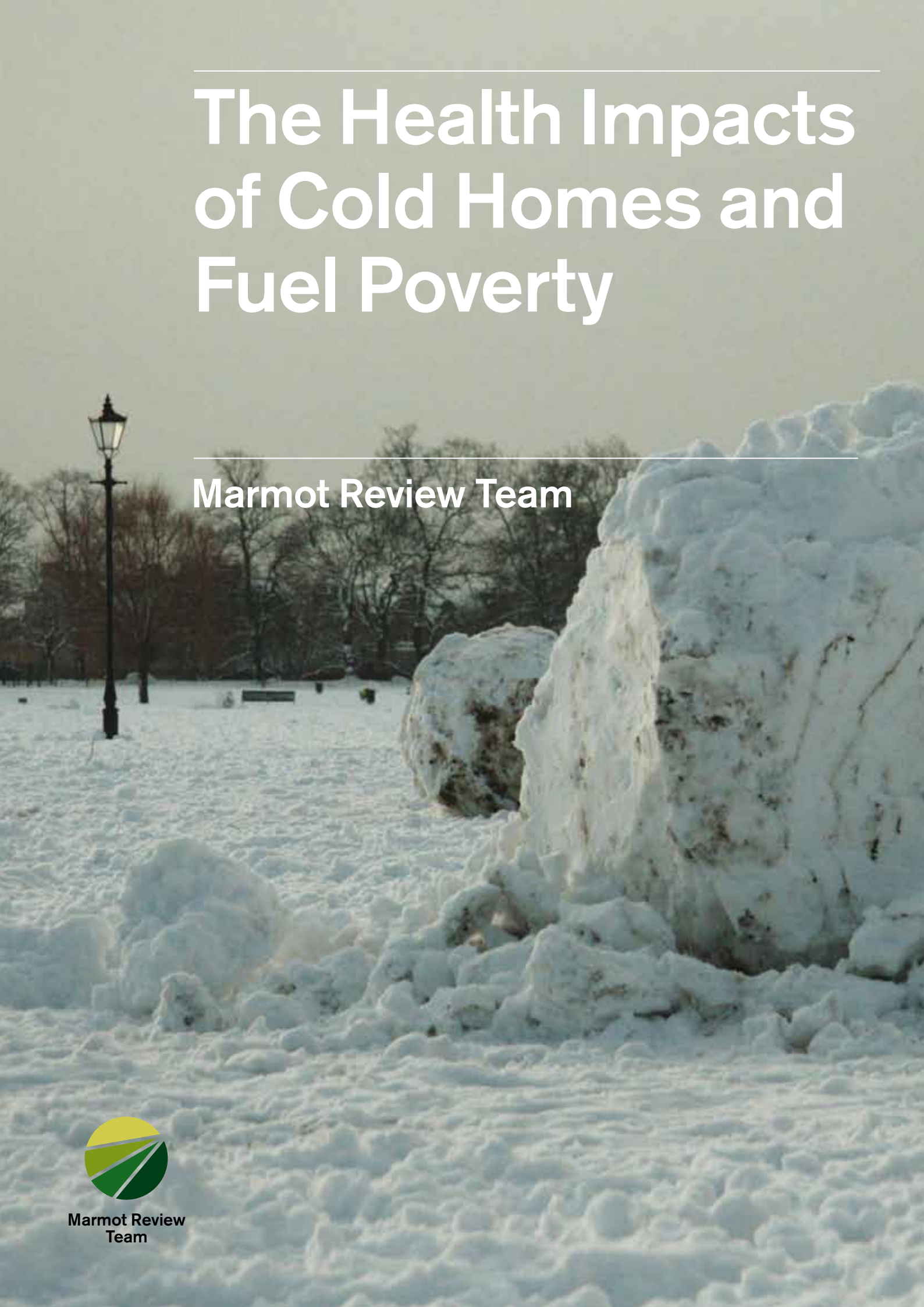
The Health Impacts of Cold Homes and Fuel Poverty



Marmot Review Team

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The Health Impacts of Cold Homes and Fuel Poverty

Written by the Marmot Review Team for Friends of the Earth

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Foreword

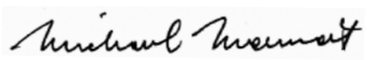
I am delighted that Friends of the Earth have commissioned us to write this report. Fuel poverty is a long-standing health issue: the impact of cold housing on health and the stresses brought on by living in fuel poverty have been recognised for decades by researchers, medical professionals and policy makers alike. At the same time, it is an issue that often gets dismissed as the 'tough nature of things' because our housing stock is old and cold housing is so widespread that many have come to regard it as a normal state of affairs.

It should not be so. Cold housing and fuel poverty can be successfully tackled through policies and interventions if there is a will to do so. There is a social gradient in fuel poverty: the lower your income the more likely you are to be at risk of fuel poverty. I have always said that inequalities that are avoidable are fundamentally unfair - fuel poverty is avoidable and it contributes to social and health inequalities.

When we published Fair Society, Healthy Lives, one of our recommendations was to "improve the energy efficiency of housing across the social gradient" in order to achieve affordable warmth and a reduction in energy usage as well as fuel poverty. We advocated aligning the agendas of climate change and health inequalities by exploiting low carbon solutions, based on the principles of sustainable development. We do so again in this report: improving the energy efficiency of the housing stock brings multiple health and environmental gains.

Building on the evidence presented in the Review of Health Inequalities, this report brings new light to the issue of cold housing and fuel poverty; it highlights not only the variety of health outcomes that are caused and aggravated by cold housing, but also how children, the elderly and the vulnerable are greatly affected by fuel poverty.

Public health must address the social determinants of health: this report comes at a crucial time in policy making for public health as the White Paper is setting the new framework for reducing health inequalities. The proposed outcomes framework includes five domains, among these is the wider determinants of health, and I am so pleased that one of the indicators under this heading is fuel poverty – it initiates the momentum for a renewed effort to tackle such an important factor and it provides a drive to addressing this issue at both the national and local level.



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Executive Summary

This report reviews the existing evidence of the direct and indirect health impacts suffered by those living in fuel poverty and cold housing. It makes the case for aligning the environmental and health agendas and reviews the evidence on the health benefits of reducing fuel poverty and improving the thermal efficiency of the existing housing stock.

The main findings on the direct health impacts of cold housing and fuel poverty are:

— Countries which have more energy efficient housing have lower Excess Winter Deaths (EWDs).
— There is a relationship between EWDs, low thermal efficiency of housing and low indoor temperature.
— EWDs are almost three times higher in the coldest quarter of housing than in the warmest quarter (21.5% of all EWDs are attributable to the coldest quarter of housing, because of it being colder than other housing).
— Around 40% of EWDs are attributable to cardio-vascular diseases.
— Around 33% of EWDs are attributable to respiratory diseases.
— There is a strong relationship between cold temperatures and cardio-vascular and respiratory diseases.
— Children living in cold homes are more than twice as likely to suffer from a variety of respiratory problems than children living in warm homes.
— Mental health is negatively affected by fuel poverty and cold housing for any age group.
— More than 1 in 4 adolescents living in cold housing are at risk of multiple mental health problems compared to 1 in 20 adolescents who have always lived in warm housing.
— Cold housing increases the level of minor illnesses such as colds and flu and exacerbates existing conditions such as arthritis and rheumatism.

The main findings on the indirect health impacts of cold housing and fuel poverty and on other social benefits deriving from improved housing are:

— Cold housing negatively affects children's educational attainment, emotional well-being and resilience.
— Fuel poverty negatively affects dietary opportunities and choices.
— Cold housing negatively affects dexterity and increases the risk of accidents and injuries in the home.
— Investing in the energy efficiency of housing can help stimulate the labour market and economy, as well as creating opportunities for skilling up the construction workforce.

Many different population groups are affected by fuel poverty and cold housing, with various levels of health impacts relating to different groups:

Children

Significant negative effects of cold housing are evident in terms of infants' weight gain, hospital admission rates, developmental status, and the severity and frequency of asthmatic symptoms.

Adolescents

There are clear negative effects of cold housing and fuel poverty on the mental health of adolescents.

Adults

There are measurable effects of cold housing on adults' physical health, well-being and self-assessed general health, in particular for vulnerable adults and those with existing health conditions.

Older people

Effects of cold housing were evident in terms of higher mortality risk, physical health and mental health.

Improving the energy efficiency of the existing stock is a long-term, sustainable way of ensuring multiple gains, including environmental, health and social gains.

Government policy documents and reports, including the Chief Medical Officer report of 2009 and the recent Public Health White Paper, recognise the tangible impact of cold housing and fuel poverty on people's health and well-being.

We could prevent many of the yearly excess winter deaths – 35,000 in 2008/09 – through warmer housing...
[Public Health White Paper, 2010]

Government policies, actions and financial support for interventions aimed at reducing fuel poverty and improving the energy efficiency of existing stock need to match its stated commitment to both the public health and climate change agendas.

The Government's current support and financial commitment to addressing the problem of poor thermal efficiency of housing remains inadequate, given the potential it has to improve the health and well-being of the population and help mitigate climate change.

A renewed effort is needed to support programmes and policies which have shown to be successful in increasing energy efficiency of homes and improving the health of their residents, such as the Warm Front Programme, and in encouraging local government action in addressing fuel poverty, such as the *National Indicator 187 – Tackling Fuel Poverty.*

1
Introduction

Living in cold conditions is a risk to health. The aim of this report is to review the existing evidence of the direct and indirect health impacts suffered by those living in fuel poverty and cold housing. Many such households will be living in homes that have poor thermal efficiency and are therefore hard or expensive to heat, as well as accounting for a significant share of CO_2 emissions from the housing stock (1), thus negatively contributing to climate change.

In 2008, 18% of households in the UK were estimated to be living in fuel poverty (2). Fuel poor households must choose either to spend more than 10% of their income on heating, which has a detrimental impact on other aspects of health and well-being, or to under-consume energy and live in a cold home to save money. Deprived and vulnerable households – especially those who do not have access to social housing - are more likely to live in energy inefficient housing, and less likely to have the resources or the resilience to deal with the negative impacts of cold homes and reduced income.

The World Health Organisation (WHO) recommends that indoor temperatures are maintained at 21 degrees in living rooms and 18 degrees in bedrooms for at least 9 hours a day.

