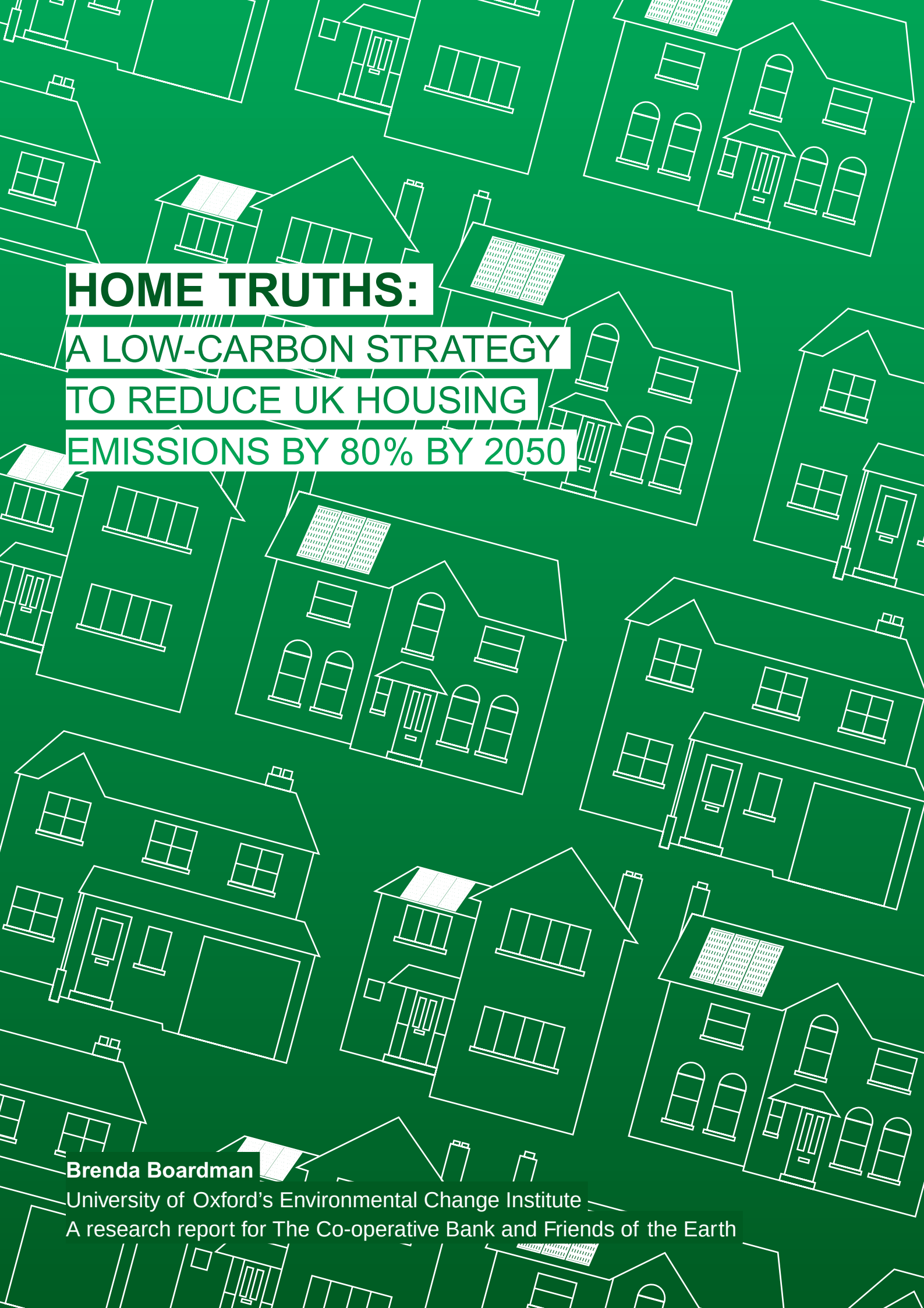

# HOME TRUTHS:

## A LOW-CARBON STRATEGY TO REDUCE UK HOUSING EMISSIONS BY 80% BY 2050

**Brenda Boardman**
University of Oxford's Environmental Change Institute
A research report for The Co-operative Bank and Friends of the Earth

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# ACKNOWLEDGEMENTS

This report could not have been written without the strong support of many members of the Lower Carbon Futures team at the Environmental Change Institute. In particular my thanks go to Becky Blandford, Daniel Curtis, Sarah Darby, Tina Fawcett, Praveen Gopalan, Mark Hinnells, Chris Jardine, Gavin Killip, Russell Layberry, Yael Parag and my successor, Nick Eyre. Important contributions have also been made by Nick Banks from Sustain; Jake Chapman; David Connor, Newcastle Warm Zone: Adrian Hewitt, London Borough of Merton; Kevin Lane from AEA Energy and Environment; Richard Moore; David Ormandy from the Law School, University of Warwick; Les Shorrock, BRE; Joanne Wade of Impetus. They all gave generously of their time and knowledge.

The progenitors for this report are the *40% house* (Boardman et al 2005), funded by the Tyndall Centre and research undertaken by the Lower Carbon Futures team for the Royal Commission on Environmental Pollution (Palmer et al 2006). The latter, and the UK Domestic Carbon Model (UKDCM) used in this report, have also been supported by the Carbon Trust and the Engineering and Physical Sciences Research Council, through the Building Market Transformation project. In the early stages of writing *Home Truths*, I was partly funded by the UK Energy Research Centre.

To each of these sources of help and inspiration, my thanks.

*November 2007*

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ISBN 1 874370 43 5

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The report can also be downloaded at:
www.foe.co.uk/hometruths
http://www.eci.ox.ac.uk/research/energy/downloads/boardman07-hometruths.pdf

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# FOREWORD

The Co-operative Bank first took decisive action on climate change in 1998. Following consultation with our customers, we developed our Ethical Policy position refusing to invest in "any business whose core activity contributes to global climate change'". Since then the bank has turned down over £100 million in related business, positively supported investment in renewables and turned our attentions to our own carbon footprint (99 per cent of our electricity use is from renewables and we have reduced our $CO_2$ emissions by more than 90 per cent since 1997).

We know our customers feel very strongly about combating climate change, which is why we have been campaigning in partnership with Friends of the Earth as part of our Customers Who Care campaign programme. *Home Truths* is a product of this partnership, which we hope will make a timely contribution in support of a strong Climate Change Bill.

This report delivers some compelling good news. An 80 per cent reduction in emissions from the housing sector by 2050 really is achievable, and will deliver both social and environmental benefits, by making homes more energy efficient and eradicating fuel poverty. That is a home truth we simply cannot afford to ignore. It's time for the UK to get its house in order.

**Simon Williams**
**Director of Corporate Affairs and Social Goals**
**The Co-operative Bank**

There is no place like home. But our homes are responsible for 27 per cent of the UK's carbon emissions. If the UK is to play its part in avoiding catastrophic climate change then we must drastically reduce them.

But at the moment carbon emissions from our homes are rising and the Government is making it neither cheap nor easy for home owners to cut them.

Friends of the Earth has led the campaign for the introduction of tough UK Climate Change legislation through The Big Ask. As the Climate Change Bill is debated in Parliament, this bold and ambitious report by Dr Brenda Boardman could not come at a more important time.

It provides a comprehensive action plan for massive carbon emission reductions from UK homes in a way which supports the needs of the poorest and most vulnerable. The blue print is here. What is required now is the political will to embrace it.

The investment and the political courage required are substantial. But the results promise to be spectacular: fuel poverty wiped out, energy security enhanced and true leadership in the transition to a dynamic low-carbon economy.

There is not a moment to lose.

**Tony Juniper**
**Executive Director**
**Friends of the Earth England, Wales & Northern Ireland**

# EXECUTIVE SUMMARY

**The Low-carbon Strategy from the Environmental Change Institute at Oxford University identifies the policies needed to deliver an 80 per cent cut in carbon emissions from UK homes by 2050. These cuts are achievable but will require a quantum leap in commitment from Government and a radical new approach.**

**The policies have been designed not only to dramatically reduce carbon emissions, but also to be delivered equitably. The poorest households will be prioritised for assistance and fuel poverty will be wiped out.**

**The scientific consensus is that for the UK to play its part in helping the world avoid a rise of more than 2°C, we must reduce our carbon emissions by 80 per cent by 2050. The household sector represents 27 per cent of our total emissions and achieving deep cuts here is an imperative.**

**The low-carbon revolution starts at home.**

## Policy failures

It's time for some home truths. Since this Government came to power in 1997 carbon emissions from UK homes have risen by more than 5 per cent. This has occurred despite powerful Government rhetoric about reducing emissions, and a plethora of initiatives including two Energy White Papers, a Climate Change Programme, an Energy Review, the Stern Review and five pieces of legislation.

The Government's projection for the residential sector represents an 11-18 per cent carbon reduction by 2020 from 1990 levels. In the absence of essential details, there can only be limited confidence in the proposed policies to deliver within this range. Even so, these savings are an insufficient contribution from homes, if the UK is going to be on target to reduce its carbon emissions by 60 per cent by 2050, let alone 80 per cent.

Furthermore the Government's policy approach is short term. There are no proposals for how the 2050 target for carbon reductions will be achieved in households.

Yet there is no shortage of opportunities. A total of 17 million homes have cavity walls, but over half are still unfilled, despite this being an inexpensive measure that makes the home much more comfortable. Despite the existence of a few much trumpeted policies, the rate of improvement in the energy efficiency of the general housing stock is largely dependent upon the initiatives of the occupiers, with little assistance from Government. At the moment it is neither cheap nor easy to make your home low carbon. The Government has even failed to protect the most disadvantaged. Although the number of fuel poor initially fell under New Labour, the number of households in fuel poverty in the UK has doubled to 4 million since 2002.

The Government is facing a rising challenge in tackling household emissions. Due to increasing population and falling household size, by 2050 there could be 23 per cent more households and, if nothing else changed, a 23 per cent increase in energy consumption. Electricity use in light and appliances rises inexorably.

The Government has provided limited support for the roll out of low- and zero-carbon (LZC) technologies, including micro-generation and community combined heat and power systems (CHP). This is an area where a seismic shift in policy is needed. There are few LZC installations in the UK: about 107,000 in the domestic sector in 2005, including community-scale CHP. No more than four out of every 1,000 homes have any LZC technologies with only £18 million currently available in Government grants for UK households.

## New versus old homes

The Government has given serious attention to emissions from new homes in England and this is welcomed. It has set a goal of all new homes being zero-carbon by 2016. However, the 2 million homes that will be constructed between now and 2016 will lead to 1.7 million tonnes of carbon (MtC) additional emissions for England alone. Wales has set a target for all new build to be zero-carbon by 2011 and this should also apply in England.

Of the homes we will inhabit in 2050, around 80 per cent are already standing today and these have to be the main focus for carbon-reduction policies. The Government has comprehensively failed to set out effective policies to significantly reduce emissions from the homes we already live in.

## The Low-carbon Strategy

*Home Truths* offers a way forward. It reveals that not only is an 80 per cent cut in household emissions achievable, but it can be done in an equitable and fair way that wipes out fuel poverty and enables every UK citizen to live in a warm, comfortable home. Our quality of life will be enhanced. Everyone stands to gain.

The vision is as follows:

**The low-carbon house:** Every household has excellent insulation. Every household has a solar installation. The individual is warmer, has more hot water and can even have more appliances than now. No household spends more than 10 per cent of its income on energy.

**The benefits:** Carbon emissions are cut, national energy security is increased; homes provide a healthier environment; there are significantly increased employment and business opportunities. Fuel poverty has disappeared.

**The approach:** Market transformation is the strategic approach recommended. It combines tough minimum energy standards for homes, lighting and appliances; regulation of utilities; generous financial support through grants, funding and the reform of energy tariffs; and much greater information for the consumer. Market transformation sets a long-term policy framework and recognises that combinations of policies are the most effective. There are more than 40 individual policy recommendations.

# THE WAY FORWARD – A 10 POINT ACTION PLAN

## Tough standards

1. **An integrated strategy with legally-binding targets for housing emissions:** The Government sets a target for reducing emissions from the household sector by 3.7 per cent every year from 2008 as part of an integrated strategy for the whole economy. Local Authorities are set the same legally-binding target for emissions from housing. Immediate and forceful action is needed, as the first few years are critical to changing mindsets and the present flat trajectory, and because every year's delay makes the challenge tougher and climate change greater.

2. **Minimum legal standards for homes:** Energy Performance Certificates, which rate houses from A to G, are rolled out for every home in the UK (not just those being sold or let) from 1 January 2008. A minimum standard is set and progressively tightened to transform the housing sector by making it illegal to re-sell (or let) the most energy-inefficient houses. Houses in bands F and G have such low levels of thermal comfort they are officially a health hazard – there are 3 million such homes in the UK today. They have to be improved before they can be re-sold. No G-rated property can be re-sold after 2010, no F-rated after 2013 and no E-rated ones after 2016. By 2050 the aim is that there is no house in the UK less than band D, today's average rating and that the rate of heat loss in the average house has been halved. The poorest and most vulnerable households are given unprecedented support to ensure the necessary changes happen quickly. The rest have access to long-term financing mechanisms and practical assistance.

3. **Local authorities:** Local authorities have a clear responsibility to ensure that the carbon emissions from all energy use in all housing in their geographical area are reduced. They are the vanguard in the battle to reduce household carbon emissions, creating Low-carbon Zones, initially to cover areas where there is a concentration of fuel-poor households. Improvements to the building envelope are undertaken for whole streets at a time, to include solid wall insulation, solar hot water, photovoltaics and/or combined heat and power. After this, no visited home is still in fuel poverty. Low-carbon Zones are rolled out across the whole of the local authority's area, in the same way that smokeless zones were. The local authorities ensure there are advice centres, to help all households make changes, they require energy efficiency improvement as a condition of planning permission and many set up Energy Service Companies.

4. **Minimum legal standards for products:** The UK Government fights for the toughest possible European minimum energy standards on lighting and appliances and rapid implementation. The minimum standards set by the Commission for energy products have to be fixed at a level that achieves a substantial reduction, beyond what the industry was going to deliver anyway. This requires political courage from the UK Government to stand up to industry. Incandescent

bulbs are phased out from sale in the UK by 2011. Standards are again tightened so that by 2030 all UK homes only have light-emitting diodes (LED) for lighting. All appliances on sale have clear energy consumption labels and retailers in the UK agree to stop selling the most energy-inefficient appliances.

