitate its deployment across the housing sector. If the government ensures that this and similar technologies are developed and successfully deployed in the UK in large numbers, then we will be well positioned globally as market leaders in emerging and expanding markets. Micro-CHP also has an important role to play in balancing our future energy needs. It matches supply and demand, by producing electricity when the grid most needs it, i.e. predominantly in the mornings and evenings when we are at home using our heating systems.

1.10 How have the improvements been modelled?

The Improvement Model that underpins the study has been developed by CSE, ACE and Dr Richard Moore over the last two years. The sophisticated computer model draws together geographically specific data from the English House Condition Survey (EHCS) and data on sustainable energy improvements from ACE's Fuel Prophet Model (which includes fuel type and savings data). This is integrated with data from the devolved administrations to build the nationwide picture.

With thanks to:



Association for the Conservation of Energy

www.ukace.org

Centre for Sustainable Energy

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Dr Richard Moore

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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