Fuel poverty is defined as having to spend 10% or more of a household's net income to heat their home to an adequate standard of warmth (3). Over the years this definition has been accepted by various Government departments with responsibility for fuel poverty[1]. However, there has been disagreement about what constitutes a household's income: the Government's definition includes housing benefit, council tax benefit, income support, and mortgage payment protection insurance, although many estimates are calculated with a formula that excludes housing subsidy.

Being in fuel poverty is the product of three factors:

1 The energy efficiency of the house which determines how expensive it will be to heat.

2 The cost of heating fuel.

3 The household income, which determines how much a 10% spend on heating would be.

Improving the energy efficiency of the housing stock is an essential step to reduce the number of households in fuel poverty, mitigate climate change and bring associated health benefits. Poverty more widely affects health, but fuel poverty should be considered distinctly because:

— Not all who are income poor are also fuel poor.
— Factors other than income poverty can be tackled to reduce fuel poverty.
— Although their causes are inter-related, the effects of fuel poverty are distinct from the effects of income poverty. They relate to specific health conditions rather than health as a whole and negative health outcomes are more immediate than the outcomes caused by income poverty.
— Fuel poverty is more amenable to change than income poverty.

This report makes the case for aligning health and environmental agendas, and reviews the evidence on the health benefits of reducing fuel poverty and improving the thermal efficiency of the existing housing stock.

Excess winter deaths (EWDs) and health conditions attributable to cold housing will be described and assessed based on existing evidence. The primary and secondary benefits of improvements in energy efficiency will be examined. Further, the report reviews the evidence on the proportion of households in fuel poverty affected by different health conditions and estimates the proportion of EWDs attributable to cold homes. The report also analyses the relationship between energy rating and the predicted health improvement which could be obtained through increased energy efficiency of housing stock.

2
The policy context

There are three possible ways to move the majority of the population out of fuel poverty: one is to increase income (the Winter Fuel Payment is an example), a second is to regulate fuel pricing and third is to improve energy efficiency of homes. Reducing fuel poverty exclusively through financial support is dependent on the economic situation, energy prices, and political will. Further, it will not tackle CO_2 emissions as it allows people to use more energy to reach a comfortable level of heating thereby increasing carbon emissions. On the other hand, making homes more energy efficient is a long-term, sustainable solution, which will allow people to use less energy to heat their homes adequately with a positive impact on carbon emissions.

The EU policy directive 2010/31/EU on the energy performance of buildings of 19 May 2010 (EPBD) requires member states to set requirements for the energy performance of new buildings (4). When undergoing major renovation, the energy performance of the building or the renovated part should be upgraded to satisfy current minimum requirements. Building elements that form part of the building envelope and have a significant impact on the energy performance of that envelope (for example, window frames) should also meet the minimum energy performance requirements when they are replaced or retrofitted. The directive also requires member states to develop a common methodology for calculating the energy performance of buildings, which has to be implemented by July 2013 and will have an impact on current methods used for Energy Performance Certificates (EPCs).

Only since the Code for Sustainable Homes (5) was introduced in 2007 have English energy standards for new buildings approached levels similar to those of other Northern European standards. The strict targets imposed by the Code make it extremely unlikely that anyone living in properties built according to its standards will fall into fuel poverty: it has initiated the most significant change in the thermal efficiency of the housing stock. However, the proportion of homes built since its introduction is minimal in comparison to stock built prior to 2007, which houses most of the population.

In 2000 the UK Government set out the Decent Homes Standard. This is a measure by which the quality of homes is rated, and includes statutory minimum standards for housing as well as thermal comfort – encompassing both efficient heating and insulation. Regulations aimed to ensure that all social housing met standards of decency by 2010, and the target was extended to include a minimum of 70% of private dwellings occupied by vulnerable households[2] also meeting the standard. These targets have not been achieved: it was estimated that 3.8% of Registered Social Landlord (RSL) properties and 12%-14% of council properties would be non-decent as of the end of 2010 (6) and a renewed policy effort, coupled with better levers and incentives is needed in order to reach such targets.

Improving standards and energy efficiency of properties in the private rental sector has proven particularly difficult as private landlords are only required to upgrade homes in line with health and safety regulations rather than any thermal efficiency standards.

Case study: The Housing Health and Safety Rating System (HHSRS)

The HHSRS system came into effect on 6 April 2006 and replaced the fitness standard as the statutory element of the Decent Homes Standard.

However, HHSRS is a risk assessment procedure and does not set a standard. It measures the risks within the home against a series of hazards which range from indoor pollution to hygiene to structural safety and also include:

— Excessive Cold Temperature: Hazards arising from consistently low indoor temperatures.

— Damp and Mould Growth etc: Includes risks from house dust mites, mould and fungal spores.

It has been identified that the majority of failures in achieving a certain rating relate to the inadequate thermal efficiency of housing.

For further information visit:
http://www.communities.gov.uk/publications/housing/hhsrsoperatingguidance

Even when health and safety regulations are contravened, private tenants may not exercise their right to address the problem because they fear eviction, from which they are not protected under UK law. It has often been reported that landlords take advantage of legislation to evict a tenant inappropriately if they have recently taken steps to enforce their statutory rights on disrepair and health and safety issues (7). The recent EPBD builds on the previous directive (2002/91/EC), which specifically mentions rented buildings with the aim of ensuring that property owners, who do not normally pay charges for energy expenditure, are required to take necessary action to comply with minimum standards (8).

"A Citizen's Advice Bureau in West Sussex reported a couple with two young children whose property was in serious disrepair. When the landlord refused to carry out essential repairs, the clients complained to Environmental Health who issued a schedule of works to be done. The landlord then served a Section 21 Notice on the clients. When the bureau contacted the homelessness department on the clients' behalf, the homelessness officer said it was common practice for landlords to seek to evict tenants who involved Environmental Health." (Crewe 2007)

The Fuel Poverty Strategy was launched by the Government in 2001 in response to the legal duty put on the Government by the Warm Homes and Energy Conservation Act of 2000 to eliminate fuel poverty by 2016. This strategy included improving the energy efficiency of homes in order to reduce fuel consumption and therefore reduce levels of vulnerability to fuel poverty. Progress was initially made in reducing the number of households in fuel poverty during a period when energy prices were stable, but since 2004 this trend has reversed due to fuel price increases.

The previous Government's support for improvement in energy efficiency of the existing stock was mainly through the Warm Front Scheme, which provided grants to eligible households to improve either home insulation or heating systems and recently piloting systems for hard to treat properties. Applications to the Warm Front programme were recently suspended but have now re-opened with tighter eligibility criteria. However, the Comprehensive Spending Review suggests that the programme will be phased out from 2013–2014, thus completely removing central government funding to improve energy efficiency. Meanwhile, other programmes to tackle energy efficiency of housing and fuel poverty are ongoing and place the obligations on energy suppliers. These are the Carbon Emissions Reduction Target (CERT), an obligation on suppliers to install energy efficiency measures, although only a proportion (40%) of this programme is aimed at priority groups[3], and the Community Energy Saving Programme (CESP), which also requires gas and electricity suppliers to deliver energy saving measures to consumers in specific low income areas.

Pilot schemes aimed at involving communities in reducing CO2 emissions have been led by Government departments as well as private partners. These provided the communities with information and funding to reduce their CO2 emissions and much funding was invested in improving the energy efficiency of their housing. Such projects include DECC's Low Carbon Communities Challenge, NESTA's Big Green Challenge and British Gas' Green Streets. The Department of Health also funded a pilot project aimed at identifying and targeting the population suffering from cold housing and fuel poverty through the development of a partnership between PCTs and Local Authorities – this project is described in the case study box below.

Although the CESP is likely to benefit a number of low-income households, at present there is no open programme aiming to reduce fuel poverty by targeting people on low incomes. There is a risk that households on higher incomes and in better quality homes living in low income areas will benefit more from this programme, rather than those who are most in need. Additionally, many low-income households live in areas outside the designated areas of deprivation. They will be missed by a programme targeting low-income areas rather than low-income households.

At the time of this report's publication, the Energy Bill is passing through Parliament. This seeks provision for merging the CERT and CESP programmes, which are running through to 2012, into the Energy Company Obligation (ECO). It sets out the Green Deal framework to enable provision of improvements to the energy efficiency of domestic, as well as non-domestic properties, which would be financed by the private sector and repaid by a charge on energy bills. The bill sets out powers for the Secretary of State to introduce regulations on energy efficiency in the private rented sector no earlier than 2015. These could prevent residential landlords from refusing tenants' reasonable requests for energy efficiency improvements and require them to improve some of the least energy efficient properties. However the use of powers is dependent on the outcome of a review and other strict conditions.

National Government also provides financial support to cope with energy bills through the Winter Fuel Payment – a yearly one-off payment for all those who have reached pension age. This is supplemented by the cold weather payment during periods of extreme cold weather for households in receipt of certain benefits such as pension credits, income support, jobseeker's allowance and employment and support allowance. However, the efficiency of such schemes in reaching the populations in need is contested, as shown Table 1.

Case study: Working in partnership to reduce fuel poverty

The programme originates from the UK Public Health Association (UKPHA) Health Housing and Fuel Poverty Forum, funded by Defra. The forum, made up of national figures from the health, housing and energy sectors, and practitioners from across England, developed the 'Central Clearing House' model. Their research concluded that a model of local area partnerships that linked health, housing and fuel poverty services was the most effective approach for directing services to the vulnerable. The CCH model identified the key systems and processes necessary to access the vulnerable fuel poor, identify high risk groups, streamline referral and delivery systems and implement monitoring and evaluation processes.

The CCH model was piloted in Manchester, with the implementation of the Affordable Warmth Access Referral Mechanism (AWARM). Funded by the Department of Health, the pilot was a partnership with Salford City Council and Primary Care Trust.

Greater Manchester invested approximately £100,000 each year into AWARM. Since April 2008 AWARM activity resulted in over £600,000 of investment in new and replacement central heating systems and insulation. During the first year of the project over 1000 referrals were made by frontline professionals from social services, voluntary, local government, housing and health sectors. In 12 months the programme trained 1,359 professionals, a third in health, with the remainder in social services, voluntary/community services, local government and housing. The lessons learned from the pilot include:

— There are numerous opportunities to share data between local authorities, GPs and PCTs to improve how referrals are targeted.
— A pop-up system on GP patient electronic records would help to immediately direct referral to a one-stop-shop.
— Involving energy companies as active project partners can help identify novel ways to target vulnerable individuals and neighbourhoods.