5. **New homes:** New construction is concentrated in urban areas, at increased densities, to reduce the need for greenfield sites, encourage the use of combined heat and power, reduce the need for private transport and enliven the community centre. Mandatory air-tightness tests are carried out on new dwellings, with failure to comply resulting in a prohibition on selling the property, until it does comply. The Government ensures that local authorities have the funds to employ sufficient building inspectors in-house, without the need to privatise any part of the service. Assessment against the Code for Sustainable Homes becomes mandatory for all new homes. The Government requires all local authorities to adopt the Merton Rule, so that most new housing has to have 10 per cent of all energy generated on-site. This proportion increases significantly, in preparation for the 2016 building regulations.

## Making it cheap and easy

6. **Reform the energy market:** A feed-in tariff is adopted guaranteeing a premium price for exported electricity that reflects the true cost of installing the equipment. This is a recognised and influential method of encouraging the installation of electricity from micro-generation. A renewable heat obligation is introduced requiring a proportion of household heat to come from LZC sources. It is complemented by a green gas tariff. Energy tariffs are reformed so that they reward energy saving rather than high consumption.

7. **Financial support:** A robust programme of Government tax incentives and investments worth £12.9 billion a year is rolled out to ensure that every UK household becomes low carbon. It includes Stamp Duty rebates of £1.4 billion for those who insulate their homes within the first year; VAT on installing energy efficiency measures is reduced to 5 per cent, to provide parity with using energy; the Landlord's Energy Saving Allowance is widely publicised with a taper effect, to ensure rapid take-up (£0.75 billion pa) and low-interest loans are there for householders substantially improving the energy efficiency of their home, at any time (building up to £3.6 billion pa). These could be linked to truly green mortgages. The utilities link nationwide Council Tax rebates to their carbon emission reduction targets.

   By 2050 permanent energy savings from UK homes worth £12.3 billion a year are achieved. At today's prices, the average household energy bill is cut by at least 66 per cent – down from £725 per year in 2008 to £250 per year in 2050. Investing in low-carbon homes now helps to avoid damage from climate change, which The Stern Review estimates could cost the UK economy over £100 billion a year by 2050.

8. **Roll out of low- and zero-carbon technologies (LZC):** There are grants for households through a revamped Low Carbon Buildings Programme, so that by 2050 there is at least one LZC technology per house, ie at least 25 million installations of LZC technologies in the existing housing stock in the next 42 years. Some of the investment is through other programmes, with £0.8 billion pa in addition. Community-wide combined heat and power is fully backed, as local authorities have to reduce the carbon emissions in their geographical area and they fire the CHP with renewable 'green' gas derived from household and commercial waste. Local Authorities are given the Government funding to support the coherent uptake of these technologies and their wider responsibilities.

9. **Fuel poverty:** The Government already has a legal obligation to ensure that people are not living in fuel poverty by 2016 and it is on course to fail if fuel prices stay high. An urgent task is to be able to identify the fuel poor, so that they can be helped. This means developing an address-specific database of the energy efficiency of every home in the UK, based on the data being collated from the Energy Performance Certificates. The most fuel-poor households are tackled via the roll out of the Low-carbon Zones. There is a second round of Decent Homes, so all social housing is rapidly brought to the level of today's building regulations. Home Improvement Agencies are given a mandate to include helping the householder obtain a home that provides them with affordable warmth. To lift 4 million households out of fuel poverty will require investment of £3.3 billion a year to treat 444,000 homes at an average cost of £7,500 per house.

## An Information Revolution

10. **Information is Power:** At least a third of the carbon savings in the residential sector come from behavioural changes. Information about the amount of carbon emissions a householder

is generating is essential to help consumers to reduce emissions. Spurred on by a European Directive, the Government's Energy White Paper 2007 requires electricity monitors to be put in, for free, from early 2008 until March 2010, but only if consumers request them. The White Paper does not put the same obligation on gas utilities. Smart Meters are being developed to enable the utilities to take remote meter readings – essential for providing customers with regular and accurate bills. In the Low-carbon Strategy, every household in the UK has an electricity and gas monitor by 2010 to help them understand exactly how much carbon they are producing. The Government undertakes a substantial trial of Personal Carbon Allowances to further incentivise energy efficient behaviour.

**The Power is in the Package:** Modelling by the Environmental Change Institute demonstrates that if the Low-carbon Strategy is implemented in full, the emissions from UK homes are reduced by at least 80 per cent by 2050.

## The Climate Change Bill:

The solutions to climate change are out there – a strong climate change law will allow them to flourish by providing the framework and the necessary oversight. *Home Truths* demonstrates the potential in the housing stock and this could surely be matched in other sectors. Members of Parliament can have confidence in their discussions on the Climate Change Bill that an 80 per cent carbon reduction in the residential sector is achievable and that these cuts can be delivered equitably and without compromising living standards.

## CHAPTER 1:
# CONTEXT

The 60 per cent reduction in carbon emissions that forms the focus of the Climate Change Bill can be achieved in the residential sector; that much has been known for some time (Boardman et al 2005, Bows et al 2006). The technology exists; the level of energy services delivered to households does not have to be compromised. It could be done, but the policies have not been defined.

The objective in this report is to examine what policies would deliver in the residential sector and, therefore, whether an 80 per cent reduction in carbon dioxide emissions by 2050, over 1990, is possible. The time for a radical re-assessment of options has arrived and this report is a contribution to that debate for the housing sector. It brings together housing and energy policy. One of the reasons for the focus on housing is that it may well be one of the easiest – and cheapest – sectors in which to achieve major reductions. It is certainly the one where the debate has been active.

This report is concerned with energy use and carbon emissions from the housing sector only. It builds on the *40% house* report (Boardman et al, 2005) which identified the scale of the actions necessary to achieve a 60 per cent carbon dioxide reduction from all household energy use by 2050. A subsequent report by the Environmental Change Institute (ECI) for the Royal Commission on Environmental Pollution (Palmer et al 2006) showed that under one scenario, C, a 75 per cent reduction could be achieved. It is this scenario that has been revisited and strengthened for The Co-operative Bank and Friends of the Earth, together with an investigation of the practical policies to deliver the reductions.

Both these ECI studies took the four walls of the house as the main boundaries for the research, with a contribution coming from community heating. The aim was to demonstrate what is possible within the housing stock, independently of what is happening with the energy supply system. That principle applies here as well. It has most relevance in relation to the fuel supply mix of electricity generation and subsequent carbon emissions. After 2020, when electricity is expected to have a carbon intensity of 0.12kg/kWh, it is assumed that no further changes to the fuel mix take place. With all end-use sectors, there is an interplay between the carbon intensity of the electricity used and the appropriate policies for the sector. The approach here is to demonstrate the potential within the housing stock, rather than try and compare the costs and benefits of two simultaneously moving targets.

## Climate Change Bill

The UK's Climate Change Bill is the Government's commitment to a legally-binding target. The bill has been the focus of considerable debate and three select committee reports. Many of the issues are shortly to be decided by Parliament and the answers to these questions will affect the issues discussed in this report. Just for clarity, the stance taken within this study is given in Table 1.1.

The Climate Change Bill is proposing that the UK carbon emissions in 2050 are "at least 60 per cent lower than the 1990 baseline" (section 1.1). To achieve these reductions, a carbon budget will be fixed for five-year periods, with the next three tranches set. The toughest target is probably for the budgetary period including the year 2020, which "must be such that the annual equivalent of the carbon budget for the period is at least 26 per cent... lower than the 1990 baseline" (Section 3.1a). This is the five-year period 2018-22.

The 60 per cent carbon dioxide reduction has been discussed for some time and is deemed to be the minimum needed for 2050, according to the recent climate change evidence, if there is to be some probability that the temperature will not increase by more than 2°C (Hare and Meinshausen 2006). It is therefore appropriate that the draft legislation bill refers to "at least 60 per cent". The target may need to be much tighter.

The UK is one of several European countries to embrace long-term, specific targets for carbon dioxide emissions: France, Poland, Germany, Switzerland all have commitments at varying levels of formality. The debate about an appropriate level of reductions continues. Recently, Angela Merkel, the German Chancellor, has proposed adopting the contraction and

**Table 1.1**
**Uncertainties in the Climate Change Bill and effect on this report**

| | |
|---|---|
| Whether shipping and aviation are to be included, which affects the baseline numbers used | Ignored – just using figures from the Digest of UK Energy Statistics, which do not include international shipping |
| Whether, as proposed, it is best to focus on carbon dioxide emissions only, to start with, and to progress to all six greenhouse gases (GHG) later | Only considering carbon dioxide emissions, not the effect of the other GHG |
| The extent to which the 'snapshot' final percentage in 2050 is sufficient, or whether the cumulative savings between 1990 and then are also important | Both considered, chapter 1 |
| Whether there should be sectoral targets, within the overall reduction | No estimate made of sectoral target for residential |
| What proportion of the carbon reduction can come from trading outside of the UK | Assume that the whole reduction has to be made within the UK, therefore ignoring any reference to 'net' savings |
| Why there is a maximum reduction of 32% identified for 2020 | The minimum reduction of 26% is all that is considered |

convergence approach, with carbon dioxide emissions based on population size (*Der Spiegel*, 31.8.07). The scientific consensus grows that there are very few years within which global emissions must peak, if the world is to avoid catastrophic climate change. There is agreement that the developed countries, of which the UK was proudly one of the first, have both to show leadership and to take responsibility for most of the reductions. We have been a major contributor to the present problems, so must demonstrate innovative solutions.

Over the period 1990-2006, despite the discussion and several major reports, the UK's total carbon dioxide emissions did not change as much as required to achieve the planned 60 per cent reduction by 2050 (Table 1.2). There were reductions and, until 1995, the rate of emissions was better than the target. Since then, the level has fluctuated: 2006 was higher than 2005 and 2007 is expected to be at least as high, so the situation has deteriorated in the last couple of years. The level in 2007 is likely to be the same as in 1994 and is 2 per cent higher than when the Labour Government came to power in 1997. Within these numbers for the whole economy, the residential sector has contributed between 25-27 per cent of the UK's emissions. The highest year was 1991 and the lowest 1997. The level in 2005 (the latest year for which the detail is available) showed a 5 per cent reduction over 1990 instead of the required 15 per cent drop.

Since 2000, there have been several major reports from the Royal Commission and the Government.

The failure of these and the associated Government policies to have an impact on UK emissions indicates both the task ahead and the lack of commitment demonstrated historically. The UK is not on an appropriate trajectory to 2050 and the absence of responses so far means that solutions are required urgently and to have a greater impact. For this report, the real reductions in carbon emissions begin in 2008 – the start date for the policies discussed here. As the Stern Review (Treasury 2006, page xxiii executive summary) has concluded:

> "There is no single formula that captures all dimensions of equity, but calculations based on income, historic responsibility and per capita emissions all point to rich countries taking responsibility for emissions reductions of 60-80 per cent from 1990 levels by 2050."

## Trajectories to 2050

The lack of progress since 1990 can be measured against the straight 'planned' line (dark blue) that would have reduced emissions to a 20 per cent level in 2050 (Figure 1.1). It is not appropriate now to redraw a straight line from 2008 to the same point in 2050 – this ignores the fact that carbon dioxide stays in the atmosphere, affecting the climate. The extra emissions that have been produced by the UK, between 1990 and 2007, have to be compensated for. Therefore, the cumulative emissions that result from adding each year's output together – the area under the line or

**Table 1.2**
**Carbon dioxide emissions on 60 per cent trajectory, actual and residential, UK 1990-2006**

| | Carbon dioxide emissions (MtC) | | | Significant reports |
|---|---|---|---|---|
| | Planned | Actual | Residential | |
| 1990 | 161 | 161 | 42.0 | |
| 1991 | 160 | 163 | 44.7 | |
| 1992 | 158 | 159 | 43.0 | |
| 1993 | 157 | 155 | 41.9 | |
| 1994 | 155 | 153 | 40.5 | |
| 1995 | 153 | 150 | 38.7 | |
| 1996 | 152 | 156 | 42.0 | |
| 1997 | 150 | 150 | 38.0 | |
| 1998 | 149 | 150 | 39.4 | |
| 1999 | 147 | 147 | 38.2 | |
| 2000 | 145 | 150 | 39.4 | RCEP 22nd report |
| 2001 | 144 | 153 | 41.2 | |
| 2002 | 142 | 148 | 39.8 | PIU report |
| 2003 | 140 | 151 | 40.6 | Energy White Paper |
| 2004 | 139 | 151 | 41.1 | Energy Efficiency Action Plan |
| 2005 | 137 | 151 | 40.0 | Energy Efficiency Innovation Review |
| 2006 | 136 | 153 | | Energy Review; Microgeneration Strategy; Stern Review; Sustainable Energy Policy; Climate Change Programme |
| 2007 | 134 | 153* | | Energy White Paper; RCEP 26th report; UK Energy Efficiency Action Plan |

Source: $CO_2$ data from (Defra 2007d)

*estimated

Note: Carbon dioxide is weighed as carbon in this report, as in most Government reports. The Climate Change Bill includes the weight of the oxygen atoms as well and so the same quantity of carbon dioxide is 3.67 times heavier. Carbon is used as shorthand for carbon dioxide

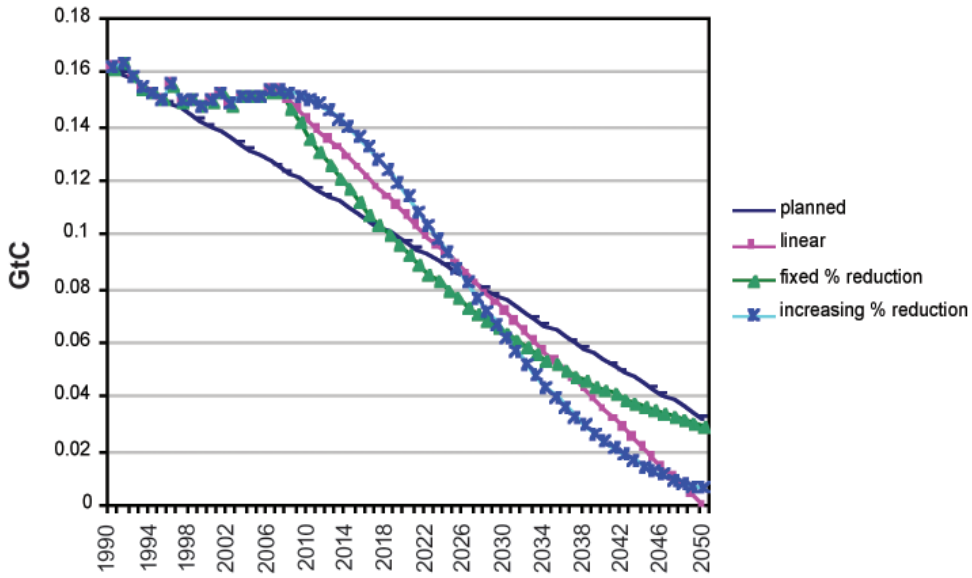
curve – is important and should not be higher than the area under the original, planned trajectory.