The funding ended in 2010, yet the project improved local delivery systems and increased the numbers receiving funding to reduce fuel poverty. Like many other ill health prevention projects, funding was invested only in a pilot, regardless of the outcomes. In this case, this means a project showing successful short-term outcomes may not be rolled out.

For more information see www.ukpha.org.uk/fuel-poverty.aspx

Table 1 Targeting efficiency of existing fuel poverty schemes

Scheme name	Targeting efficiency	
	% of recipients that are fuel poor	% of fuel poor that are eligible
Winter Fuel Payments	19% (Boardman, 2010)	50%*
Warm Front	25 – 40% (NAO, 2009)	35% (NAO, 2009)
Home Energy Efficiency Scheme (Wales)	30% (WAG, 2005)	54% (Boardman, 2010)
EEC2 Priority Group (Includes people on passport benefits)	20%	58–70% (Boardman, 2010 and Lees, 2008)
CERT Priority Group (Includes those on passport benefits and all over 70s)	24% (England) (Tandy, 2010)	Unknown

Source: Association for the Conservation of Energy (9)
* All over 60s received WFPs, 50% of the fuel poor are estimated to be over 60 (Boardman, 2010)

Further, the Warm Homes Discount is a new mandatory scheme that requires energy suppliers to provide a fixed amount rebate to vulnerable customers. This replaces the voluntary scheme of social tariffs previously provided by energy suppliers on an ad-hoc basis in different areas and for different households. The Feed-in Tariffs (FIT) and Renewable Heat Incentive (RHI) aim to provide financial support for those who install renewable energy systems which qualify for support under the schemes. The schemes are designed to support meeting the requirements of the EU Renewable Energy Directive, which sets a binding target of having 20% of the EU's energy consumption coming from renewable sources. It is expected that households and landlords will take advantage of the scheme; it is likely that such a scheme will appeal to those for whom other options to improve energy efficiency are not viable or cost-efficient, such as those in older rural housing or who are not connected to the grid.

Local government action has been driven by National Indicators 186 and 187, which monitor CO_2

emissions and levels of fuel poverty respectively at the local level, as well as by the requirements of the Home Energy Conservation Act (HECA), which placed an obligation on local authorities to draw up plans to increase domestic energy efficiency in their areas by 30% between 1995 and 2010. Some local authorities have been very pro-active in encouraging residents to access funding to reduce energy use and fuel poverty. These have been awarded Beacon status for best practice in tackling fuel poverty and have produced a toolkit for other local authorities to develop effective strategies to reduce fuel poverty taking account of local circumstances. However, further progress of local action on fuel poverty is likely to be hampered by the funding cuts to Local Government, the abolition of HECA and the fact that National Indicator 187 will become optional from 1 April 2011.

3
Climate change and health

Protecting and improving health, reducing health inequalities, and the mitigation of climate change have a shared agenda. Measures and policies intended to respond to climate change can help reduce health inequalities and vice versa (10). There is sufficient evidence to link the agendas and argue for concerted Government action to tackle fuel poverty and thereby improve quality of life and health, as well as reducing CO_2 emissions: climate change is predicted to result in an increase in deaths, disability and injury from extreme temperature and weather conditions, heat waves, floods and storms including health hazards from chemical and sewage pollution (11). Less direct long-term impacts include the effects on mental health of flooding and other climate-related events, which could cause anxiety and depression (12).

Domestic energy use is responsible for around a quarter of the UK's CO_2 emissions. The greatest share of such emissions – over 70% - is through space and water heating (12). It is estimated that poor insulation means around £1 in every £4 currently spent heating UK homes is wasted. A third of CO_2 emissions from housing relate to domestic space heating and could be reduced through making the existing stock more energy efficient (13). Improving energy and fuel efficiency are the mechanisms to reduce fuel poverty and improve health and these efficiencies are also beneficial to the climate change agenda.

Those likely to be most vulnerable to the health impacts of climate change are those already deprived by their level of income, quality of homes, and their health (14) – the same groups more likely to live in fuel poverty. People on low incomes in the UK are more likely than the better-off to live in urban areas which will be worse hit by extreme weather events, and therefore to be at greater risk of heat stroke (15), such as during the heat wave of summer 2003. They are more likely to live in homes that are less well protected (15) and in areas that are more exposed to weather extremes and flooding (16). They are also less likely to have access to insurance against risks associated with climate change such as storm and flood damage (17). Improving the thermal performance of homes can help mitigate climate change, while protecting households from summer overheating as well as winter cold.

There is a strong relationship between the individual house and its immediate neighbourhood not just in terms of vulnerability to climate change, but also in terms of domestic energy use. How a neighbourhood is planned and designed can take more or less advantage of natural resources such as solar energy and green cover, which can also aid energy conservation as well as mitigating climate change. Consideration must be given to the wider environment when considering interventions to improve energy efficiency, reduce fuel poverty and mitigate climate change.

4
Fuel Poverty and Energy Efficiency

This section describes how fuel poverty is distributed across the population and how this relates to certain housing characteristics, including age of property, tenure and thermal efficiency.

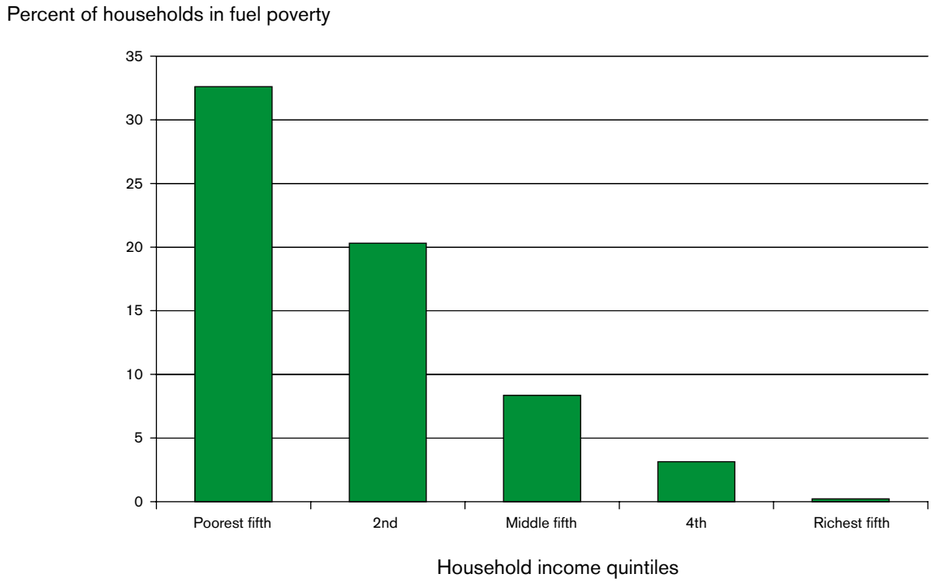
As the graph below shows, the risk of fuel poverty rises sharply as household income falls – very few households with above-average incomes are in fuel poverty.

Other factors besides household income affect whether a household is in fuel poverty or not, such as housing costs and type of ownership. Barnes, Butt & Tomaszewski (19) used the Families & Children Survey to estimate that children in families with a black mother, a lone parent, or with a number of debts were twice as likely to experience persistent cold indoor temperatures than other children.

As a proportion of the total number of households for a given tenure (for example private rented, owner occupier or social housing) households living in private rented accommodation have a higher likelihood of living in fuel poverty – 19% of households in private rented were in fuel poverty compared with 11% in other tenures (20). There are various reasons for this: tenants in the private rental sector can be put off seeking help to improve the energy efficiency of their homes because they may not see it as worth the effort or investment if they plan to move, they may not know it is an option that they could take advantage of, subject to the agreement of the landlord, or they may even fear eviction if some cost or disruption might fall on the landlord. Financial incentives are also low for landlords, who are put off improving properties by the upfront costs while most financial benefits will be to the tenants through lower energy bills.

Despite policies such as Warm Front and the Winter Fuel Payment, the number of fuel poor households in England dramatically increased

Figure 1 The risk of fuel poverty according to household income, 2009



Note: Percent in fuel poverty relates to households in fuel poverty after deducting housing costs
Source: ONS (18)

between 2004 and 2010 from 1.2 million to 4.6 million (20). The winter of 2009/10 saw 25,400 deaths in England and Wales (21). Much of the increase in fuel poverty in 2008/9 was due to the increased costs of energy and it is estimated that in the long term, energy costs will increase (20), potentially increasing a typical annual energy bill by 50% (20).

One of the most sustainable ways of tackling fuel poverty and limiting the impact of fuel price increases is to build energy efficient housing and retrofit the existing housing stock to an energy efficiency level that would make it extremely hard for people to fall into fuel poverty, as space heating accounts for the greatest share of energy use in homes – over 50% (12). This is known as 'fuel poverty proofing' and it has been estimated that raising all properties in England to SAP 81 (equivalent to Energy Performance Certificate band B) would lift 83% of households out of fuel poverty (22).

While new homes need to become highly energy efficient by 2020, in line with European directives, typical energy efficiency for the existing stock is much lower than current building regulations require. The Standard Assessment Procedure (SAP) is the Government's approved mechanism for measuring home energy efficiency: it calculates a home's typical annual energy costs for space and water heating as well as lighting. The SAP scale runs from 1 (low) to 100 (high). Energy Performance Certificate (EPC) bands are based on the SAP scores, and run from G (low) to A (high). Current building regulations require a SAP rating of between 65 and 81 as a base-line, ie. a level above EPC band D – more than 50% of the existing housing stock falls well below this standard, as shown in Table 2 below.

F and G band homes have very low standards of energy efficiency. There is a broad correlation between these homes and those which constitute a category 1 hazard for excess cold, as defined in English and Welsh environmental health legislation.

Damp and mould are more likely to occur in cold, poorly insulated homes, and thermal efficiency is strongly linked to the age of the property: on average properties that were built before the 1920s fall within the F and G categories and average indoor temperatures are lower the older the property, as shown in Table 3 below.