To achieve the same 80 per cent cumulative reduction in carbon dioxide as in the original, planned target, three different trajectories are plotted, starting to reduce emissions in 2008:

- Linear (pink), the same absolute reduction in carbon each year (3.6tC) – this curve hits 0 emissions in 2050, so it does not quite reach the total cumulative reduction needed.
- Fixed (green), the same percentage reduction of 3.7 per cent in carbon each year.
- Increasing (bright blue), the percentage carbon reduction increases, year on year (up to 14 per cent in 2050).

The type of reduction gives the curves very different shapes: the 'fixed' curve can be called convex and the 'increasing' one is concave. Between 1990-2050, the area under all four curves is the same (5.9GtC). For the shorter period of 2000-2050, this is similar to the

**Figure 1.1**
**Trajectories for 80 per cent carbon dioxide emission reduction, UK 1990-2050**




4.6GtC cumulative target (since revised to 4.8GtC) suggested by Bowes et al (2006).

The choice of trajectory will influence policy, though regular adjustments will undoubtedly be needed as a result of the levels of UK emissions in practice. To the extent that there is a choice, the 'increasing' reduction assumes that the present lack of progress will continue and that it will be difficult to convert the country into saving carbon. This slow start results in very stringent annual reductions by 2050, when there is likely to be even more concern about levels of climate change and, possibly, a desire to get below even 80 per cent. The 'fixed' reduction does the opposite. It assumes that there is quite a lot of slack in the system and that, if properly motivated, people would be able to make quite substantial reductions in carbon emissions quite quickly. Whichever trajectory is aimed for, the clear message is that delay is making it necessary to have tougher policies and larger annual reductions. The fixed trajectory is also more equitable – UK residents have to make an equal effort in each year from now on. The effect of present inaction and a slow start would be that tomorrow's generations will have to compensate for today's.

With the planned trajectory, the final level in 2050 is higher than that of the three other cases (Table 1.3). These figures demonstrate the effect of looking at a cumulative approach – the result in the year 2050 varies significantly according to the trajectory taken from now on. The target in the Climate Change Bill of a minimum 26 per cent reduction by 2020 can be achieved by all the trajectories, assuming that the reductions commence in 2008 and that the final target is an 80 per cent cumulative reduction. With a similar approach, but a 60 per cent reduction, only the linear and fixed trajectories achieved this level of reduction – the 'increasing' trajectory did not get there, confirming the importance of an early start.

**Table 1.3**
**Index of carbon emissions, 80 per cent cumulative reduction trajectories, UK 1990-2050**

| | Planned | Linear | Fixed percentage | Increasing percentage |
|---|---|---|---|---|
| 1990 | 100 | 100 | 100 | 100 |
| 2008 | 76 | 92 | 91 | 94 |
| 2020 | 60 | 66 | 57 | 71 |
| 2030 | 47 | 44 | 39 | 38 |
| 2040 | 33 | 22 | 27 | 15 |
| 2050 | 20 | 0 | 18 | 4 |

Within the European Community, there is a binding commitment to achieve a 20 per cent reduction in greenhouse gases (slightly easier than just carbon dioxide) by 2020 (compared to 1990 levels) and to increase this to 30 per cent if there is a wider international commitment. The sub-division of the 20 per cent reduction between the 27 member states has not yet been agreed, but it is possible that the UK's responsibility would be higher than the average, as with Kyoto. Hence, the Climate Change Bill's minimum 26 per cent reduction by 2020 is only echoing our likely European commitments, which the Government has already signed up to.

As a result, the 'fixed' trajectory appears to be the most appropriate design, to ensure that the UK can comply with our own and EU commitments, and to provide the greatest contribution to climate change mitigation, by acting as quickly as possible. It is also the most equitable. The aim of this report is to identify the policies that will deliver this trajectory and is the 'Low-carbon Strategy' referred to throughout.

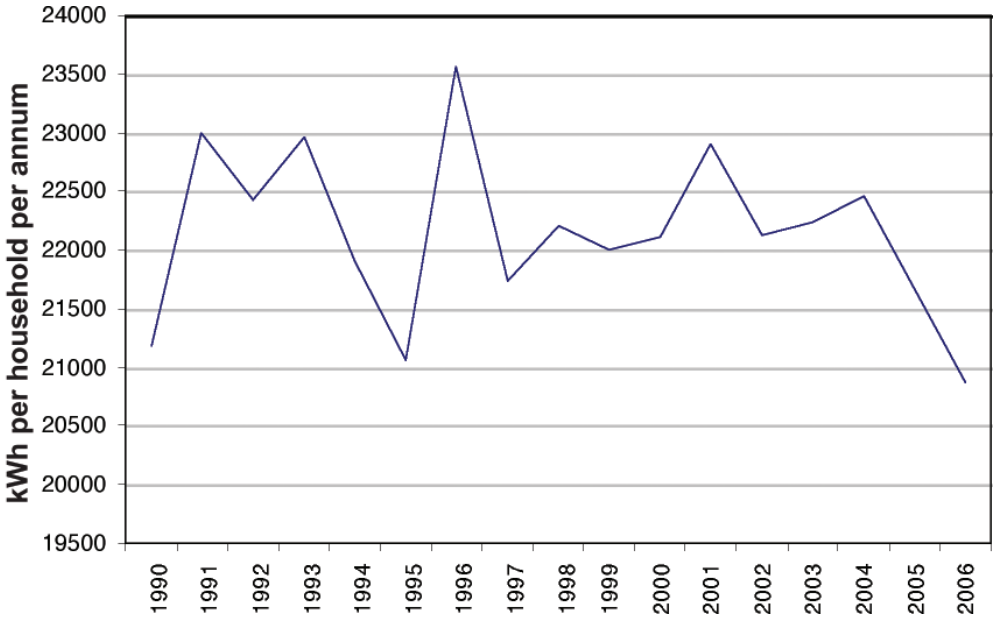
## Residential energy use

Whilst the target is to reduce carbon emissions, much of the text in this report and policies refer to energy use. The relationship between the two depends upon the mixture of fuels used and their relative carbon content. The most effective route is to both reduce demand and to reduce, simultaneously, the carbon content of the fuels used to meet that demand (Boardman et al 2005).

Throughout the report, the focus is on the reduction of the demand for energy. Some of this lower level of demand does come from improved energy efficiency, but energy efficiency on its own is insufficient. This is because it is usually a relative, not absolute figure. For instance, with refrigerators, the energy efficiency index comes from the relationship between total electricity use over a year and the volume of the interior of the refrigerator. As a result, the manufacturers have been producing more energy efficient refrigerators, that are both larger and, in absolute terms, consuming more electricity. The same situation occurs with housing, cars and washing machines.

The problems of using real data are demonstrated by the erratic pattern of recent household energy consumption (Figure 1.2) and the problems of identifying trends. For the period 1995-2001, consumption rose, but the reverse situation was the trend between 1996-2006. 2006 appears to be the lowest year, at 20,875kWh per household pa. As a guideline, household energy consumption is in the range 21-22,000 kWh a year, for all energy use in the home, from all sources of fuel. Of this, roughly 65 per cent is for space heating, 22 per cent for hot water and 13 per cent for lights and appliances. In carbon terms, lights and appliances are more important, because electricity is more polluting than gas.

**Figure 1.2**
**Delivered energy use per household, UK 1990-2006**




BERR (2007a)

Note: not weather corrected

Between the second quarter of 2006 and the second quarter of 2007, domestic sector energy consumption fell by 10.9 per cent (BERR 2007b, p4). It is too soon to confirm that this is a definite trend – there have been false hopes before, for instance in 1995. If confirmed in the next few quarters, the extent to which this is a welcome trend depends upon its causes. If most of the reduction in energy use is caused by fuel price rises and the increase in fuel poverty, then this would be an unwelcome trend.

Consumption per household is only one of the components of the equation: total energy consumption depends upon the number of households.

## Housing

One of the major effects that housing policy has to cope with is the long-term trends of increasing population and household numbers (Table 1.4). By 2051, there is expected to be at least a 12 per cent growth in the UK population over 2003, as a result mainly of greater longevity and net immigration. This effect of this growth is compounded by the declining household size – a trend that is difficult to predict into the future. In 2002, the average household contained 2.3 people and it is assumed that this will drop to 2.1 people per household (pph) by 2050. As a result, between 2003 and 2050 there would be a 23 per cent increase in the number of households. Very few, if any, social policies can address these trends, so that they have to be taken as a given, for energy policy. Obviously, other areas of Government can address some of the issues, and housing policy is tackling the shortage of houses and resultant high prices.

If nothing else changed, the growth in household numbers would mean roughly a 23 per cent increase in energy consumption in the housing stock (slightly less because new homes are less energy intensive). It is this growth in household numbers that is a substantial part of the demand for new houses: most of the construction of new homes is for new households. They are rarely to replace existing properties that have been demolished.

The effect of rising household numbers is one of the main reasons for increasing energy use in the residential sector as a whole. Also, UK households are demanding a higher level of energy services (more warmth, hot water, space, etc) and this trend is not being offset by improvements in energy efficiency, so demand continues to grow (NERA 2007, page i):

> "household energy use is still growing at a rate of 1.5 per cent per year. Household energy use will need to fall by 1.8 per cent per year to deliver a 60 per cent fall in emissions by 2050."

## Statistics and definitions

Because of devolved responsibilities, some of the statistics used in the report are for England only. These represent 84 per cent of households and are sometimes used to indicate the picture for the whole of the UK. This is not out of disrespect for the other three countries in the UK, but is generally a reflection of the more detailed data available in England, with all its resources.

**Table 1.4**
**Household and population projections, UK 2003-2050**

| Year end | 2003 | | 2011 | 2021 | 2031 | 2050 |
|---|---|---|---|---|---|---|
| | Household (m) | Population (m) | Population (m) | Population (m) | Population (m) | Population (m) |
| England | 21.6 | 49.86 | 51.60 | 53.95 | 55.89 | |
| Wales | 1.27 | 2.94 | 3.02 | 3.10 | 3.15 | |
| Scotland | 2.19 | 5.06 | 5.03 | 4.96 | 4.83 | |
| Northern Ireland | 0.74 | 1.70 | 1.75 | 1.81 | 1.84 | |
| United Kingdom | 25.78 | 59.55 | 61.40 | 63.84 | 65.70 | 66.80 |
| Household size | | 2.31 | 2.28 | 2.23 | 2.19 | 2.1 |
| Household numbers (m) | | 25.78 | 27.0 | 28.63 | 30.0 | 31.81 |

Source: based on Shaw 2004, as used in Boardman et al 2005, p27

One of the other issues that bedevils housing policy is the multiplicity of measurement methods and the problems of converting between them:

- fuel expenditure;
- energy use;
- carbon emissions;
- some of these are for all energy use, some of them are only for a subset (eg space and water heating);
- some of these are per square metre of floor area;
- some of the measurements are of actual consumption;
- some of them are modelled to a standard set of energy services (eg comparable indoor temperatures) to ease comparisons.

The link between these different measurements and policy is also complicated, and becoming more so. For instance:

- SAP (standard assessment procedure) is used as the basis for Energy Performance Certificates and building regulations;
- six levels and stars are in the Code for Sustainable Housing;
- bands A-G on Energy Performance Certificates.

As SAP is so central to many policies, it is important to understand what it does and does not do. It assesses the theoretical energy costs of the building (but not all its contents) from 1-100 points with SAP 2005. As SAP 2001 was on a scale of 1-120 points, many historical figures are over-rated. SAP 2005 is based on energy costs for space and water heating, ventilation and fixed internal lighting per square metre of floor area within each home, representing a measure of energy efficiency. The detailed methodology for calculating SAP ratings was comprehensively updated in 2005 (DCLG 2007e, p26).

The difference between actual and theoretical expenditure also requires some additional explanation, because of the confusion that it causes. Every household on a tight budget makes its own decisions about the extent to which it will spend money on fuel to be warm, adequate hot water and other energy services, and the extent to which it will give priority to other items. This means that actual household expenditure, in the absence of data on temperatures in the home, is only a partial indicator of fuel poverty or the likely effects of energy efficiency improvements. To get round this, SAP is used to assess the costs of achieving a standard level of warmth. This theoretical calculation ranks people and their homes on an equal basis. However, the savings demonstrated by moving from one SAP level to another are also theoretical, particularly in cold homes. In practice, the savings are not there to be made, because the expenditure was not actually occurring. This means that a previously-cold household is likely to take some of the benefit of improved energy efficiency as greater comfort – known as the rebound effect (Sorrell 2007) – the expected energy and cost savings will not be achieved in full.

It is extremely difficult to estimate how many households are colder than they would like to be, especially as the definition of 'warmth' is changing over time (Boardman et al 2005, chapter 4; Shorrock and Utley 2003, p77). For the Low-carbon Strategy by 2050, a temperature of 21°C is provided when the heating system is on – this represents increased warmth for many households.

## Energy policy and market transformation

Energy policy can focus on two different aspects of energy use: the cost of the energy to the householder – the running costs; or the products that transform the energy into the uses that the householder wants, such as warmth, light and hot water. The focus here is on product policy; running costs are discussed in relation to fuel poverty and taxation is briefly examined under human behaviour. The products examined are sometimes pieces of equipment (eg refrigerators), sometimes building components (eg double-glazed windows), but could also be the whole house. The extension of market transformation to the building stock is both innovative and helpful.

Market transformation is the strategic approach that brings together several types of product policy (Hinnells and Boardman, in press), such as labels, grants and minimum standards. These separate policies each contribute to transforming the market for energy efficient products, but what market transformation recognises is that combinations of policies are particularly effective. The ideal market transformation strategy identifies a long-term, overarching plan, which is clearly stated from the beginning. In that way, market transformation can be extremely effective at getting more efficient products into people's homes, perhaps for no extra cost.

Market transformation provides a strong theme throughout this report, as it helps to identify the importance of and sequence for individual policies. One of the interesting implications for the Government is that there are several policies focusing on a single point, for instance the improved efficiency of the existing housing stock. With market transformation,

there are several policies producing an energy or carbon saving, to ensure that they are achieved. To attempt to identify the carbon benefits of individual policies would be impossible and result in considerable double counting. As a DEFRA senior civil servant has stated, with reference to including micro-generation in the Energy Efficiency Commitment (HC88-II 2007, Ev 365):

> "Are we giving multiple subsidies? If so, is that a bad thing or is it, because micro-generation is so costly, actually a positive thing?"

## Report structure

The major focus of the study is on the reductions that can be achieved through physical changes, such as insulating the housing stock, installing micro-generation and buying more efficient appliances. Individual areas of policy are dealt with in separate chapters to identify how the total reduction is achieved and, in particular, the scale of the problem that has to be solved in the existing housing stock.

First, there is a review of existing and pending European and UK Government policy (Chapter 2). This identifies what is expected to happen, for subsequent chapters to examine and extend.

Lights and appliances are common to all buildings, whether new or existing, so an assessment is made of how much energy (predominantly electricity) consumption could be reduced here (chapter 3). This is an area where there is considerable European legislation, so the pace of change is common to all Member States; the UK has limited additional powers.

There are several initiatives in relation to the construction standards for new buildings and the combined effect of these will indicate the size of the additional carbon emissions to be added by these extra homes (chapter 4).

The existing housing stock provides the biggest challenge, partly because at least 87 per cent of all properties will still be standing in 2050 (chapter 5). There is a strong tension between how much needs to be achieved and the speed with which it can be achieved. The policies to deliver these major savings are the primary focus of the report.

When demand has been reduced as much as is feasibly possible, the remaining carbon savings can be delivered through the installation of less carbon-intensive technologies for space and water heating, or that generate electricity or heat on or in the building. Collectively these are called low- and zero-carbon technologies and fuels (chapter 6).

The growing problem of fuel poverty is another major concern for this report and the ways in which low income households can be helped to have both affordable warmth and low carbon emissions (chapter 7).

The role of personal responsibility and the extent to which this is helped, or not, by the utilities is examined, together with broader, people-based approaches such as personal carbon allowances and community activity (chapter 8).

Local authorities have a wide range of existing powers in the areas of housing and energy and the ways these might be extended (chapter 9).

Finally, the recommendations, findings and costs are brought together into one Low-carbon Strategy (chapter 10).

## Summary

It has been known for over two years that the UK could achieve a 60 per cent reduction in the carbon emissions from energy use in the home. The technology is known and levels of energy service do not have to be compromised, but the detailed policies were not identified. The Home Truths report investigates the practical and policy implications of getting to an 80 per cent reduction, by 2050. This reflects the Stern Review recommendation that developed countries should take responsibility for 60-80 per cent cuts in carbon emissions by 2050, over 1990.

Between 1990 and 2005, there was only a 5 per cent cut in the carbon emitted from the residential sector (from 42 to 40MtC), in comparison with the 15 per cent that was the target. Worse than that, residential emissions have increased by 5 per cent since the Labour Government came to power in 1997. This lack of progress requires a radical transformation of present trends and the immediate introduction of strong policies that will deliver certain cuts.

The effect of the present inaction and a slow start would be that tomorrow's generations will have to compensate for today's, so an equitable target would be a fixed annual carbon reduction of 3.7 per cent, starting in 2008. This would be across the whole economy, although only the residential sector is considered here.

The most effective route is simultaneously to reduce demand and the carbon content of the fuels used

to meet that demand. The policy focus here is on products, rather than pricing, to provide certainty of delivery. Efficient, low carbon products have to be available or easy to identify, before price rises can be influential. These product policies interact with each other, to provide a strong sequence that transforms the market.

By 2020, residential carbon emissions have to be reduced by nearly 9MtC from 40MtC now to meet the objectives of the Climate Change Bill and, in this Low-carbon Strategy, by 31.6MtC by 2050. These are huge challenges and require a clear commitment from the Government, with policies that are effective from today onwards.

## CHAPTER 2:

# EXISTING GOVERNMENT POLICY

Policy, in the widest sense, results from actions by a host of institutions, including retailers, the manufacturers and utilities. In this chapter, there is a narrower definition, referring just to the European Commission – the source of much environmental legislation – and the UK Government. In reality, the Commission is both forcing progress, but also slowing down action when all 27 member states have to act together.

## European policy

The Commission believes that if nothing is done to reverse present trends, energy consumption could increase by almost 10 per cent over the next 15 years (CEC 2006b, p3). Therefore, there has been a new emphasis in EU legislation to reduce carbon emissions, either through greater energy efficiency, lower demand or the use of renewables – the level of present and recent activity represents a welcome new commitment by Brussels. Each Member State is responsible for its own taxation policy, so the Commission's main focus is on products. This was originally just goods that could be traded (moved across frontiers), but recently the Commission has become involved in setting standards for items beyond traded goods, such as buildings. European legislation covers a wide range of issues and targets that are relevant to this study (Table 2.1). Where these are Directives, they have to be transposed into UK policy. Some of these targets will be unbundled, to give an individual target for each member state, but UK levels are not yet agreed, for instance the proportion of energy to come from renewable sources.

The last two items in the table are both extremely important, though not yet Directives. They have been passed by the Council, so they represent political commitments by the Member States, which includes the UK. These two commitments interact: if energy demand has been reduced, it is easier to provide 20 per cent of this smaller number from renewable sources. The Strategic Energy Review also mentions that the goal for 2050 could be 60-80 per cent carbon reductions.

The renewables target for a 20 per cent share of all energy (not just electricity) by 2020 is one that the UK Government is reputedly reluctant, now, to accept (*The Guardian*, 13 August 2007). The combined 20 per cent + 20 per cent targets mirror the 26 per cent reduction by 2020 in the Climate Change Bill.

Not all of these individual pieces of legislation fit well or clearly with earlier Directives. For instance, it is difficult to know which of the following is the more challenging:

- a 9 per cent reduction in delivered energy by 2008-16, in comparison with a baseline (Energy Services Directive); or
- a 20 per cent reduction in primary energy by 2020, in comparison with baseline (EU Energy Efficiency Action Plan); or
- a 20 per cent absolute cut in greenhouse gases by 2020, over 1990 (Strategic Energy Review 2007).

The UK appears to ignore some of these EU targets, such as cogeneration and renewables, with impunity, so it is difficult to assess how effective this swathe of European policies will be, when enacted in the UK. Enforcement is vital and often ignored. The Commission appears to be committed to strong action and the UK Government is planning for reductions through these policies, so there is some reason to be hopeful that they will be tough in practice. However, in the past, particularly in relation to electricity disclosure (Boardman and Palmer 2007) and car energy labels, the way in which the UK Government has interpreted the European legislation has resulted in the weakest possible policies.

The EU Energy Efficiency Action Plan 2006 is not a Directive, but extends the previously adopted framework directive on Energy-using Products (EuP). The European Commission has announced its intention to adopt minimum performance requirements for 14 priority product groups by the end of 2008 and a further seven product areas shortly after (CEC 2006c, para 122). Of those that are relevant to the residential sector, studies are underway to assess the actual potential and to recommend measures to the Commission (Table 2.2).

**Table 2.1**
**Relevant European policies and directives**

| Directive identifier | Title | Relevant coverage |
|---|---|---|
| 92/75/EEC | Energy labelling of domestic appliances | Overarching, with several daughter directives, specific to each appliance group. Being redrafted. |
| 2002/91/EC | Energy Performance of Buildings (EPBD) | Basis for Energy Performance Certificates; cost-effective, realisable saving potential of 22% from existing buildings by 2010. |
| 2004/8/EC | Promotion of cogeneration | Supporting combined heat and power. This is permissive, because it is about promotion with an indicative target of 18% of EU electricity to be from cogeneration by 2010. |
| 2005/32/EC | Eco-design – requirements for energy-using products (EuP) | Setting minimum environmental performance criteria for products. In UK transposed through SI 2037, 11.8.2007. |
| 2006/32/EC | Energy end-use efficiency and energy services | Requires Energy Efficiency Action Plans from individual Member States by June 2007, identifying how to achieve a 9% reduction in delivered energy 2008-16, in relation to baseline, ie 1% pa. Covers metering and billing by utilities. |
| | Energy Star | Co-operation with US product standards. |
| Overview document – November 2006 | EU Energy Efficiency Action Plan | For six-year period 1.1.2007-31.12.2012; objective to save 20% of the EU's primary energy consumption compared to projections for 2020, through energy efficiency improvements (double the recent rate). Identifies 75 measures before 2013. |
| | EU Strategic Energy Review 2007 | Cut greenhouse gases by 30% by 2020, if others do, and a binding, unilateral EU commitment to cut them by at least 20% by 2020 compared to 1990 levels. |
| | Renewable generation | Binding targets for a 20% share of renewable energies in overall EU energy consumption by 2020 – equates to 34% of electricity. Also, a minimum 10% use of biofuels. |

Source: DEFRA (2007b), para 419

It is important that the studies are beginning to focus on the major energy users, such as the TV on-mode and not just the popular issue of stand-by consumption. A large-screen plasma TV could easily have a power demand of 400W, whereas its stand-by would be only a few watts, even if it is inefficient. Collectively, however, stand-by in the myriad of appliances that now have it, is important and amounts to 10 per cent of all household electricity (EST 2006).

The assumption is that most of the policies the Commission recommend will be in the form of mandatory minimum standards, rather than weaker voluntary standards favoured in recent years. A minimum standard states that appliances below a certain level (for example the C category on the energy label) cannot be sold after a specified date. Mandatory standards are extremely effective if announced several years in advance, so that the manufacturers can include them in their redesign and retooling cycles. The minimum standard for refrigeration equipment, that became effective in September 1999, resulted in major energy savings (a 15 per cent reduction in 15 months in the energy consumption of the fridges being sold in the UK) and, as a result of industry competition, substantially lower purchase prices (Schiellerup 2002; Boardman 2004a). The consumer benefited from both less capital expenditure and reduced running costs, in conjunction with these major energy savings, demonstrating the power of clear, planned targets.

**Table 2.2**
**Residential product policy studies for Energy-using Products Directive**

| Product | Measures adopted by Commission after: |
|---|---|
| Battery chargers, power supplies* | May 2008 |
| Personal computers and monitors (ICT) | July 2008 |
| Televisions (CE)* | September 2008 |
| Standby and off-mode losses* | September 2008 |
| Domestic refrigeration (freezers, fridges, etc) | November 2008 |
| Washing machines, dishwashers | November 2008 |
| Boilers | January 2009 |
| Water heaters | January 2009 |
| Room air conditioning | February 2009 |
| Domestic lighting | March 2009 |
| Simple converter boxes for digital TV | date unknown |
| Solid fuel small combustion installations (in particular for heating) | date unknown |
| Laundry dryers | date unknown |
| Vacuum cleaners | date unknown |
| Complex set top boxes (with conditional access and/or functions that are always on) | date unknown |

Source: CEC (2007a)

Note: *study complete

The likelihood of the Commission proposing mandatory minimum standards has been greatly enhanced by the announcement from the appliance manufacturers' association (CECED) that it will not update its existing voluntary agreements. It has called for "the adoption of legally binding efficiency limits" because of increased competition from importers of "cheap inefficient products" (ENDS 391, Aug 2007, p54). Suddenly, mandatory minimum standards are becoming acceptable. It would be helpful if there is now a similar endorsement from the consumer electronics industry (EACEM).

The introduction of more minimum standards across Europe would represent progress towards the North American approach: there are 40 minimum standards in Canada and the United States, but only three in Europe.

The minimum standard still has to be fixed at a level that will achieve a substantial reduction, beyond what the industry was going to deliver anyway. This requires political courage from the committee of Member States (Boardman 2004a). Most of the products being discussed have an average lifetime (ie half-life) of 10-14 years, so double this is how long improvements will take to work through the whole stock; only a proportion of old appliances fail and are replaced each year. The benefit of product standards is that they continue to be effective, with no extra effort, for many years.

The Commission is developing potentially strong policy on climate change mitigation and a major area of concern is energy use in appliances. The strength of the policies in practice and what level of reduced demand will be delivered remains to be seen. But as much of the policy is being formed now, as the studies come in, there are real opportunities for the UK to have a positive influence.

## UK policy

The UK has various targets for reductions in either greenhouse gases or solely carbon dioxide emissions, in comparison with 1990 levels:

- A 12.5 per cent reduction in greenhouse gases by 2008-12, under the First Commitment period

of the Kyoto Protocol, which the UK is on target to achieve, largely because of success at cutting back in emissions from the five greenhouse gases (eg methane) that are not carbon dioxide.

- A non-binding national target of a 20 per cent reduction in carbon dioxide by 2010, which is not going to be achieved (a commitment in three election manifestos).
- Its share (to be defined) of the European 20 per cent reduction in greenhouse gases by 2020.
- The 26 per cent minimum reduction in carbon dioxide by 2020, in the Climate Change Bill.
- 'At least 60 per cent' reduction in carbon dioxide emissions by 2050, also in the Climate Change Bill.

Of these, the last two are the most challenging and the focus of this report, with the 60 per cent target extended to an 80 per cent reduction.

**Kyoto:** Two of the main reasons the UK is likely to achieve the Kyoto commitment are the early 'dash for gas' that resulted, fortuitously, from electricity privatisation in 1990, and the accountancy convention that assumes no methane is released from the moment a coal mine is closed (Jardine et al 2004, p65; DEFRA 2007d). Neither of these were caused by overt carbon reduction policies. The subsequent increase in coal-fired generation is the cause for the recent growth in carbon dioxide emissions (Table 1.2).

**2010 target:** The failure to achieve the 2010 target demonstrates both the ease with which a target can be announced and the real challenge for Government in delivering the policies that will achieve it. This failure was despite warnings from the Royal Commission on Environmental Pollution about the inadequacy of the proposed policies (RCEP 2000). In 2006, the Government acknowledged the pending shortfall, when announcing the policies to try and deliver the target, but this was six years later (DEFRA 2006b). Even by the end of 2006, the UK's carbon dioxide emissions were only 5 per cent below the 1990 level (Table 1.2), leaving a 15 per cent reduction to be achieved in just four years.

**Other targets:** The Government has acknowledged that energy efficiency is the most cost-effective route and helps with all four major policy objectives, as listed in the Energy White Paper (2003): climate change, fuel poverty, security of supply and competitiveness. DEFRA have confirmed that household energy efficiency measures are more than four times more cost-effective per tonne of carbon saved than the next best demand-side sector, which is business (HC 88-I 2007, para 46). However, with regard to energy efficiency, the Energy Saving Trust (EST) believes there is (HC 88-II 2007, p15):

> "a gap between that which is talked about and that which needs investing in in terms of resources and, indeed, in terms of Parliamentary/ ministerial air time for this particular subject. It really still is somewhat of a Cinderella subject."

The first Energy White Paper (DTI 2003) endorsed the 60 per cent reduction in carbon emissions and included the social obligation of making sure everyone had 'affordable warmth'. Long-term planning, ie beyond 2020, has not been undertaken, as Defra have confirmed (HC 88-II 2007, Ev 372):

> "Before the Government committed itself to the 60 per cent target for 2050 a technical feasibility assessment was carried out… However, no specific route for reaching the target – with specific contributions for particular measures – was set out for the period up to 2050."