F and G rated homes are characterised by a number of elements which mark them as poor in energy efficiency. The Energy Saving Trust (1) has highlighted that properties falling into these two categories tend to be:

— Large or medium sized, semi or detached houses, gas heated and double-glazed, but with an unfilled cavity wall, which are generally rated as F. These are estimated to be about a third of all properties falling in categories F or G.
— Properties which lack gas- or oil- fired heating system. These are estimated to be about half of F–G rated homes.
— Smaller homes (flats or terraces), which are electrically or oil-heated and are single glazed. These tend to fall in the G banding, but are estimated to be only a small number.
— Large, semi or detached houses, generally electric or oil-heated, with solid walls, either double or single glazed. The average SAP for single glazed homes of this type is under 20. These tend to be large and old rural homes.

Table 2 Percentage of homes in England by EPC banding and SAP rating, 2008. Source: EST 2010 (1)

EPC	SAP	% homes in England
A/B	81+	0.3
C	69–80	10.0
D	55–68	35.4
E	39–54	37.4
F	21–38	13.4
G	1–20	3.5

Percentage of homes in England by EPC banding and SAP rating, 2008. Source: EST 2010(1)

Table 3 Indoor temperature by age of property (23)

Ages of property	Number of dwellings	Mean measured temp (°C)	Temp under standard conditions	% of households with hall temp <16°C at standard conditions
Pre 1900	660	17.3	16.7	38.8
1900–44	1,157	17.5	16.8	36.0
1945–64	853	17.6	17.0	35.8
1965–80	621	19.1	18.4	17.6
Post 1980	116	19.5	18.7	14.7

Whether households living in such properties are in fuel poverty depends on the household's income. A number of households living in large and older properties at the higher end of the housing market may not be in fuel poverty due to high incomes. However, the fact remains that households living in such properties are either in fuel poverty or at risk of quickly falling into fuel poverty if their family circumstances or income change. Moreover, such properties are detrimental to the environment as – in order to keep warm - the households residing in them are bound to emit more CO_2 than they would if their home's efficiency was improved.

Rural Homes

Fuel poverty is a particularly concerning problem in rural areas, where it is estimated that half of homes in sparsely populated English communities have an energy efficiency rating of below SAP30, which is considered a significant health hazard. In 2006, 21% in rural areas were in fuel poverty compared with 11% in suburban and 10% in urban areas (24). Rural homes are likely to be detached and larger in size than urban homes (25), meaning that they are more difficult and more expensive to heat, or to make more energy efficient.

Access to mains gas is rare in most areas more than about 5 or 10 miles from an urban area (25) , meaning many rural homes must pay more for their fuel and a high percentage of them are in fuel poverty (The House of Commons Select Committee on Energy and Climate Change, March 2010, cited in (26)). They are heated by electric, oil or solid fuel, which tends to be more expensive and less efficient.

Many rural homes are older buildings. They are more likely to have solid walls (almost all homes built before 1919 are solid walled), which are generally less well-insulated than cavity walls (as can be found in nearly all homes built after 1945) (25). While over 60% of homes in urban areas and rural towns are cavity walled and on mains gas, this is true of only 32% in villages and 21% in hamlets (25).

These factors mean that it is on average more difficult and more expensive to improve the energy efficiency of a rural home and need to be considered when developing policies and interventions aimed at reducing fuel poverty.

5
Direct health impacts of living in a cold home

The direct health impacts of living in a cold home can be divided into higher risk of mortality and increased morbidity rates. There is a longstanding body of evidence describing the relationship between higher mortality rates in winter and cold temperatures (27) as well as higher morbidity rates (28). Fuel poverty itself is also detrimental to health, especially mental health, through the financial stress that it causes to households.

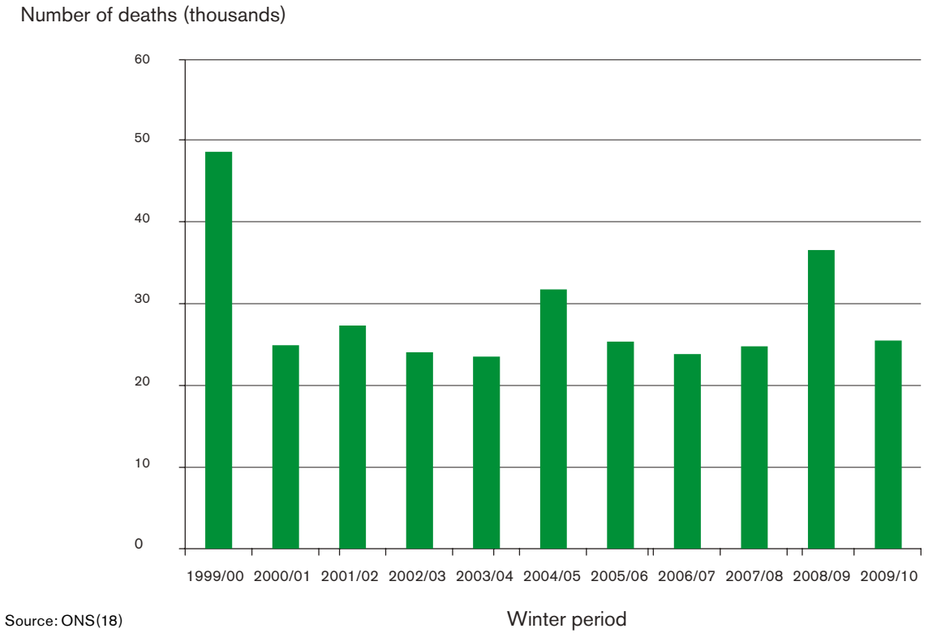
> We could prevent many of the yearly excess winter deaths – 35,000 in 2008/09 – through warmer housing...
> [Public Health White Paper, 2010]

5.1 Mortality: Excess Winter Deaths

The graph below shows the levels of excess winter mortality over the past ten years. In 2009/2010 there were an estimated 25,400 excess winter deaths. Although this represents a 30% decrease from the previous year due to low levels of influenza (21), the level remains persistently high when compared to other European countries (see Table 5)

The Office for National Statistics calculates excess winter deaths as the difference between the number of deaths in December – March and the average of deaths in the preceding August – November and the following April – July. If a two month period is taken instead of the four months, the peak of excess winter deaths is consistently more than 40% higher than the summer trough (23). Each centigrade degree reduction below 18°C in temperature in the UK corresponds with an extra 3500 deaths (29).

Figure 2 Excess winter deaths 1999–2010



Source: ONS(18)

There are many factors which play a part in excess winter deaths: increases in deaths from respiratory and circulatory diseases cause most of the excess winter mortality, influenza is a contributing factor rather than a main cause of death (18). Cold weather, and in particular cold homes, is believed to be a main factor in causing the winter increase of respiratory and circulatory diseases (30).

It has been noted by researchers that EWDs do not usually relate to socio-economic deprivation (32–35). This is because socio-economic deprivation indices do not include an energy efficiency variable and although deprivation and fuel poverty are related, they are not the same – the lack of a significant relationship between deprivation and excess winter mortality suggests that in the UK those who are deprived often live in social housing, which is, on average, more energy efficient.

Wilkinson and associates (23) analysed 80,331 deaths from cardiovascular disease in England, between 1986–96, linked by postcode of residence to data from the 1991 English House Condition Survey. Deaths from cardiovascular disease were 22.9% higher in winter months than the average for the rest of the year. There was a statistically significant excess winter mortality seen with the age of the property (28.8% in properties built before 1850 compared to 15% in properties built after 1980) and with poor thermal efficiency ratings, where a gradient can be seen with SAP rating.

Further, there was a strong association between excess winter deaths and lower indoor temperatures, with residents of the 25% coldest homes having around 20% greater risk than those in the warmest. 'The findings provide strong, although not conclusive, evidence that winter mortality and cold-related mortality are linked to sub-optimal home heating' (23).

> "Diseases of the circulation – including heart attack and stroke – account for around 40% of excess winter deaths. Around one third of excess winter deaths are due to respiratory illness…" [Chief Medical Officer Report, 2009]

Circulatory diseases are believed to cause around 40% of excess winter deaths, while respiratory diseases are responsible for about a third (31). Deaths directly attributed to influenza or hypothermia represent a small proportion of excess winter mortality (32). While there is a clear link between marked winter mortality peaks and the incidence of influenza, cold housing still plays a role in the development of health complications from influenza, and there is still excess winter mortality in years when influenza incidence is at a low level. For example, in Scotland in 2000/2001 there were an estimated 1500 to 3000 EWDs while flu rates were lower than 150 per 100,000 (32).

The elderly are subject to the greatest increase in deaths in winter, with 20,200 more deaths in the UK among those aged over 75 years during the winter of 2005/06 compared with levels in the non-winter months. Older people are more likely to be vulnerable to cold weather, partly because they are more likely to have existing medical conditions. Further, their temperature control is weaker because of less subcutaneous fat, making them vulnerable to hypothermia (29). In older people, a 1°C lowering of living room temperature is associated with a rise of 1.3mmHg blood pressure, due to cold extremities and lowered core body temperature (33). Older people are more likely to be fuel poor, as they are likely to spend longer in their homes than other people and therefore require their houses to be heated for longer periods (34).

Other groups are also vulnerable, including children and people with long term illness (30). In addition, many of the most vulnerable members of society spend longer in the home than most, and therefore require the heating on all day, and not just in the morning and evening (31).

Table 4 Excess winter deaths by age of property (23)

Property age (n=80,331)	Winter deaths	% excess in winter	Risk (95% confidence interval) relative to baseline group	P-value for trend*
Pre 1850	701	28.2	1.0	0.001
1850–99	5,469	25.6	0.98 (0.88–1.09)	0.001
1900–18	3,063	24.1	0.97 (0.87–1.08)	0.001
1919–44	6,978	26.0	0.98 (0.89–1.09)	0.001
1945–64	6,709	23.9	0.97 (0.87–1.07)	0.001
1965–80	6,612	17.1	0.91 (0.82–1.01)	0.001
Post 1980	935	15.0	0.90 (0.79–1.02)	0.001

* The p-values test for a trend of increasing or decreasing risk across ordered groups (for example, increasing age). However, in the case of region, there is no logical order and the p-value tests whether the winter excess varies between regions.

The number of excess winter deaths attributable to cold housing

Excess winter deaths occur in both cold and warm housing. However, there is a greater risk of death in colder housing than in the warmest housing. The authors of this report have estimated that 21.5% of all EWDs can be attributed to the coldest quarter of housing, due to it being cold, over and above the amount of deaths which would have occurred had these houses had the same winter excess as the warmest housing. This means that EWDs in the coldest quarter of housing are almost three times as high as in the warmest quarter.

This estimate was based on existing estimates of the risk of excess winter deaths due to living in cold housing, as calculated by Wilkinson in 2001. More recent estimates are not available as there are no comprehensive sets of measured indoor temperatures since the English House Condition Survey stopped collecting such data in 1996.

Wilkinson estimated that, in winter, death rates in the 25% of coldest homes rose to 1.5 times the summer minimum for all types of housing. The corresponding risk ratio for the 25% of warmest homes was 1.3. His estimate was based on mortality rates for the period 1986–1996 in England and Wales and a household sample of 3337.

We used these risk ratios to calculate estimates of excess winter deaths in cold housing and of numbers expected if rates for warm housing applied. The difference between these estimates is the number attributable to the house being cold rather than other factors (e.g. flu epidemics, air pollution, cold outside temperature, etc.). This value was than divided by the average EWDs for the period 1986–1996 in order to calculate the proportion of EWD attributable to cold housing in this period (21.5%). The details of the calculations and key assumptions used to develop the model and calculate the estimate are given in the appendix.

International comparisons

Healy carried out an analysis of excess winter deaths, describing variations in excess mortality in southern, western and northern European countries (35). Table 5 below shows the different levels of excess mortality rates: it is clear that these do not necessarily match different climatic conditions – meaning that often higher rates are found in countries with less severe, milder winter climates ("the paradox of excess winter mortality"), such as Greece, the UK, Spain, Ireland and Portugal. These findings highlight that colder countries, which have had higher building standards than the UK for many years, have much lower rates of excess winter deaths.

For this study levels of fuel poverty were calculated using a set of indicators which included housing conditions, affordability of home heating and energy efficiency levels based on a consensual approach[5] (35). It is suggested by this study that the paradox of excess winter mortality being highest in warmer countries could be explained by the fact that countries with milder climates often have the worst domestic thermal efficiency. Table 6 below shows the countries' differences in thermal efficiency variables and how they relate to the coefficient of seasonal variation[6]: the study shows that cross-country levels of cavity wall insulation, double glazing, and floor insulation are all significant at the 5% level in the model.

The study also analyses the impact of different lifestyle factors on excess winter mortality, in particular smoking and obesity. Interestingly, it shows that there is no relationship between these factors and excess winter mortality despite the fact that these factors are strongly associated with higher non-seasonal mortality rates. The study concludes that variations in mortality rates are due to differences in indoor temperatures, healthcare spending and socio-economic circumstances.

Other studies have supported Healy in associating excess winter deaths with internal temperatures,

Table 5 Coefficient of seasonal variation in mortality (CSVM)[4] in EU–14 (mean, 1988–97) (35)

	CSVM	95% CI
Finland	0.10	0.07 to 0.13
Germany	0.11	0.09 to 0.13
Netherlands	0.11	0.09 to 0.13
Denmark	0.12	0.10 to 0.14
Luxembourg	0.12	0.08 to 0.16
Belgium	0.13	0.09 to 0.17
France	0.13	0.11 to 0.15
Austria	0.14	0.12 to 0.16
Italy	0.16	0.14 to 0.18
Greece	0.18	0.15 to 0.21
UK	0.18	0.16 to 0.20
Spain	0.21	0.19 to 0.23
Ireland	0.21	0.18 to 0.24
Portugal	0.28	0.25 to 0.31
Mean	*0.16*	*0.14 to 0.18*

demonstrating a strong association between excess winter mortality and levels of domestic heating (33) or protection from low outdoor temperatures (36).

Summary

— Countries which have more energy efficient housing have lower EWDs.

— There is a relationship between EWDs and low SAP rating/low indoor temperature.

— EWDs are almost three times higher in the coldest quarter of housing than in the warmest.

— 21.5% of all EWDs are attributable to the coldest quarter of housing, because of it being colder than other housing.

— Around 40% of EWDs are attributable to cardio-vascular diseases.

— Around 33% of EWDs are attributable to respiratory diseases.

5.2 Morbidity: Health Conditions

The main health conditions associated with cold housing are circulatory diseases, respiratory problems and mental ill-health. Other conditions influenced or exacerbated by cold housing include the common flu and cold, as well as arthritis and rheumatisms. The level to which such conditions rise during the winter months and their relationship with cold housing is harder to measure than for mortality, which is systematically recorded. The literature on excess winter morbidity is reviewed below.

Low indoor temperatures have been shown to be associated with poor health (41), excess winter mortality (37), as well as a variety of social and economic problems for residents (38). Trends such as the ageing population, rising unemployment, and an increase in numbers of people working from home will make the need for a warm home even more crucial (39). There are recommendations from the World Health Organization (WHO) to keep indoor temperatures above 18 degrees, but there are also some critical thresholds around acceptable temperatures in relation to health (40). For instance, the longer an individual is exposed to cold temperatures, the greater risk of harm to health (41). The impact is exacerbated for vulnerable individuals and the colder the temperature the greater the risk of harm:

— Temperatures that are lower than 16 degrees appear to impair respiratory functions.
— Temperatures below 12 degrees place strain on the cardiovascular system.
— Temperatures below 6 degrees place people at risk of hypothermia.

Liddell (42) has reviewed the main large scale studies of the health impacts of fuel poverty carried out over the past 10 years. These were the Warm Front Evaluation, the Scottish Central Heating Programme (CHP), the New Zealand Housing, Insulation and Health Study (HIHS), and Housing, Heating and Health Study (HHHS), a NATCEN longitudinal study of housing conditions and their association with English children's well-being, and the US Children's Sentinel Nutritional Assessment Programme (C-SNAP).

Liddell concludes that, despite the risks to physical health from cold homes, improvements to energy efficiency and the reduction of fuel poverty achieved by some of the programmes had a modest measurable impact in improving the physical health of adults. However, the potential for measuring such effects is hampered by methodological limitations in the evaluations, including the sample sizes of the studies. Measuring the health impact of improvements in energy efficiency and reduced fuel poverty is particularly difficult for adults who may have long term health conditions related to cold housing which are the result of lengthy exposure to cold houses. The impacts are easier to measure in children, who are more readily susceptible to changes, and for the elderly who are at higher risk of mortality or developing life-threatening conditions. The main findings across the studies are summarised in the points below, while some of the detail is discussed further in this report:

— Significant effects on the physical health of the **young** were evident, especially in terms of **infants**' weight gain, hospital admission rates, and caregiver-rated developmental status, as well as self-reported reduction in the severity and frequency of **children**'s asthmatic symptoms.
— Mental health impacts emerged as extremely strong amongst both **adults and adolescents**.
— After improvements have been made to homes, health improvements for **adults** were measurable, although modest, and mostly related to perceptions of physical well-being and self-assessed general health.
— Large-scale studies suggest that impacts of cold temperatures as a function of poor housing on mortality and morbidity are almost certain across the whole population.

Table 6 Coefficient of seasonal variation in mortality and domestic thermal efficiency in EU–13 (35)

	CSVM	Cavity wall insulation (% houses)	Roof insulation (% houses)	Floor insulation (% houses)	Double glazing (% house)
Finland	0.10	100	100	100	100
Germany	0.11	24	42	15	88
Netherlands	0.11	47	53	27	78
Sweden	0.12	100	100	100	100
Norway	0.12	85	77	88	98
Denmark	0.12	65	76	63	91
Belgium	0.13	42	43	12	62
France	0.13	68	71	24	52
Austria	0.14	26	37	11	53
Greece	0.18	12	16	6	8
UK	0.18	25	90	4	61
Ireland	0.21	42	72	22	33
Portugal	0.28	6	6	2	3

Circulatory diseases

Much of excess winter mortality can be attributed to cold temperatures, and a significant proportion can be attributed to cold housing. Excess winter deaths that are attributable to circulatory diseases are estimated to be between 40% (43) and 50% (44). Cold affects circulatory health because temperatures below 12 degrees celsius result in raised blood pressure (Collins et al., 1985, cited in (44)) caused by the narrowing of blood vessels, which also leads to an increase in thickness of the blood as fluid is lost from the circulation. This, with raised fibrinogen levels due to respiratory infections in winter, is associated with increased deaths from coronary thrombosis in cold weather. Increases in blood pressure, along with increased blood viscosity, increases the risk of strokes and heart attacks (31).

Barnett et al. (45) studied people aged 35–64 in 21 countries who had had a coronary event between 1980–95 and found a small overall increase in the number of heart attacks in cold periods (26.3% events were in 25% of periods). More significantly, fatal events (compared with non-fatal events) were more common in cold than warmer periods. The researchers also found that women were 1.07 times more likely to suffer a coronary event in a cold period than men.

It has been suggested that exposure to cold temperatures only brings forward those events that would have happened within the next couple of weeks (the mortality displacement hypothesis). However, in a Barnett and associates (45) study of cold weather and coronary events, there was no increased odds (above the population average) of experiencing a coronary event during a cold period for people who had previously had heart attacks. This suggests that the cold temperature mechanism affects both high and low risk groups equally.

Although the relationship between cold temperatures and circulatory diseases is evident, there is little research on the relationship with cold housing. One study, which monitored cardio-vascular health in the elderly population (aged 75 and over) monthly for one year, found that there was no relationship between indoor temperature and excess circulatory ill-health (46). However, there are shortcomings to this research, such as the fact that measures were taken only once a month during a mild winter, and the population in the warm housing was in residential or sheltered accommodation, which means that they might have been more vulnerable to ill-health in the first place.

More recently, research using case control study has shown significant improvements in circulatory health through improvements in the thermal efficiency of housing (47). In this study the blood pressure of individuals subject to interventions fell significant and there were improvements to their general health including self-reported reduction in the use of medication and hospital admissions, while no changes were recorded for the control subjects whose housing had not been upgraded.