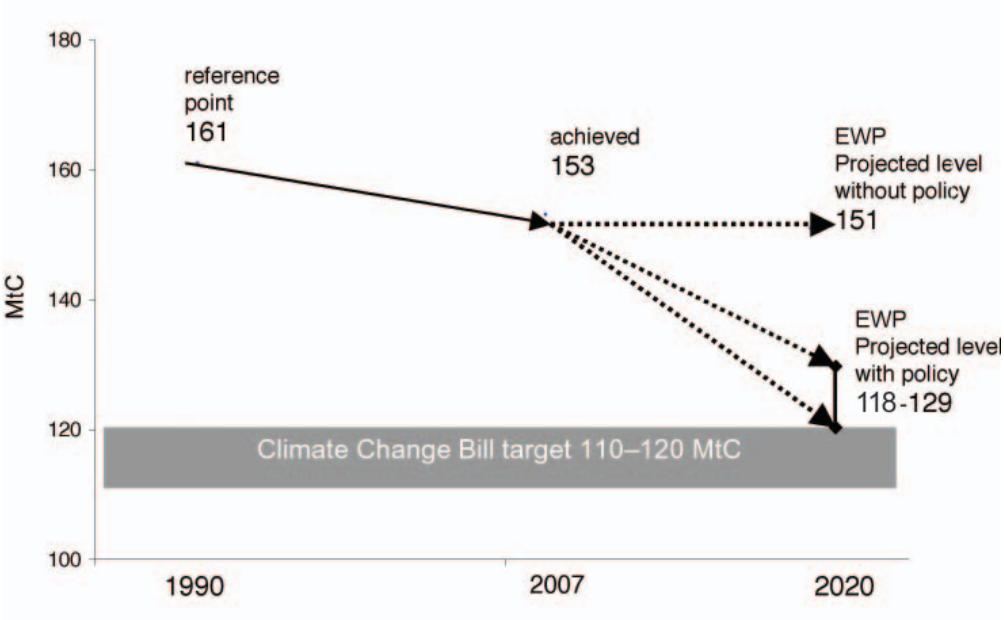
The major components of policy to reduce residential energy demand have focussed consistently on:

- European commitments, under various directives, including Energy Performance Certificates (the Energy Performance of Buildings Directive), smart metering, monitoring and informative bills (the Energy Services Directive) and product standards (Energy-using Products Directive);
- building regulations and other initiatives aimed at new buildings, and condensing boilers and double glazing in existing homes;
- expenditure on energy efficiency in the homes of their customers by the utilities.

## Energy White Paper 2007

The Government rarely issues energy white papers, but then does one in 2003 (DTI 2003) and another in 2007 (DTI 2007a). The latter has slightly more policy detail, but less emphasis on fuel poverty; it is also strongly focused on carbon dioxide reductions, rather than energy. In between these two white papers there have been seven major reports (Table 1.2) and since the Energy White Paper 2007, the UK Energy Efficiency Action Plan (DEFRA 2007b) to comply with the requirements of the EU Energy Services Directive (Article 14). This action plan is particularly difficult to use as it discusses the reductions to be made against a hypothetical, undisclosed expected level of growth – a reference case – as if no new policy had been introduced. This demonstrates the difficulty of, simultaneously, trying to work with top-down

**Figure 2.1**
**Government's proposed carbon trajectory, UK 1990-2020**




Source: DTI 2007a, p283-4

econometric modelling (as used for the Government's projections of the whole economy) and bottom-up, policy proposals (that are independent and specific).

According to the Energy White Paper 2007, the net effect is that all policies announced prior to and including the Energy Review 2006 are only expected, by the Government, to be sufficient to offset the projected carbon impacts of growth in the whole economy up to 2020 (Figure 2.1). By then, despite all these publications, carbon emissions are projected to be 151MtC, the same as in 2006. The policies announced since the Energy Review 2006 (eg the continuation of the EU emissions trading scheme and the energy efficiency commitment) and in the Energy White Paper 2007 are estimated to reduce this to somewhere in the range 118-129 MtC, ie a reduction of 23.4-33.0 MtC. As the figure illustrates, this is very different trajectory.

The importance of these total projected reductions is that, in ideal circumstances, they will just deliver the Government's aspiration of a 26 per cent saving by 2020, as required in the Climate Change Bill. For instance, up to 58 per cent of the saving is due to come from the EU emissions trading scheme. For this total reduction to happen, the Government's proposed policies have to have a certainty and conviction to them that has been lacking so far. This is what will be examined, for the residential sector, in the following chapters.

In several cases, early predictions of possible savings have had to be revised downwards. For instance, when over half way through the programme, the savings by 2010 from the first two rounds of the energy efficiency commitment were expected to be 1MtC (DEFRA 2006b, p77). One year later, the combined effects were down by 20 per cent to 0.8MtC (DTI 2007a, p59). Another example from outside the residential sector is the Climate Change Levy, where the estimated savings have been reduced by a third, by the National Audit Office, from 2.9MtC to 1.9MtC (Warren 2007). Some of these differences result from the difficulty of predicting people's responses to a policy and part from the way in which the 'saved' money is re-used, or the rebound effect. The latter is likely to be less than 30 per cent (Sorrell 2007) in the residential sector, but higher where people are living in cold homes at present (Milne and Boardman 2000) – they want to be warmer. All of which is why targets should be designed to compensate for people's actual behaviour. An ambitious policy, which is feasible and rigorously enforced will deliver the savings.

## Energy White Paper 2007 and residential sector

The Government's target carbon reductions for the residential sector are in the range 4.7-7.6 MtC by 2020, over the 2006 level of about 40 MtC (Table 2.3). Whilst this would be useful, it represents a reduction of only 11 per cent to 18 per cent from 1990, barely half the

**Table 2.3**
**UK residential carbon savings from energy efficiency in 2020, Energy White Paper 2007**

| Policy | Energy savings (MtC) |
|---|---|
| Supplier obligation (post 2011) | 3.0-4.0 |
| Energy Performance of Buildings Directive* | 0.2-0.7 |
| Zero carbon homes | 1.1-1.2 |
| Billing and metering | 0-0.2 |
| Real time displays | 0-0.3 |
| Product policy* | 0.4-1.2 |
| TOTAL | 4.7-7.6 |

Sources, DTI 2007a, pp 75, 283-4

*estimated domestic allocation

required 30 per cent, if the Government were to be on a trajectory to reach a 60 per cent reduction by 2050.

The individual policies are discussed in later chapters, to assess the extent to which they are likely to deliver the required savings, and brought together in chapter 10. There are real problems is making these assessments, because of the limited detail given in the Energy White Paper or accompanying documents:

- The supplier obligation reflects the continuing reliance on the role of the utilities to deliver up two-thirds of all the savings in the residential sector. As the response to the consultation is awaited, this is only briefly discussed in chapter 6.
- The Energy Performance on Buildings Directive, in the domestic sector, means Energy Performance Certificates, which, together with zero-carbon homes, are discussed in detail in chapter 5.
- Billing, metering and real time displays are largely in response to the requirements of the Energy Services Directive and are covered in chapter 8, as they affect how people respond to information about their consumption.
- Product policy covers domestic lights and appliances, as well as non-domestic ones, motors, etc. The studies being carried out under the Energy-using Products Directive (Table 2.2) are part of the process of delivering these savings, though no detail is available.

In summary, three of these policies have been required by European Directives. Zero carbon new homes and the supplier obligation are innovative UK-specific policy. Other actions, such as information and advice, reinforce these policies, but are not additional. The main focus on improvements to existing housing and low- and zero-carbon technologies comes from the actions taken by the electricity and gas companies, supported by information from the Energy Performance Certificates. The Government has no strategic approach to the existing housing stock.

There are no new policies announced to assist the fuel poor and the language in the Energy White Paper is distinctly weak and vague. For instance the Government will (DTI 2007a, p82):

- take a more localised approach;
- issue guidance to encourage local authorities to exceed the decent homes standard;
- enable data sharing, for instance of who is on which benefits, for better targeting;
- be ‘working with’ Ofgem and energywatch (although energywatch is being wound up next year).

There is some focus on encouraging personal responsibility, through information campaigns and advice and discussion of personal carbon allowances (p61), but these are not quantified.

## Legislation

In the last few years, there has been a plethora of reports (listed in Table 1.2) and several new Acts (Table 2.4) demonstrating that there is no shortage of powers or rhetoric. These are in addition to the Acts incorporating building regulations, or the energy efficiency commitment.

**Table 2.4**
**Recent UK legislation on energy and housing**

| | |
|---|---|
| Sustainable Energy Act 2003 | Requires the Government to publish a statutory aim for residential energy efficiency in England. This requirement was fulfilled in the 2004 UK Energy Efficiency Action Plan (DEFRA 2004), with an aim to save 4.2MtC pa by 2010. Updated by DEFRA 2007b. |
| Housing Act 2004 | Brings in the HIPs (Home Information Packs) and Energy Performance Certificates and requires (clause 217) "The Secretary of State must take reasonable steps to ensure that by 2010 the general level of energy efficiency of residential accommodation in England has increased by at least 20 per cent compared with the general level of such energy efficiency in 2000." Because this is in terms of energy efficiency, it is likely to be achieved. |
| Sustainable and Secure Buildings Act 2004 | From a Private Member's bill – which has several important sections, for instance allowing building regulations to be introduced at the change of occupant. |
| Energy Act 2004 | Promotes "cleaner, greener power" (BERR 2007, p231). |
| Climate Change and Sustainable Energy Act 2006 | Confers powers on the Government to force suppliers to offer tariffs for exported electricity and allows the energy efficiency commitment to be extended to micro-generation and behavioural measures for CERT 2008-11 (para 93). Promotes the use of renewable heat. These powers came into force from August 2007 (DEFRA 2007b, para 82). |

## Summary

The European Commission is providing a complex framework for carbon reductions in the domestic sector – the most important of elements of which are the requirements to reduce carbon dioxide emissions by 20 per cent and to have 20 per cent of all energy from renewable sources, both by 2020, for the whole of Europe. These are mutually reinforcing objectives.

European legislation is the foundation for much UK legislation: policies on appliance standards, labelling buildings for their energy efficiency, smart meters all originated in Brussels. They are, however, only expected by Government to provide a maximum of a third of the UK residential sector's carbon emissions by 2020.

There is a continuing European focus on product policy with 15 groups to be covered by new measures in the next two or three years. Industry is supportive of these being mandatory, minimum standards. The toughness of future announcements from Brussels is difficult to predict, although with products there may be little opportunity for the UK to weaken the policies. A prompt response and strong enforcement will still be necessary.

There have been numerous statements and new legislation in the UK, aimed at delivering energy and carbon savings. Most of the UK focus has been to reflect Brussels priorities (eg on Energy Performance Certificates), or to comply with existing legislation (eg fuel poverty) or to rely on investment by the utilities (eg the Energy Efficiency Commitment). The most successful policies are where there is a clear target, provided by a specified organisation, such as building regulations and the utilities and the energy efficiency commitments. Where neither is clearly defined, the results are both difficult to achieve and to identify.

The Government's track record of achieving climate change targets, so far, rests more on circumstances, than policies that deliver. The policies in the Energy White Paper 2007 are projected to achieve real savings by 2020 – a complete change from past trends. However, at best, these will deliver less than half the level required to deliver the Government's 60 per cent target in the residential sector by 2020. The likely effectiveness of these policies is examined in the following chapters.

The importance of the existing housing stock is not reflected in a strong, clear strategy that will make these homes low carbon and no policies have been defined by the Government for beyond 2020 – hence the need for *Home Truths*.

## CHAPTER 3:
# LIGHTS AND APPLIANCES

Lights and appliances (including for cooking) are owned by all householders, regardless of whether they live in a new or an existing house. There is some gas used, mainly for cooking, but most of the energy used is electricity. As the latter is the most carbon-intensive domestic fuel, there are significant opportunities to reduce the carbon impact of this equipment. Lights and appliances also have a quick turnover – they are replaced in a relatively short timeframe, much shorter than that in the housing stock.

Because lights and appliances are traded goods, the maximum savings that could be achieved depends largely on policy initiatives from Europe. The full range of European legislation was highlighted in Table 2.1, most of which is specific to lights and appliances (12 study areas). There are some rare opportunities for the UK to implement measures independently of Europe and these combine with influencing UK household purchasing decisions and usage patterns.

The energy consumption in lights and appliances is the fastest growing home-based activity: electricity consumption doubled from 44TWh in 1970 to 89TWh in 2004 (DTI 2007a, p69). This is mainly because each household has more appliances: the average home had 17 electrical items in 1970, whereas the number may be as high as 47 in 2004 (EST 2006, p9).

Recent trends in the domestic sector have shown an increase in the use of electricity for lights and appliances, whilst energy use for cooking and hot water has been declining. The energy consumption in lights and appliances is responsible for 27 per cent of residential carbon emissions, about 11MtC in 2006 in total, or 420 kgC per household in 2005 (Table 3.1). By 2050, this has to be reduced to just 60kgC pa, to reach the 80 per cent target.

In the Low-carbon Strategy, the average household electricity and gas consumption in these appliances is reduced by 42 per cent between 2005 and 2050 (Table 3.2). For the 80 per cent carbon target is to be achieved, this level of energy reduction must be reached. The detail for the individual appliances is given in *40% house* (Boardman et al 2005, chapter 6). This is the maximum level of reduction envisaged and several different strategies are required to achieve it. The gas use, per household, increases because some functions are switched from electricity to gas, for instance cooking and tumble dryers (Fawcett et al 2000, p33). Because gas is a less polluting fuel than electricity, total carbon emissions drop. Even so, being able to guarantee the necessary energy reduction is extremely problematic and requires strong policy on both the efficiency of individual new appliances and on the proliferation of new uses. These figures are for the average across the whole stock, but give an indication

**Table 3.1**
**Carbon emissions by use, per household, UK 2005**

| End use | Percentage of total | Carbon emissions (tC) | |
|---|---|---|---|
| | | 2005 | 2050 |
| Appliances, inc cooking | 21 | 0.33 | 0.05 |
| Lights | 6 | 0.09 | 0.01 |
| Water heating | 20 | 0.31 | 0.05 |
| Space heating | 53 | 0.81 | 0.12 |
| Total | 100 | 1.54 | 0.23 |

Source: DCLG 2007d, p7

Note: there are 1,000 kg in a tonne (t)

**Table 3.2**
**Electricity and gas usage, lights and appliances, UK 2005-2050 (kWh per household)**

| | Electricity | Gas | Total |
|---|---|---|---|
| 2005 | 3174 | 337 | 3511 |
| 2010 | 3155 | 331 | 3486 |
| 2020 | 2812 | 369 | 3181 |
| 2030 | 2148 | 412 | 2560 |
| 2040 | 1739 | 447 | 2186 |
| 2050 | 1558 | 465 | 2023 |
| % change | -51 | +38 | -42 |

Source: UKDCM2, Low-carbon Strategy

of the scale of change required in the standards for new appliances.

It is not possible to identify the standards behind the level of expected policy-induced reductions outlined in Government reports. As shown in chapter 2, the Energy White Paper (DTI 2007a) states that by 2020 there will be 0.4-1.2MtC saved from product policies in the residential sector. This appears to include lighting. Few details are available and these are insufficient to debate the likely effectiveness of policy. Brussels is expected to introduce minimum standards for different products, so that they become more energy efficient (Table 2.2); however, lower levels of consumption assume restraint on ownership levels as well. This has not been discussed in any Government reports.

## Lighting

Electricity use in lighting presents one of the best opportunities for quick, major savings. Nearly a quarter of the electricity used in the average home in lights and appliances is used solely for lighting – 700kWh pa – in about 25 bulbs per household. In the last few years, policy has focused on getting every home to have at least one low-energy, compact fluorescent lamp (CFL), mainly through the Energy Efficiency Commitment: 40 million were distributed through the commitment between 2000-4 (EST 2006, p23). With 25.8 million homes, this is just over 1.5 CFLs per house, given for free. Since then, more have been introduced as a result of changes to the building regulations for new buildings. Furthermore, prices have dropped dramatically. In total there may be as many as 5 CFLs in the average house in 2007.

The opportunities for reducing lighting energy consumption are significant. Energy use in bulbs is measured by efficacy, the amount of light given out per Watt of energy input (lumens/W). The standard bulb (GLS – general lighting service) has only a quarter of the efficacy of a CFL (Table 3.3) and halogens around half. Light emitting diodes (LEDs) are already available

**Table 3.3**
**Typical efficacies of different light bulbs**

| Type | Efficacy (lumens/W) |
|---|---|
| 40W GLS | 10 |
| 60W GLS | 12 |
| 100W GLS | 15 |
| Halogen | 25 |
| Compact fluorescent lamp (CFL) | 40-60 |
| Linear fluorescent | 60-80 |
| Light emitting diode (LED)* | 150 |

Note: *expected to be commercial in 10 years time, already in the laboratory

and the technology is developing rapidly. At the moment, many are not sufficiently advanced to replace all bulbs, but they are expected to be up to 10 times as efficient as a 100W ordinary bulb within 10 years.

One of the problems with the public acceptability of CFLs is the perception that they are not as bright as the GLS bulbs they are replacing. Under European Standards EN 60969 and EN 60064, manufacturers are able to make equivalency claims that tend to overstate the light output of CFL compared with GLS bulbs. It is standard for a ratio of 1:5 to be used, e.g. a 20W CFL is the same as a 100W GLS. The problem with this is that insufficient consideration is given to several factors; two of which are of particular importance:

- CFL bulbs reach around 80 per cent of their full light output within a few seconds but take a few minutes to reach their full light output
- The light output of CFL bulbs diminishes over time – by around 20 per cent after 2000 hrs.

A better equivalency ratio would therefore be obtained by compensating for the above factors and ensuring that the brightness of the CFL would never normally be less than that of the GLS bulb it is replacing. A ratio of 1:4 is suggested.

The European Commission has a policy to replace the traditional, inefficient bulbs (sometimes called incandescent, GLS or tungsten). In reality, the phase out is expected to be of bulbs that have a low efficacy (below 40 lumens/W), ie all GLS and halogens. Phasing out inefficient incandescent bulbs under the EuP Directive cannot be implemented before 2010 with completion of any EU-wide phase-out some significant time afterwards. This will be mandatory.

As only the European Commission can introduce mandatory minimum standards, because these are traded goods, the only option for the UK Government is to negotiate earlier, voluntary action with industry. With the Government's encouragement, the lighting industry aims to phase out the GLS bulb for domestic use, where an efficient alternative exists, by the end of 2011(ENDS October 2007, p49):

- By January 2008, retailers will not replace stocks of standard incandescent bulbs with an energy rating higher than 100W.
- By January 2009, retailers will cease selling standard incandescent bulbs with an energy rating higher than 60W.
- By January 2010, retailers will cease selling standard incandescents with an energy rating higher than 40W.
- By 31 December 2011, retailers to cease selling all remaining standard incandescents, as well as 60W candle and golf-ball shaped lamps.

DEFRA does not believe there are suitable energy-efficient alternatives to replace other bulbs, such as halogens, but the Government will issue a consultation document to confirm the schedule, or update it.

## Appliances

Market transformation (chapter 1) underpins European energy policy on lights and appliances. The EU Energy Label, first introduced in 1995, is the first step towards other policies, such as minimum standards, that form part of a market transformation approach. The impact of policy has been most effective at reducing demand in refrigeration equipment (Boardman 2004a). Policies such as labels, grants and minimum standards (the inefficient models can no longer be sold) are extremely effective and inexpensive, particularly in combination. There are studies underway across Europe as precursors to introducing policies and, probably, minimum standards on 15 product groups (table 2.2). Labels on their own provide information, but have to work with other policies to be influential.

The combined effect of policy has not, so far, prevented continuing growth in demand. Recent increases result from both expected and unexpected trends (Lane pers comm):

- extra households;
- higher ownership levels, eg of tumble dryers and dishwashers;
- larger equipment, particularly cold appliances and TVs;
- appliances using more energy than was predicted, eg set-top boxes;
- new types of equipment, for instance plasma TVs and patio heaters.

All of these are likely to be reasons for demand continuing to rise. The rate and level of this future growth is difficult to predict and different authorities come up with quite widely varying projections (MTP 2006; Boardman et al 2005), but all of them are high. The growth in consumer electronics is seen as particularly worrying by the Energy Saving Trust, which envisages that consumption could nearly double from 18-32TWh between 2004 and 2010 (EST 2006, p34).

The Market Transformation Programme issued a consultation on consumer electronics in May 2007. Following this consultation there will be an action plan

for the next 10-20 years. Consultation documents on lighting and electronic motors will be published in Autumn 2007. This is the only way to get insights into the figures behind the Government's policy expectations.

New equipment is constantly coming onto the market, often for limited real improvements in the quality of life. Manufacturers have not yet demonstrated their commitment to reducing climate change risks by only producing new, energy efficient and essential products. Some retailers and some manufacturers are doing their bit towards energy efficiency, but, according to the Energy Saving Trust, with others "you would be forgiven for thinking that the energy debate had never happened; they [eg electronic items] are not labelled, the staff are not trained, they are not interested, actually, in talking to the public and engaging the public on this agenda" (HC 88-II 2007, Q9).

One of the problems is certainly the need to discourage both manufacturers and householders from the production and purchase of additional, debatable pieces of equipment. This is nearly as important as making sure that the necessary appliances are efficient. Meanwhile, the underlying trend, which Government models should be recognising, is still for rising energy consumption in lights and appliances, as people buy plasma TVs and patio heaters. Since 1995, this growth in new equipment has been sufficient to offset the gains made from policies on more efficient appliances (Boardman 2004a).

## RECOMMENDATIONS FOR THE LOW-CARBON STRATEGY

In the Low-carbon Strategy, the process of phasing out incandescent bulbs and halogen lights is both speeded up and made more comprehensive, as adequate alternatives are either on the market or extremely close. CFLs are the primary replacement, at the moment, and can be used in almost all fittings. LEDs (1-5W) are already on the market, mainly as replacements for existing halogen lights, and are expected to become the primary choice by 2015. By 2018, CFLs are phased out and replaced by LEDs.

Early action on good quality CFLs: The speed of both of these change-overs is quite a challenge for the lighting industry (manufacturers and retailers), so it would help them if substantial progress could be made in phasing out the incandescent over the next couple of years. Ownership of compact fluorescent lamps needs to continue to rise and current rates of growth need to be supported, to ensure that this happens. To foster this process, the individual retailers could undertake major promotions of CFLs as soon as possible. Retailer initiatives could be powerful at converting consumers to CFLs and LEDs and could limit any hoarding of the traditional bulbs.

In this Low-carbon Strategy, sales of bulbs with an efficacy of less than 40 lumens/W would have ceased by mid-2011, this would include the phasing out of most halogen bulbs. For such a policy to succeed, it is essential that the replacement bulbs be of sufficient quality. A number of hurdles, all of which can be overcome with existing technologies, are outlined:

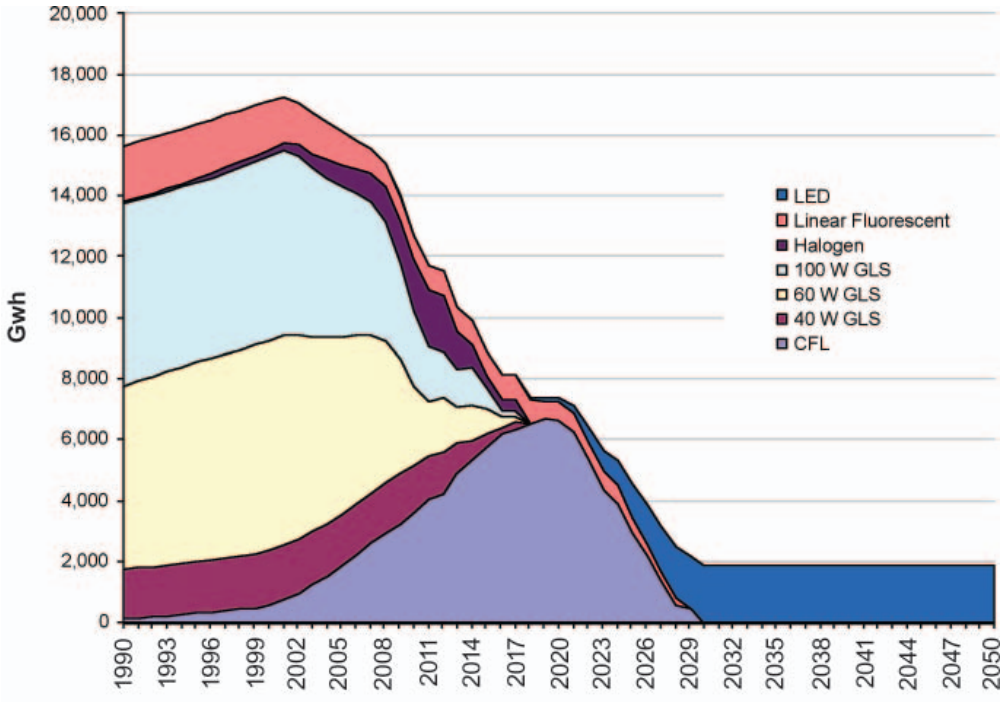
- Durability – quoted lifetimes must be accurate and the bulbs should be sufficiently robust to handle tens of thousands of on-off cycles.
- Equivalency – should be stated accurately on the packaging (see above).
- Quality of light – the colour rendering index (CRI) should be increased to 90+ for compatibility with filament bulbs.
- Colour of light – packaging should clearly state whether the light output is 'warm' or 'cool' white ('warm white' being the closest approximation to filament bulbs).
- Start-up times should be minimised through use of suitable integral electronic ballasts.
- Dimability needs to be a widely-available option.
- Concerns over mercury vapour hazards through bulb breakages can be relieved through the production of 'unbreakable bulbs';
- Further miniaturisation through which a greater range of fittings can be accommodated is needed for full compatibility in niche applications.

**Correct advice:** The packaging on CFLs should replace the 1:5 ratio with more accurate advice based on a 1:4 or even 1:3 ratio. It is because of this over-optimistic advice that many people think CFLs are not bright enough.

**Cost:** The price of CFLs would be lower if the anti-dumping duty (66 per cent) is removed. This is levied at the point of entry on CFLs, but not on the inefficient incandescent bulbs and halogens (BBC 2007). All three types of bulbs pay import duty of 2.7 per cent, whereas LEDs pay 3.7 per cent. The US Energy Star voluntary light standards could be used as a reference, as these require both good efficacy and colour rendering.

**LED replacements:** The policy is then extended, such that by 2018, CFLs begin to be phased out in favour of LEDs; which will, by then, offer vastly superior efficacies. By 2030, all lights in all houses are

**Figure 3.1**
**Total electricity consumption in domestic lighting, UK 1990-2050**




Source: UKDCM2

LEDs, a position not reached in *40% house* until 2050 – a substantial escalation. Although all bulbs sold are LEDs by 2023, it takes a few years for the maximum energy reduction to occur – the time for the existing stocks of CFLs and linear fluorescent lamps to be replaced. After 2030, the level of energy use in lighting stays the same: any increase in household numbers or extra fittings is offset by some further improvements in LED technology.

If research and development money could be focused on improving the efficacy and light characteristics of LED bulbs now, then LED technology would progress more rapidly. This would lead to the earlier commercialisation of LEDs and would be beneficial and save energy more quickly. Government procurement could assist with this development.

**Energy savings:** Electricity use for lighting in houses is down to about 12 per cent of present consumption, despite the increase in the number of households (Figure 3.1). The carbon savings would be somewhat less, because the grid electricity emits less carbon, but is still a significant 1.5MtC by 2030. No other policy could produce such certain savings, so quickly. And this is from residential only – there are comparable savings from the non-domestic sector.

Around 10TWh pa of electricity use in homes could be saved within 15 years – an important, early contribution to carbon reductions. From 2030 onwards, the average household would save around £60 (at today's prices) from their energy bill and the carbon emissions from actual use would be down to 6kg pa, well below the target of 10kg given in Table 3.1. Lighting is a generous contributor to carbon savings.

**Building Regulations:** Since 2001, the Building Regulations, Part L, have required the installation of dedicated low-energy fixed light fittings indoors (at 1 per 25m$^2$), plus one external fixed fitting (efficacy >40lumens/W). This proportion should be increased with each of the improvements to the building regulations, to at least 10 per 80m$^2$ house – there are over 20 bulbs, fixed and moveable, in the average house.

**Minimum standards for appliances:** The tough, prompt introduction of mandatory minimum standards, for the full range of equipment being considered (Table 2.2) is the most important policy initiative, as it affects all new purchases. Many of these are replacements (eg fridges and washing machines) that are going to be bought anyway. For instance, a new energy-efficient technology that could be introduced soon is vacuum-insulated panels for refrigeration equipment.