During the summer months, heat waves can be detrimental to people's health, and cause additional avoidable deaths. During the heat wave of August 2003, when temperatures were much hotter than usual, it is estimated that there were 2139 excess deaths in England and Wales (48), mostly through circulatory diseases**.** This was particularly significant for those over 75 years of age, and those living in the London region (48), showing that vulnerability to excess heat was found among the elderly population, which is also the most vulnerable to cold temperatures**.** However, urban areas were at higher risk of excess heat. Although many energy efficiency improvements are likely to protect from extreme outdoor temperatures, hot or cold, the problem of summer excess deaths should be taken into consideration when carrying out home energy efficiency improvements, particularly when considering materials used and the adequacy of ventilation.

Despite evidence of unusually hot summers causing excess summer deaths in the UK, these excess summer death rates are relatively low in comparison to excess winter deaths. Excess summer mortality sometimes receives considerable media attention as it did during the heat wave of August 2003. Excess summer mortality occurs to a lesser, though still notable, extent in England and Wales. Circulatory morbidity and mortality are higher in the winter than even the warmest of UK summers. The increase in the number of heart attacks during the winter months and an analysis of excess non-fatal heart attacks and strokes in relationship to cold housing is an obvious avenue of research to explore the causes of increased cardio-vascular morbidity during the winter months.

Respiratory problems

Cold air affects the normal protective function of the respiratory tract, with increased bronchoconstriction, mucus production and reduced mucus clearance. The relationship between respiratory problems and cold temperatures is evident in the seasonal level of contact between sufferers and the healthcare services. Increased contact for adults during the winter months has been related to fuel poverty (49), and increased contact and symptoms for children has been strongly associated with cold housing (42).

Hajat, Kovats & Lacowycz (50) found that GP consultations for respiratory tract infections can increase by up to 19% for every one degree drop in mean temperature below five degrees celsius. Hospital admissions for respiratory conditions and ischaemic heart disease (reduced blood supply to the heart) also increase substantially during winter months (51).

Afza & Bridgman (52) support this in their paper which looks at the contribution of respiratory disease to the burden of excess winter (November-February) hospital admissions in the North Staffordshire district, 1995–2000. They found that respiratory disease related emergency admissions increased twofold in the winter months. Cold, damp houses also promote mould growth, which lowers resistance to respiratory infections, thus increasing the risk of respiratory morbidity during winter (31).

A study by Gilchrist (53) focused on measuring morbidity in relation to fuel poverty: costing emergency respiratory admissions followed by the probability of dying following admission. The paper could not conclude whether there was a relationship between mortality and fuel poverty, but it showed that morbidity counts rise with increasing fuel poverty risk, with a notably large effect in December, over and above the underlying effect of winter itself. Effects were particularly relevant for age and gender, with higher counts for older people and lower counts for women.

A time series analysis of short-term effects of temperature on daily GP consultations made by people over 65 for lower (LRTI) and upper respiratory tract infections (URTI) was conducted over a ten year period (1992–2001) in 16 urban UK locations (54). This showed an association between low temperatures and an increase in LRTI consultations in all 16 locations. A slightly weaker relationship was observed in the case of URTI consultations.

Importantly, a large scale study which looked at residents aged over 65 in the London Borough of Newham, calculated 'excess winter morbidity' (EWM) based on emergency hospital episodes for all respiratory diagnosis codes, and ranked this against a Fuel Poverty Index (FPI) which included factors of energy efficient housing, low income, householder age and under-occupation. The FPI was shown to be a predictor of EWM, indicating supporting evidence of a relationship between energy-efficient housing and winter respiratory disease among older people (28).

> "I'm all right, but I worry about my husband because he's got bronchitis. In the summer, he can do the dishes in the kitchen. But in the winter, he can't because it's too cold in there because of the draught coming in from the roof." (Susan, retired couple) [Harrington et al, 2005]

Barnes, Butt & Tomaszewski (19) used the Families & Children Survey to estimate that 13% of children spent at least a year living in inadequately heated accommodation between 2001–05. Damp is more likely to occur in cold, poorly insulated homes, and this often results in mould which may trigger an allergic response such as asthma. Children living in damp, mouldy homes are between 1.5 and 3 times more prone to coughing and wheezing – symptoms of asthma and other respiratory conditions – than children in dry homes (55) (Peel et al 1998, cited in (19)). Children persistently living in accommodation with inadequate heating and poor conditions were more than twice as likely to suffer from chest and breathing problems, such as asthma and bronchitis (19).

A child who develops asthma this way is likely to have it for many years and possibly life, and this is particularly concerning given 2009 estimates that 1.1 million children in the UK are affected by asthma (39). Brambleby and associates (56) estimated the cost of asthma is at least £847 millions per annum, just under 1% of the national NHS budget in 2008 (39).

Adequate heating systems have been shown to improve asthma symptoms and home energy improvements have reduced the number of sick days off school by 80% in children with asthma or recurrent respiratory infections (57).

The Warm Front Programme showed that a majority of participants suffering from respiratory problems reported improvements in breathing, however a small but significant proportion felt that the new heating systems aggravated their chest conditions (58). Bone and associates (59) also highlight a number of concerns surrounding home energy-efficiency measures and their negative impacts on health. Insufficient ventilation in increasingly airtight houses may lead to increased levels of indoor pollutants such as radon, carbon monoxide, nitrogen dioxide, and formaldehyde, and the higher relative humidity might promote growth of mould and dust mites, which are implicated in the development and worsening of asthma.

Risk of overheating in heatwave conditions, increasing the risk of illness and death from conditions, most commonly cardio-vascular and respiratory disease, is a further concern. These impacts, however, are not a result of home energy-efficiency measures per se, but rather inappropriate choice and maintenance of ventilation systems and design and refurbishment of buildings, and these are the issues that should be addressed. These findings around worsening of respiratory health in a minority of cases receiving increased air-tightness in the home reiterate the importance of ensuring adequate and high-quality refurbishments of the existing stock.

Mental health

A study carried out by Shelter in 2006 suggested that children in bad housing conditions, including cold homes, are more likely to have mental health problems, such as anxiety and depression, to contract meningitis, have respiratory problems, experience long-term ill health and disability, experience slow physical growth and have delayed cognitive development (60). These adverse outcomes reflect both the direct impact of the housing and the associated material deprivation.

> *Interviewer*: If you are cold in your house, what effect does that have on your life in general?
> *Respondent*: It makes you feel depressed, very much so. (Edwin, single middle aged) [Harrington et al, 2005]

The Warm Front and the Scottish CHP evaluation assessed mental health impacts on adults and both found that effects were prominent in the mental health domain, in particular for borderline anxiety and depression. In the short and medium term, receiving a Warm Front package is associated with significantly better mental health. The study showed that as average bedroom temperature rose, the chances of occupants avoiding depression increased. Residents with bedroom temperatures at 21°C are 50% less likely to suffer depression and anxiety than those with temperatures of 15°C (61).

Even greater impacts were found in the New Zealand HIHS study. This could perhaps be accounted for by the fact that all households were at clinical risk in the New Zealand study. "It is possible that the joint effects of fuel poverty and ill health (especially if one is perceived to exacerbate the other) generate a significantly greater toll on mental health than might be evident in a more diverse range of healthier households." (42)

The NATCEN study found that lack of affordable warmth was associated with multiple mental health risk for young people, meaning that they manifested four or more negative mental health symptoms: 28% were classified as having such risk, compared to 4% of young people who had always lived in warm homes (19). A significant proportion of children living in cold homes felt unhappy in their family – 10% as opposed to 2% of the group living in warm homes. Complementary studies point to the fact that young people living in cold homes try to find respite and privacy in other venues outside home, where they are more exposed to mental health risks (62,63).

Other conditions

Medical conditions exacerbated and/or complicated by exposure to cold and which show winter associations include diabetes complications, certain types of ulcer exacerbations, osteoarthritis knee pain severity and hip fracture (29). Chronic conditions may also lower body metabolism which means the body generates less heat, while stroke, Parkinson's disease and dementia restrict activity, slowing body heat generation and conservation (29). Cold housing may also delay recovery following discharge from hospital (64).

As part of the Warm Front health impact evaluation, Gilbertson and associates (58) conducted semi-structured interviews with 49 households which received home energy improvements under the scheme from five urban areas. Almost all reported improved and more controllable warmth. Two thirds of participants reported improved comfort, while those with limited mobility all acknowledged the warmer home environment as beneficial. 20% reported less minor illness during the winter. The Warm Front health impact evaluation also found improvements to mental health and emotional security. 24.5% reported feeling more relaxed and content, 55.1% reported feeling better, and 26.5% reported better mood and temperature (58).

> *Interviewer*: How important is being warm for you?
> *Respondent*: Very, because I can't stand the cold very much because I get pains in my legs from the cold. (Claire, young mother, living with husband and children) [Harrington 2005]

The Warm Front health impact evaluation found that 24.5% of respondents reported easing of chronic conditions such as arthritis (30).

A survey-based evaluation of a programme to tackle fuel poverty by installing energy efficiency measures in homes in a rural community in Northern Ireland demonstrated that energy efficiency intervention can lead to improvements in

health and well-being, increased levels of comfort in the home and a reduction in the use of health services. Key findings include a reduction in the occurrence of condensation, a reduction in the numbers of people reporting arthritis/ rheumatism, a reduction in the use of health services, an increase in temperature satisfaction for those who had a new heating system installed, and for those who did not, there was an increase in benefit uptake (70).

Interviewer: Do you think being warm is connected to your health?
Respondent: Yes, because you can catch more colds [if colder]. (Betty, retired couple) [Harrington 2005]

Cold conditions can also increase the risk of minor illnesses. The common cold replicates faster in a cold nose whereas the immune system becomes more sluggish in colder temperatures, meaning a common cold is more likely to develop. This can have more severe consequences for patients with existing conditions, as it may lead to a chest infection in patients with chronic obstructive pulmonary disease (COPD) (44).

Summary

- There is a strong relationship between cold temperatures, cardio-vascular and respiratory diseases, which has been associated with fuel poverty and cold housing.
- Children living in cold homes are more than twice as likely to suffer from a variety of respiratory problems than children living in warm homes.
- Mental health is negatively affected by fuel poverty and cold housing for any age group.
- More than 1 in 4 adolescents living in cold housing are at risk of multiple mental health problems.
- Cold housing increases the level of minor illnesses such as colds and flu and exacerbates existing conditions such as arthritis and rheumatisms.