The ideal framework is for the Commission to announce a long-term strategy, with a sequence of minimum standards notified well in advance (EST 2006 p36):

"The UK Government could press for a long term EU-wide approach where the least efficient (eg bottom 25 per cent) of the market is removed on a regular basis (eg every 3-5 years). A sustained policy over a 15-20 year timescale would provide the necessary forward signals for manufacturers to innovate and improve their products."

The recommendation is that the British Government provides all the support that it can for the European Commission and works with other Member States to achieve an ambitious, long-term framework that reduces energy consumption in appliances.

**New EU labelling procedure:** The Energy Labelling Directive is being rewritten and this needs to be focused more on reducing energy demand, rather than just energy efficiency, ie on absolute energy use, not energy consumption per unit (eg kWh per litre of internal space or kWh per wash cycle). The latter approach, as used at the moment, has encouraged manufacturers to produce ever-larger pieces of equipment.

A typical American-style A-rated fridge-freezer consumes on average 150kWh pa more than the typical average-sized A-rated appliance (eg 500 kWh vs 339kWh pa) (EST 2006, p27).

**UK energy labels:** There is a need for all appliances to be clearly labelled with their energy consumption, so that consumers are not purchasing energy-guzzlers in ignorance (Boardman 2006). This could be brought in rapidly, just by using the power rating of the appliance. The Select Committee recommended all consumer electronic equipment should be labelled, as a minimum (HC 88-I 2007, para 73). The Energy-using Products Directive should perform a useful function in limiting the production of profligate equipment, as it requires any product which has sold more than 200,000 items in a year to be given an operating standard. All energy-using equipment should have a label on the front, clearly displaying its power rating, by the end of 2008.

This should not contravene any EU legislation, as the UK labels would only go on appliances that do not have an EU energy label.

**Stand-by:** In the Gleneagles Plan of Action 2005 there was agreement by the major countries of the world (G8 + 5) to adopt a 1 Watt limit on stand-by power in new equipment. Two years later, this relatively simple initiative has still not been implemented (DEFRA 2007b, para123). The 1W initiative agreement should be introduced immediately with a timetable to reduce it further. In many instances, 0.1W is adequate. Stand-by in existing appliances is already wasting 10TWh pa, worth £1 billion or 10 per cent of household electricity consumption (EST 2006, para 7).

**Retailers:** the UK Government is in discussions with major retail chains about the promotion of energy-efficient equipment, starting with consumer electronics. This might be part of a competitive process between the retailers. A potentially powerful new initiative, if it means that the major retailers start to promote energy efficient appliances, only stock good equipment, train their staff and have an influence on the whole supply chain. At present, this happens in very few outlets. The UK could promote this policy unilaterally without infringing any European trading rules.

**Fridge-savers:** the UK utilities funded a programme to replace energy-inefficient, but working, old refrigerators in low-income homes with a new, efficient model, for the price of a second-hand appliance. This is a highly successful way of ensuring both that old equipment is removed and that low-income households have the benefit of low energy consumption. This scheme should be reinstated into the Carbon Emission Reduction Targets for the utilities, from 2008.

**Standard Assessment Procedure:** the SAP for the energy efficiency of houses ignores changes in the energy use in lights and appliances. This will become an even greater problem with the energy labelling of houses, as the benefit of more efficient appliances is never pointed out to the householder. A revised, open-access version of SAP that will reflect changed appliance and lighting ownership in the SAP grading is needed urgently. Through this, householders would be encouraged to consider the energy consumption of their lights and appliances in their purchasing decisions.

**Consumer responsibility:** Whilst restraining what the manufacturers produce is part of the answer, it is also important to give householders the appropriate frame of reference, within which to make their decisions. One way of encouraging householders to reflect on their purchases of household equipment and to constrain their use would be through the introduction of personal carbon allowances. Another policy tool for aiding this decision-making process would be making bills and displays more informative – this is discussed in chapter 8. Such measures are designed to foster greater focus on personal carbon footprints by consumers, to encourage people to limit their ownership and use of equipment and to promote awareness about the need to consider the rate of energy consumption at the point of purchase.

A major recommendation is that the Government investigates ways to encourage consumer responsibility and restraint over the quantity of equipment that is purchased for the home. Without such a policy, the benefits of more efficient appliances will be squandered on profligate, superfluous purchases.

**Likely saving:** The Government expects there to be carbon savings of 0.4-1.2MtC by 2020 from energy use in residential lights and appliances (table 2.3), out of the present total of 10MtC. This could be achieved from lighting alone, as 10TWh saved represents about 1MtC by then. However, in the absence of other supportive policies that restrain the growth of electricity use in appliances, this could easily be offset, for instance by energy use in additional consumer electronics.

## Summary

Electricity and, to a lesser extent, gas use in lights and appliances is common to every household, whether the building is old or new. Energy use is growing rapidly, largely because more equipment is purchased, especially consumer electronics.

Substantial savings in electricity use by appliances are possible, but these depend primarily upon the policies of the European Commission, which can only be partially influenced by the UK, as just one Member State.

With lighting, the UK Government has a voluntary agreement with retailers to phase out the less-efficient light bulbs from January 2008. This process will be more rapid than the European timescale.

The Low-carbon Strategy undertakes the process of changing to CFLs more rapidly than the Government's voluntary agreement and includes halogen bulbs. The agreement is then extended to LEDs from 2018. A saving of 10TWh could be achieved in 15 years, saving each household £60. No other policy could save as much carbon, with as much certainty, as quickly as phasing out incandescent bulbs.

A similar approach could be taken on appliances. The Government has been talking with the major retailers for over a year. A unilateral voluntary agreement should be entered into promptly so that the retailers positively promote sales of efficient equipment. If they only stock low-energy goods, this would have a powerful effect on manufacturers, customers and carbon emissions.

The Government's projected saving of 0.4-1.2 MtC by 2020 could be achieved from lighting alone, but, in the absence of other policies, is likely to be offset by the growth in energy consumption as a result of additional appliance purchases, particularly of consumer electronics.

## CHAPTER 4:

# NEW HOUSES

New buildings are a relatively small component of the UK housing stock, because of the slow turnover. Even at the enhanced levels of construction now being discussed, they will only form between a quarter and a third of the building stock in 2050. The extent to which new buildings are a solution depends on the rate at which old, inefficient properties are removed from the stock, by demolition. Otherwise, a new, additional building is an extra source of carbon, whereas a replacement building is a saving. The Government appears to be proposing that the majority of new construction is additional properties to provide for new household formation, not replacements. With buildings that are additional to the stock, it is important that the carbon emissions, per new property, really are minimal.

New homes provide important exemplars to the community and general population when they are attractive and provide a high standard of comfort. They also provide the opportunity for the construction industry to develop new skills and experience with new technologies.

The main focus of recent Government policy is to work towards new homes that have reduced, then zero, emissions. For instance, in July 2007, the Government's green paper on affordable and sustainable housing was accompanied by 11 supporting publications (DCLG 2007a, p12-13), several of which have energy implications. Many statements apply to different geographical regions, eg England, or England and Wales, or the UK. The Devolved Administrations are being similarly, or even more, proactive. For instance: in Wales, the Building Regulations require that new homes are zero-carbon by 2011 (Welsh Assembly 2007) and in Scotland a task force has been set up to bring Scottish building regulations to Scandinavian standards (Scottish Executive 2007). Therefore, many of the statements in this chapter, even when primarily concerned with England, have been taken to indicate the trends in the whole of the UK. This is not to imply any disregard for the separate administrations, it is just that this is an overview, to indicate trends, not a precise mathematical approach.

There are four recent policy initiatives, each of which is discussed below:

- The Merton Rule requires a minimum proportion of on-site generation in housing developments, in some local authorities. Where adopted, this is a mandatory standard.
- The Government's statement that the rate of housing construction should be increased to 240,000 additional homes a year by 2016 in order to relieve the pressure on house prices and first-time buyers.
- The Government's budget commitment to refund stamp duty, up to £15,000, on new homes that are zero-carbon. This offer stands until 2012 and is mainly designed to encourage higher building standards.
- The introduction of the voluntary Code for Sustainable Homes that acts as a ladder to future Building Regulations. Again, this is designed to promote low-carbon homes by innovative builders, clearly linked to future compulsory standards.

First, there is some background on what is happening with the Building Regulations that apply to all new houses and the Standard Assessment Procedure (SAP) that is used for some of the calculations.

## Building regulations

The building regulations define the minimum standard that a new home in England and Wales has to be built to and Part L is the section that deals with the energy efficiency of the fabric and boiler, and a few dedicated low-energy light fittings. The major emphasis is definitely on the fabric, as that is the longest lasting. The regulations were last revised in 2006 and will be upgraded in 2010, 2013 and 2016.

The first problem is the way that the construction industry builds homes at present. Future improvements to the building regulations are framed in terms of a percentage improvement on the last ones (2006), but this introduces some real uncertainties. It is relatively easy to ensure that a design complies with the building regulations, but much more complicated to check that the way that it is built complies. One of the best ways

to test a home, quickly, is to build up air pressure inside and see how quickly it disperses. This indicates how many 'punctures' there are in the building and how much it would leak warm air. A recent study found that a third of new homes failed this pressure test. Within this average, flats were relatively compliant as they have few external walls (87 per cent achieved the required standard of tightness), whereas only about half (57 per cent) of the other homes were adequately air-tight, for instance terraces, semis and detached (BRE 2004). Another finding was that in 20 per cent of the properties, the energy efficiency of the boiler that was actually installed was less than the one on which the original permission had been based. Again, this would result in unexpectedly high energy consumption and means that the house purchaser is not getting the product they had been sold. These findings cast doubt on the predicted savings from new construction.

There are opportunities for testing the air-tightness of a new building, but there is little evidence that this is happening. Nor is it clear what would happen if a building is found to be too leaky when pressure tested. In Canada, with the R2000 programme, a failed building could not be sold until it had met the air pressure standard. This process was facilitated by having accredited builders who had proved they could build to the required standards.

Not only is enforcement of the building regulations technically complex, the problem is exacerbated by other enforcement issues, which include (FES 2006):

- insufficient local authority building inspectors, so that they each have a high case load;
- the privatisation of enforcement to independent Building Control Officers, who can choose which projects they do. The most successful of these Building Control Officers are the least stringent;
- non-compliance due to onsite cost cutting and ignorance, that is not picked up on the relatively few visits by a Building Control officer (public or private);
- a perception that Part L, dealing with energy efficiency, is trivial, in comparison with those parts of the building regulations that deal with health and safety.

If the energy efficiency components of the building regulations are not taken seriously by those that have to enforce them, then the construction industry is not going to take them seriously either, and houses will continue to be built to a lower standard than the design. If there have been any prosecutions for non-compliance, they have had very little publicity. And it is the publicity that would be needed to ensure builders take more care and deliver the right standards.

## Standard assessment procedure (SAP)

SAP, as described in chapter 1, is the auditing method behind many of the calculations, for instance in the building regulations and the Energy Performance Certificates (chapter 5). It has a strong focus on the building fabric and heating system. Energy use by lights and appliances are not included, so more energy-efficient equipment cannot contribute to good ratings. This is important as appliances make up a significant proportion of energy use in new homes – currently 40-50 per cent (DCLG 2007d, para 3.15), a trend that will grow as buildings are better insulated and heating becomes a smaller proportion. SAP provides a theoretical level of consumption, based on such things as standard levels of heating.

The Government is recognising the shortcomings of the present SAP and has stated that "SAP in its existing form does not adequately take account of [emissions from domestic appliances], nor does it provide for proper accounting for the range of technologies that will reduce them" (DCLG 2007d, para 3.19). Considerable detail of the changes needed have been itemised (DCLG 2007c, para 31), but meanwhile policy is framed around an inconvenient tool.

## Merton Rule

The Merton Rule, first introduced by the London Borough of Merton, requires new buildings to provide 10 per cent of their total energy demand from renewable sources, on site. This is a requirement of planning permission, which can be amended locally, rather than the national building regulations. The Merton Rule has been adopted or is being considered by about 165 local planning authorities. Of these, in England alone (The Merton Rule 2007):

- 23 have fully adopted the Merton Rule
- 67 have included it in their draft plans
- 62 are actively progressing with including it
- 13 are assessing the feasibility.

The details vary a little on the proportion of energy to be provided and the size of development affected. Where housing is included, the requirement is usually applied if 10 or more dwellings are being built, but not for smaller or single developments. By implication, the more energy efficient the design is, the smaller the 10 per cent provision has to be, so the Merton Rule has the advantage of promoting lower-carbon buildings through both energy efficiency and building-integrated renewables. In reality, the on-site renewable energy is usually provided by solar thermal (for hot water) in low-density housing and photovoltaics, biomass

combined heat and power or heat pumps in high-density housing (Hewitt pers comm). This represents an important contribution both to carbon dioxide reduction targets and to building the capacity and skills of the construction industry.

The Government has published a requirement that local planning authorities should consider incorporating renewable energy projects in all new developments (PPS 22, 2006), but may be about to weaken this by failing to clearly support the Merton Rule in the forthcoming Planning and Climate Change supplement to Planning and Policy Statement 1 (EDM 2048 2007; DCLG 2007d). It is essential to keep the Merton Rule for housing, until it is replaced with mandatory building regulations of a comparable or tougher standard. At the moment, because of the Merton Rule, a growing proportion of new build housing has to provide 10 per cent of its energy on site. This is approximately equivalent to an additional saving, beyond the current building regulations, of 0.1tC per house built. The saving will be greater in high density developments, where on-grid electricity is replaced.

A further reason for including the Merton Rule is that it forms part of a package of measures to increase local authority involvement in and responsibility for the carbon emissions from their area (chapter 9). Local authorities will not be able to deliver carbon reduction targets unless they have the freedom to respond to their own priorities.

## Stamp duty rebates on zero-carbon homes

The zero-carbon homes initiative is designed to encourage higher building standards, as one of the two policies to prepare for mandatory standards in 2016. Stamp duty will be refunded – up to a maximum of £15,000 – on any new home that is built to 'zero-carbon home' standards and acquired between 1.10.07 and 1.10.12, anywhere in the UK (Treasury 2006, para 9.3). The policy will be reviewed in 2012, but at the moment represents a small, tight window of opportunity.

The standard has yet to be defined – the relevant Statutory Instrument is still in draft form (DCLG 2007d, para 3.31) – but does refer to all energy use in the home, which is excellent. The expectation is that the zero-carbon house is going to be of a PassivHaus thermal standard with low heating demand (a rate of heat loss less than 0.8W/m2K). The European definition of the PassivHaus standard is 15kWh for space heating per $m^2$ of heated floor area pa (DCLG 2007c, para 51). In both cases, the consumption is divided by floor area – so large houses are not penalised.