6
Indirect health impacts of living in a cold home

Evans (65) carried out a study of wider housing quality and children's health and well-being. Housing quality was based on an observer-rated standardised index[7] which included indoor temperature, as well as other variables (structural quality, privacy, hazards, cleanliness/clutter, and children's resources). The study found that independently of household income, children residing in poorer quality housing have more psychological symptoms and less task persistence than their counterparts living in better quality housing. There were no gender differences. The research showed not only that housing quality is associated with psychological health in children, but that it may also affect certain aspects of children's motivation. The motivational data suggests that chronic exposure to poor housing conditions may lead to greater helplessness[8].

Significant improvements in health-related quality of life were found in a randomised controlled trial of home insulation, which concluded that targeting home improvements at low-income households significantly improved social functioning and both physical and emotional well-being (including respiratory symptoms) ((41) cited in (66)).

The level of energy efficiency affects people with low incomes more severely because it affects life chances and how they spend disposable income on other basic items such as food and clothing (14). Poor families will face the choice to "heat or eat": either less money can be spent on basics such as a sufficient, healthy diet (with obvious health impacts such as obesity or malnutrition), or less can be spent on heating their homes to a reasonable temperature.

Warmer homes could bring potential physical health benefits from improvements in cooking and nutrition. Interviews with participating households as part of the Warm Front health impact evaluation found that 10% of householders felt more and better quality food could be purchased because of cost savings, and 20% reported improved cooking since previously cold kitchens were now comfortable to work in (58).

Bhattacharya and associates (67) looked at the impact of cold weather periods on family budgets and nutritional outcomes in poor American families. Their results suggested that these families tended to decrease spending on food by a similar amount to the extra spent on fuel during cold spells, and both children and adults reduced their caloric intake by about 200 calories in winter months. Rich families, on the other hand, increased spending on food, demonstrating that deprived families are more likely to suffer from some of the indirect impacts of cold weather.

Cold, damp homes increase the risk of arthritic symptoms. This impacts on strength and dexterity, which both decrease as temperatures drop, increasing the risk of non-intentional injuries. A cold house increases the risk of falls in the elderly (31). Domestic accidents, including fatalities, are more common in cold homes in winter. This can result in periods of prolonged immobility, making it even more difficult to keep warm (44).

Social isolation among older people is exacerbated by living in a cold home. Costly fuel bills prevent them from going out, they fear returning, already feeling cold, to a cold home, or they are reluctant to invite friends into a cold house (44). Older people who are unable to keep their homes warm, who have a health condition exacerbated by the cold or have sustained injuries due to the cold, may need increased care or need to go into residential care, increasing the financial burden on the country (44).

Interviewer: If you're cold in your own home, what effect has that on your life in general?
Respondent: Terrible. Sometimes we go to bed at 7 o'clock, and all our regular visitors know it's pointless coming after that time because they know where we are. We find it easier to go upstairs to sit underneath the blankets to keep warm. (Evelyn, middle aged couple) [Harrington 2005]

Some respondents to a survey carried out after the Warm Front programme tended to think of cold indoors as exacerbating health problems rather than causing them. This may illustrate lay beliefs rather than the absence of causality, but it also shows a clear perception on the part of the respondents that cold housing had an impact on their well-being. In particular, respondents identified positive effects of warmer homes on social relationships and mental health (68).

6.1 Social benefits of improved housing

The main benefits arising from improving the thermal efficiency of the existing housing stock are the beneficial effects on the health of residents and the reduced carbon emissions from heating needs. However, there are other benefits to warmer homes and to investing in thermal efficiency.

A study found that an increased duration of living in inadequately heated accommodation is significantly associated with having multiple negative outcomes across the range of the Every Child Matters outcomes framework[9]. For example, 67% of children who persistently lived in inadequately heated accommodation had not had a holiday in the past year compared to 50% who lived in inadequately heated accommodation on a short term basis, they were more likely to feel safe and less likely to fail to attend school (19).

Further, an increased duration of living in inadequately heated accommodation is significantly associated with having no quiet place at home to do homework (19). This may be because the family can afford to only part heat their home and heating is focused on the most used (and therefore noisiest) rooms. This can affect a child's educational attainment and therefore work opportunities in later life (31). Educational and work factors are particularly important determinants of long-term health (66): cold housing, its impact on family life and early years can heavily weight on other spheres of life, which affect long-term health outcomes.

The investment in energy efficiency measures can also help with neighbourhood renewal by creating more local jobs and improving local economies (10). Area based approaches such as the Community Energy Savings Programme currently being trialled throughout the UK could help to deliver this. Such investment can bring vitality to the green economy, work opportunities in the building industry and opportunities for up skilling the building workforce (14).

Summary

- Cold housing negatively affects children's educational attainment, emotional well-being and resilience.
- Fuel poverty negatively affects dietary opportunities and choices.
- Cold housing negatively affects dexterity and increases the risk of accidents and injuries in the home.
- Investing in the energy efficiency of housing can help stimulate the labour market and economy, as well as creating opportunities for skilling up the construction workforce.

7 Conclusions

Cold housing and fuel poverty not only have direct and immediate impacts on health, but also indirect impacts and a wider effect on well-being and life opportunities, as well as on climate change. The evidence reviewed in this paper shows the dramatic impact that cold housing has on the population in terms of cardio-vascular and respiratory morbidity and on the elderly in terms of winter mortality. It also highlights the stark effect that fuel poverty has on mental health across many different groups, while also having an impact on children and young people's well-being and opportunities.

Addressing energy inefficient housing and bringing all homes up to a minimum standard of thermal efficiency would have the strongest positive impact on the poorest households, even though households from a variety of socio-economic backgrounds are likely to be residents of such properties.

A medium scenario model for fuel price increases developed in 2008 predicted fuel poverty in England to jump to four million by 2016 if improvements to the energy performance of the housing stock, and growth in the incomes of low-income households, were maintained at only current rates (69). Fuel poverty has now already risen to this level because the fuel price increase was much higher than the model predicted: the current energy efficiency of the existing housing stock is unable to mitigate such high increases. However, it is unlikely that anyone living in a dwelling built to current and near-future standards will be at any risk of being in fuel poverty (70). The Government should aim to make improving energy efficiency standards a priority: any step forward in achieving certain minimum standards in the existing housing stock will reduce the risk of fuel poverty for current and future households and bring associated health benefits.

The Energy Savings Trust estimate that the overall total cost of improving to an E band all F and G homes would be £12.5 billion. Other estimates for upgrading all fuel poor homes to a SAP 81 range from £21 to £28 for England or £49 to £64 billion for the whole of the UK (71). If all homes in England were brought up to an EPC E band, 9.4Mt CO2 would be saved, just under 2% of the UK's net CO2 emissions[10]. Major energy efficiency retrofit programmes that would bring homes to a SAP of 81 have been estimated to reduce fuel bills of the fuel poor by half, thus removing 83% of fuel poor households from fuel poverty, as well as reducing CO2 emissions related to domestic energy requirements by over 50% (22).

> "The annual cost to the NHS of treating winter-related disease due to cold private housing is £859 million. This does not include additional spending by social services, or economic losses through missed work. The total costs to the NHS and the country are unknown. A recent study showed that investing £1 in keeping homes warm saved the NHS 42 pence in health costs..."
> [Chief Medical Officer Report, 2009]

NHS costs are associated mainly with morbidity rather than mortality, and the Department of Health in 2009 estimated that for every cold-related death there are eight non-fatal hospital admissions (39). In the coldest months of the year, NHS expenditure was reported as rising by 2% in 1998 (Hansard 1998, cited in (39)) , and Brenda Boardman estimated that the annual cost to the NHS of cold-related ill-health is almost certainly in excess of £1 billion (39).

An investment in upgrading all homes in England would be recouped though savings in energy consumption and NHS costs; additional savings would be gained through mitigating climate change, while achieving large scale environmental and social benefits through the number of lives saved and improved health and quality of life for all households affected by cold housing and fuel poverty.

Improving the energy efficiency of the existing stock is the only long-term sustainable way of ensuring a number of multiple gains: environmental gains, health gains, the mitigation of climate change and social gains through a reduction in health and environmental inequalities. It is also a good lever to stimulate the economy and the labour market in relation to the green economy, as well as providing opportunities for the up-skilling of the workforce in building construction and related sectors.

Government policy documents and reports, including the Chief Medical Officer report of 2009 and the recent Public Health White Paper, recognise the tangible impact of cold housing and fuel poverty on people's health and well-being. However, there is a clear contradiction between the Government's recognition of the link between health and cold housing, its statements of support for the reduction of fuel poverty and CO_2 emissions and its lack of identifiable commitment to support this agenda through regulation, target setting, guidelines, or funding. The recent cuts to Warm Front with its clearly reported

record of health improvement, ahead of any significant detail on the future level and arrangement of the Energy Company Obligation (ECO), are of particular concern. The impact of the funding cuts to local authorities on investment in fuel poverty and energy efficiency programmes is likely to be highly detrimental, especially when combined with the removal of National Indictor 187 and the repeal of the Home Energy Conservation Act.

While an estimated £3 to £8 billion annually is needed to address fuel poverty (71), ECO is planned to deliver only about £1 billion of investment through energy companies' contribution (72), while other existing schemes and requirements are being either reduced or abolished. The Government's current support and financial commitment to addressing the problem of poor thermal efficiency of housing remains inadequate, given the potential it has to improve the health and well-being of the population and to help mitigate climate change.

Ensuring effectiveness of interventions

Some studies (74;79) have shown that, following interventions aimed at improving thermal efficiency, trade-offs have taken place between energy use and thermal comfort. In some cases, the benefits of improved fuel efficiency were taken in the form of reduced fuel consumption rather than extra warmth, which may indicate more disposable income (68). These cases were often elderly householders, who found it difficult operating new heating controls or feared higher energy bills because they were unsure how the improved efficiency would impact on consumption.

These issues can undermine the potential health benefits of interventions. However, susceptible households can be identified and thermal efficiency interventions can be supplemented by other actions aimed at avoiding subsequent trade-offs.

A number of households who received improvements through the Warm Front programme reported a preference for retaining colder homes following improvements. Such preference was based partly on a long-term adaptation to low temperatures experienced throughout life and partly on lay beliefs of what constitutes a healthy temperature (73).

Interventions, especially in older people's homes, should be coupled with training in the use of new heating systems and ideally easy-to-use smart metres, which can indicate how much is being spent on fuel consumption. Such training should include information on what constitutes a healthy indoor temperature.

If heating or efficiency improvements are hard to implement and/or the household income is extremely low, upgrading the worst homes to a higher standard would still leave a number of households in fuel poverty. These cases need to be identified and consideration should be given to financial support with meeting energy bills for at-risk households, which would bring health benefits. Even better, the Government should give consideration to implementing a strategy for ensuring investment into upgrading such homes to a high efficiency standard, such as bands A and B. This would bring dual health and environmental benefits as well as making current and future households less susceptible to energy price increases.

A study showed that at pre-existing temperatures of 16.5C, about 30% of the benefit of an energy efficiency improvement would be taken as a temperature increase and the rest as an energy saving. This means that the great majority of interventions bring a multiple health and environmental gain. Where pre-existing temperatures were as low as 14C, such as in very poor standard homes or very low income households, a 50% energy saving is achieved and the rest is taken as a temperature increase. In circumstances where the house is already maintained at 20C on average, energy efficiency improvements will achieve a 100% energy saving (74).

This means that once the trade-off issues for at-risk households are addressed, energy efficiency interventions always bring multiple health and environmental gains.

7.1 Policy Recommendations

The studies reviewed in the sections above have shown not only that cold housing and fuel poverty have an impact on physical and mental health, but also that policies aimed at improving the thermal efficiency of homes and reducing fuel poverty can reduce mortality and morbidity. In this section we propose some areas for policy development and highlight interventions that are likely to have the greatest impact in improving cold homes and reducing fuel poverty.

The Energy Saving Trust (EST) has carried out an analysis of the measures needed to improve all houses to SAP39, thereby getting rid of all F and G homes (17% in 2008). The main measures needed are loft installation, full cavity wall insulation, a modern gas condensing boiler and double glazing. These homes will cost less than £3000 to raise to a band E. However, there are a small proportion of hard to make decent homes which will cost more than £5000 to bring to an E band. These should not be ignored when considering policy assistance measures.

Improving the energy efficiency of housing has to occur in all communities, across the social gradient and not just where it might be 'easy'. At times the households in most urgent need are those who are least likely to access support, such as tenants in the private rental sector, or who live in homes that are hardest to upgrade such as older rural housing.

1 It is vital that programmes and funding remain in place to reduce fuel poverty and improve the health of those on low incomes through improvements in the energy efficiency of homes at no cost to vulnerable consumers. Such funding should be provided to low income households through a renewed Warm Front Scheme and through the proposed Energy Company Obligation (ECO), which is currently planned to pass the costs on to consumers, regardless of income, though not upfront and with potential longer-term savings. This scheme needs to be adequately financed and its details should ensure that low-income households and vulnerable groups should be exempt from meeting costs.

2 The Warm Front programme, which provided a package of insulation and heating improvements to qualifying households, has been shown to have a positive impact on mental health, alleviating respiratory problems in children and reducing deaths among older people (61). In the context of increasing energy prices and an ageing population, as well as the need to mitigate climate change and adapt to more extreme weather events, it is recommended that the Warm Front Scheme is not only renewed to at least its pre-CSR levels, but its eligibility criteria widened or at least maintained, rather than restricted as is currently proposed.

3 Funding mechanisms must be in place to enable households across all tenures to upgrade their homes. However, beyond supporting low income households in any area, more intensity of intervention is also needed on two other levels: deprived areas should be targeted through programmes such as the Community Energy Savings Programme, and poor quality housing should be targeted through the introduction of a renewed energy-focused Decent Homes Standard, as suggested by the Communities and Local Government Committee (75). Low-income households could also be aided by further increasing targeting for the social housing sector, as suggested by the Home Energy Management Strategy, which proposed a minimum SAP standard of 70 for all social housing, as well as further action engaging with landlords to improve efficiency in the private rental sector (76).

4 More appropriate legislation must be developed on the side of tenants in private rented accommodation who are put off seeking help to make energy efficiency improvements to their homes. The Government should develop targets for upgrading the energy efficiency of the existing stock, including some form of minimum energy efficiency regulation for the private rental sector, which is supported by the Fuel Poverty Advisory Group (20). This could be facilitated through a statutory register for landlords held by local authorities, which could help identify non-decent homes, at risk households and implementation of regulation. This has the potential of raising 150,000 households from fuel poverty if privately rented F and G rented properties were brought up to a band E (72).

5 National Indicators are effective levers for local action and we recommend that the National Indicator on fuel poverty should be maintained as mandatory and a new National Indicator of housing quality, focused on energy efficiency, and specifically related to the private sector should be made available to local authorities. Fuel poverty has been included as an indicator in the proposed public health outcomes framework (77), while at the same time much of the responsibility from public health will move to local authorities: it is fundamental that data on fuel poverty at the local level continues to be collected if the this indicator is to be implemented and monitored.

6 Energy standards and guidelines should be coupled with quality standards for adequate ventilation when sealing homes. This is particularly necessary when 'quick fixes' such as double-glazing and draught proofing are carried out to properties. In major refurbishment and regeneration projects consideration should be given to using solar heat gain, while at the same time avoiding summer overheating through

shading and shelter belts. Some building materials – especially natural materials with a high density perform much better in avoiding summer overheating than light-weight counterparts, such as rockwool or polystyrene. Government funded projects should specify materials that address both problems.

7 Ensuring that all F and G rated homes are upgraded to an E standard by 2016 is a basic step towards achieving carbon emission reduction targets and ensuring that the existing housing stock is ready for upgrades to nearly zero-energy standards when undergoing further renovations as suggested by the EU policy directives on the energy performance of buildings (4). It is therefore recommended that, whenever viable, homes are upgraded to as high a standard as possible. In a few cases where some of the worst homes are involved and where it is cost-efficient, consideration should be given to demolition and rebuilding to current standards as this may avoid further expenditure in the future. It is often cost effective to deliver measures as packages, bringing them up to a band D or C, for example internal solid wall insulation and window replacements are usually most cost effectively delivered at the same time.

8 Past Government policies aimed at tackling fuel poverty have not equitably addressed those issues faced by rural communities. There are no policy instruments supporting the financing of double glazing, limited policy measures supporting financing for solid wall insulation and no strong incentive encouraging homeowners in inefficient homes to switch away from electric heating systems (1). It is recommended that policy instruments and incentives to implement the above are included in the Green Deal. There has been a lack of funding to assist off-gas properties, and remote areas suffer higher costs of delivery when it comes to home energy efficiency measures (26). Specific policies and interventions need to be developed to address the energy efficiency of rural homes, in particular FIT and RHI should be adapted to provide further support to low income households in rural homes.

Appendix

Methodology for developing model and calculating estimate of EWDs attributable to cold housing

The details of the calculations are given below. They are based on a simplistic model for estimating what proportion is attributable to cold housing and make some key assumptions:

1 The difference between the relative risk of death in cold and warm housing was constant over the 4 winter months.

2 The average risk for the non-winter months was half way between the summer minimum and the average level for the 4 winter months.

3 The population at risk in the 25% of coldest homes comprised a quarter of the general population and had the same age-sex profile.

A similar calculation could be performed for any other time periods if estimates of the risk for cold and warm housing were available for these other time periods. An assumption cannot be made that the difference in risks would be the same for other time periods, as it is not possible to predict how outdoor temperature and flu epidemics would influence this difference in risk.

The calculation was as follows:

Retrieved from ONS data

A Total EWDs for 1985/6–1995/6 = 368,850
A1 Total registered deaths 1986–1996 = 6,251,491

Calculations

B Average EWDs (A÷11)
C Monthly average EWDs (B÷4)
D The total number of deaths excluding EWDs (A1–A)
E The average monthly deaths excluding EWDs (D/(12×11))
F The average summer minimum (E–C)
G The monthly winter deaths in the coldest 25% of housing (F×1.5÷4)
H The monthly winter deaths that would be expected in 25% of housing based on death rates for the warmest housing (F×1.3÷4)
I Monthly winter deaths due to the coldest 25% of housing (G–H)
J Deaths due to the coldest 25% of housing over the winter period (I×4)
K Proportion attributable to the 25% of coldest housing (J/B)

Notes

All estimates are based on the period 1986–1996
Risk factors were taken from Wilkinson et al. 2001
Registered deaths, mortality rates and estimates of EWDs for the period 1986–1996 are all taken or derived from ONS data.

Endnotes

Denoted by [n] in the text

1 Although the emphasis in the definition is on heating the home, fuel costs in the definition of fuel poverty also include spending on water heating, lights and appliance usage and cooking costs.

2 Defined as those in receipt of one of the principle means tested or disability related benefits.

3 Those in receipt of certain income and disability benefits and those over the age of 70.

4 The CSVM is the proportionate increase in mortality during the winter months (Dec–Mar) in comparison to the average for the other two quarters of the year (Apr–Jul and Aug–Sep).

5 The 'consensual approach' is a method to measure poverty by looking at direct measures of living standards as determined by public opinion and identifying the population subject to an enforced lack of such standards.

6 The CSVM is proportionate increase in mortality during the winter months (Dec–Mar) in comparison to the average for the other two quarters of the year (Apr–Jul and Aug–Sep).

7 This index comprised 88 items which were scored between 0 and 2 by trained independent observers according to criteria listed in the index.

8 The definition of 'learned helplessness' is used here: a behavioural trait by which humans, following persistent lack of control over their surrounding environment, stop attempting to improve their circumstances, to achieve better results, or to change their own behaviour and environment.

9 This is an indicator framework of children's health and well-being developed by the Department for Children, Schools and Families in 2008 (http://www.dcsf.gov.uk/childrensplan/downloads/ECM%20outcomes%20framework.pdf)

10 The total UK net Co2 emissions in 2009 were 473.7Mt (http://www.decc.gov.uk/assets/decc/Statistics/climate_change/1214-stat-rel-uk-ghg-emissions-2009-final.pdf)

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