In a zero-carbon house (ZCH), the energy for heating and the other uses (hot water, lights, appliances) will be met by low- or zero-carbon technologies (LZC). The target is net zero-carbon, which permits the import of electricity, provided this is offset by an equivalent amount being exported, because it is generated on the premises, but not used. The ZCH will effectively be preparation for the more demanding targets (eg level 6) being discussed in the Code for Sustainable Homes.

There are some problems with the expected definition of zero-carbon homes. It is likely that the heating system will be biomass-fired community combined heat and power: biomass because that is zero-carbon and a community system because the heat load in individual properties is so small. If the combined heat and power system has to be self-contained, as there is no wider network for it to join up to, it would only be economic on estates of 250 homes or more, perhaps a third of all new developments. It will be quite challenging to get these planned and built before 2012. It is not yet clear how smaller developments are going to achieve the zero-carbon standard.

An alternative approach would be for the insulation levels to be even higher, so that new homes should require zero heating, as recommended in *40% house* for 2020 (Boardman et al 2005). In reality, zero heating is unlikely to occur, as people will have some small demand for heating, for instance from a wood-burning stove, if only for psychological comfort on cold days (Boardman et al, 2005; Cyril Sweett 2007). These would count as zero-carbon.

The Select Committee on Environment, Food and Rural Affairs considers that "the technology required to create 'zero-carbon' homes already exists, so we are puzzled as to why it is not already mandatory to build all new housing to this standard" (HC 88-I, 2007, para 52). This is correct – the technology is there – but what is uncertain is how it meshes with whatever the Government defines as 'zero' carbon.

As the amount of stamp duty levied is related to the value of the home, the builders may try and achieve the zero-carbon standard on large, expensive properties: £15,000 purchases a lot of extra insulation and micro-generation. The effect of this policy depends critically on the way in which 'zero' carbon homes are defined, but its main impact could be on the debate within the construction industry.

## The Code for Sustainable Homes (CSH)

The CSH sets out a set of design principles and is a tool for scoring the resultant home design using

a mix of minimum standards and discretionary additional points. It does not set minimum standards for construction – that is still the role of the building regulations. The CSH is more of a labelling procedure and is for England only. It certainly provides an important and useful framework as the levels of performance indicate the future direction of building regulations. Its methodology is an updated version of the BRE ecohomes tool and since April 2007, CSH has taken over as the methodology for new homes in England. Ecohomes will continue to be used in Scotland and for existing homes in England.

For housebuilders, it is voluntary as to whether they have a property assessed against the CSH and get a certificate showing what level has been reached. The Government are consulting as to whether this should be a mandatory process, so that all new buildings have to be identified against the CSH levels (DCLG 2007b), which would increase awareness of the standards behind the levels. The real power of the CSH comes from its confirmed links with future building regulation standards and thus represents an open invitation to designers and builders to start experimenting with new options now.

All of the CSH levels are above present building regulations, so only those properties that are designed to a higher standard will have reached any of the CSH levels (Table 4.1). All six levels would result in the properties being in bands A and B on the Energy Performance Certificates (chapter 5), as the present building regulations are about the boundary between B and C. Levels 1-5 are based on the Standard Assessment Procedure (SAP), so they exclude any detail on energy used in appliances. The savings in levels 1-5, therefore, refer to reductions in space and water heating. Level 6, however, does cover all energy use, as does the zero-carbon homes standard.

Since 2006, compliance with the building regulations has been framed in carbon emissions, rather than energy consumption, to facilitate the move towards zero-carbon. The beauty of a target-based approach, as in the code for sustainable homes, is that there are numerous permutations that could be used by the developer. This range makes it impossible to predict what technologies will be used, merely to state the level of performance that will be achieved. For instance, in one study, four options were examined to get to level 3 (Cyril Sweett 2007), these were:

Scenario 1: initial energy efficiency measures followed by use of solar thermal technology and then photovoltaics and biomass systems.

Scenario 2: initial energy efficiency measures followed by use of small scale wind turbines and then biomass systems.

Scenario 3: development with shared energy services, such as combined heat and power (CHP).

**Table 4.1**
**Code Levels for sustainable homes**

| Code level | Improvement* | Mandatory** | Cost *** | Equivalent rating |
|---|---|---|---|---|
| 1 ★ | 10% | | | Ecohomes pass; EST good practice |
| 2 ★★ | 18% | | | Ecohomes good |
| 3 ★★★ | 25% | 2010 | +3% | Ecohomes very good; EST best practice; Minimum standard for Housing Corporation from April 2008 |
| 4 ★★★★ | 44% | 2013 | +5% | Ecohomes excellent; EST exemplary; approx PassivHaus |
| 5 ★★★★★ | 100% | | | |
| 6 ★★★★★★ | Zero-carbon | 2016 | | Similar to zero-carbon homes standard for stamp duty rebates |

Source: DCLG 2006d; 2007c; costs – 2007d (para 4.5)

Notes: * percentage better than Part L, 2006 building regulations, based on a gas-heated home;
** year in which the building regulation incorporate this standard;
*** extra costs in relation to 2006 building regulations

Scenario 4: no recourse to renewable energies, through the use of a whole-house mechanical ventilation system with heat recovery.

The range of options is increasing as new technologies become available and existing ones become cheaper. The Government has confirmed, for level 6 and zero-carbon homes, that some of the low- and zero-carbon technologies (chapter 6), for instance combined heat and power, can be used across the whole estate. Not everything has to be solved at the level of the individual house (DCLG 2007d, para 3.21, 3.29). It is assumed that this will also apply to levels 1-5.

At level 6, because the coverage is all energy, some form of electricity generation (from combined heat and power, photovoltaics or micro-wind) will be needed to power the lighting and appliances. Low- and zero-carbon technologies can be used to meet the requirements at any level and this may be the solution for developers at all levels in the code for sustainable homes. Their installation can transform a design, based on relatively traditional construction methods, into a low carbon one. The benefit of this would be that the designer and the builder do not have to alter, immediately, the way in which homes are being built.

One of the uncertainties is the extent to which the higher levels of the code require an entirely different type of service provision, for instance an energy service company, or ESCo. The house purchaser would not pay the full capital cost of installing the LZCs in the purchase price, as these costs would be recouped by the ESCo through higher running costs to repay the capital. In addition, the ESCo would have responsibility for maintaining any community heating system, such as combined heat and power. An ESCo approach, therefore, requires a long-term contract to supply gas and electricity. In the short-term, up to 2012 at least, there may be a happy synergy for the householder between financing the extra capital cost through an ESCo and receiving a stamp duty rebate: the reward is up-front, but the costs are delayed. The choice of financing method, the size of the development and the energy systems chosen all interact in interesting ways.

Because the savings for levels 1-5 refer to reduced space heating, the total carbon savings (including for other energy uses) can be assumed to be dependent on other policies (eg chapter 3). The savings are estimated in Table 4.2.

Even so, the improvements to the building regulation standards implied in this trajectory are very substantial: in eight years' time, all new English homes are to be zero-carbon.

## Levels of new housing construction

Recently, in the UK, new construction has been occurring at a rate of about 186,000 houses pa, of which 166,000 were private homes and 20,000 social housing. This level included the replacement of any homes that had been demolished, varying from 10-30,000 pa in the last ten years. In response to the Barker Review (2004), the Government has declared its ambition to have a higher rate of construction, to relieve the pressure on house prices. The Barker Review itself did not consider the demolition rate and took the 5,000 pa figure then current. The reference is to "net additional new homes" (DCLG 2007d, para 2.2), so the assumption here is that any construction to replace demolished homes is extra.

There have been three different, interlocking commitments for England (DCLG 2007a):

- 240,000 additional new homes a year by 2016, continuing up to 2020;
- 3 million new homes by 2020 in total;
- 5 new ecotowns each with 5-20,000 homes, since increased to 10 ecotowns by the Prime Minister at the Labour Party Conference 2007. All of these homes should be built to Level 6, Code for Sustainable Homes (TCPA and Lock, 2007) and the first five will be ready to be lived in by 2016;

**Table 4.2**
**Approximate carbon emissions from all energy use in new buildings**

| Building regulation standard | For heating (tC pa) | For other energy uses (tC pa) | Total energy use (tC pa) |
|---|---|---|---|
| 2006 | 0.4 | 0.6 | 1 |
| 2010 | 0.3 | 0.5 | 0.8 |
| 2013 | 0.2 | 0.5 | 0.7 |
| 2016 | 0 | 0 | 0 |

**Table 4.3**
**Additional carbon from new building, England 2006-2020**

| | Houses built (years x annual rate) | | Carbon emissions (tC) | |
|---|---|---|---|---|
| | | | per dwelling | Total |
| 2006-9 | 740,000 | (4 x 185,000) | 1 | 740,000 |
| 2010-12 | 600,000 | (3 x 200,000) | 0.8 | 480,000 |
| 2013-15 | 660,000 | (3 x 220,000) | 0.6 | 462,000 |
| 2016-20 | 1,200,000 | (5 x 240,000) | 0 | 0 |
| Total | 3,200,000 | | | 1,682,000 |

- the Government believe that "as much as one-third of the total housing stock" will have been built between 2007-50 (DCLG 2007d, p1). If the total is 31.8 million homes, as in this strategy, that would represent over 10 million new homes to be built by 2050, with an implication of high demolition rates.

It is not possible to align all these statements completely, though the first two commitments do come together (Table 4.3). If these numbers are combined with the carbon emissions postulated in Table 4.2, the additional emissions by 2015 will be 1.7MtC pa, for England alone. These will have to be offset by savings elsewhere and, for this report, they are assumed to be in the housing sector.

It is not clear whether the rate of new construction is going to stay high as this has impacts both on the size of the total housing stock and on the rate of demolition. In the Low-carbon Strategy, the numbers for the UK have been brought together as follows:

- There are 31.8 million homes in the housing stock in 2050.
- The rate of constructing new homes drops from 2020, to 120,000 pa until 2050, so that there will be 7 million homes built between 2006 and 2050 in total.
- The rate of demolition from 2011-2050 is 17,000 dwellings pa, meaning that a total of 800,000 homes are demolished between 2006-2050. This is a much lower rate than in the *40% house* report, where the rate increased to 80,000 pa, and therefore creates a bigger challenge for the existing housing stock.

Of this new construction, the Government wants (DCLG 2007a, p10-11):

- 70,000 more-affordable homes a year by 2010-11;
- At least 45,000 new social homes a year by 2010-11, to rise to 50,000 beyond that. This is over a 50 per cent increase in social housing (from the present rate of 20,000 pa) in three years. English Partnership and the Housing Corporation are already proposing to build 40,000 pa at level 3 from 2008;
- These two targets combine to give a total of 115,000 (58 per cent) affordable or social houses, out of the entire 200,000 homes built annually at that stage. A very considerable and welcome change in the availability of new homes for households on below-average incomes.

The link between these rates of construction, the code for sustainable homes and future building regulations means that there will be 7 million new homes by 2050, of which a minimum of 4.8 million will have low- and zero-carbon technologies, including some micro-generation, designed into the house by 2050. This will provide the installation industry with substantial experience. The number will be higher if the developers respond, soon, to the voluntary process, but not if they only comply with the building regulations.

There are also links between this rate of construction and the stamp duty rebate initiative. Of the 2 million new homes to be built between 2007 and 2016 (Table 4.3), around 850,000 will be in the private sector and potentially paying stamp duty. The remaining new construction, from 2010 onwards, will either be affordable or for rent, so with few, if any, of them will the new owners be paying stamp duty. It is, presumably, not levied on social housing and affordable housing should often be below the £125,000 starting point.

## Types of new construction

The number of new homes is an important target, but there are other aspects of new construction to consider. For instance (Boardman 2007):

- The proportion built on brownfield sites. This supply interacts with demolition rates.

- The density, in terms of people, per hectare.
- Whether flats or houses are built.
- The orientation to ensure that roof-top solar technologies can be effective.
- The promotion of the community-combined heat and power for dense developments.
- The size, in terms of floor area, of new construction, particularly in urban centres, to provide attractive alternatives for elderly people living in large family homes.
- Access to good public transport, to minimise the need for cars, particularly for elderly people.
- All of the other factors, such as access to green space and shops, that make an attractive home environment. The resultant properties must provide a good standard of living for the occupants.

One of the main influences on some of these decisions is the type of household that is the expected occupant. As already stated, over half of new housing has to be affordable or is for social housing. Another priority group is those at present under-occupying their homes, many of whom are elderly owner-occupiers. The problem has arisen because social changes in the size of the family unit have been more rapid than changes to the physical fabric of the dwelling. Hence, the UK has a legacy of many, large, old buildings, suitable for Victorian families of six or more, whereas they are often occupied now by one or two people. In England, in 2006, there were over 7 million households of just two adults, with no dependent children, and nearly 6 million one-person households (DCLG 2006c, p26). Of these one and two-person households, over 5.5 million own their home outright, implying that they are older people, often still occupying the family home. Recently, flats have increased as a proportion of new construction, which is helpful as they are generally smaller in area than houses.

## RECOMMENDATIONS FOR THE LOW-CARBON STRATEGY

**Enforcement:** Defining tough targets is stage one, delivering them in practice is another set of challenges. It is not certain that Building Regulation inspectors, or even the Building Regulations themselves, are able to confirm that these standards are achieved in practice. Enforcement is a neglected issue that has the ability to negate many of the expected benefits. Mandatory pressure tests should be carried out on a high percentage of new dwellings, with failure to comply resulting in a prohibition on selling the property, until it does comply. It is important to move towards standards that are based on performance, not on design.

**Building Control Officers:** the Government should ensure that local authorities have the funds to employ sufficient building inspectors, in house, without the need to privatise any part of the service. The delivery of high standards and the protection of the buying public is best achieved through independent surveyors. This will become increasingly important with the introduction of new technologies and the expectation that homes require zero, or close to zero, heating.

**Size:** The increase in the number of households is inevitable, but the increase in the amount of built fabric can be ameliorated by building smaller dwellings for smaller households and an ageing population, probably to a higher density. The link between energy consumption and size of dwelling is not well understood, but less space does imply fewer appliances and equipment and, therefore, less energy use.

A substantial proportion of the new homes should be flats in urban centres, to a high density, particularly for single people, young or old. This will reduce pressure on green fields and reflect the needs of an ageing population and would be in preparation for the effect of policies on the existing housing stock (next chapter) and the substantial rate of improvement and investment required there to make them energy efficient.

**Density:** If new buildings are constructed within urban areas, at an increased density (in terms of people per hectare), this means they do not encroach on the green belt, reduces the need for transport and provides a greater commercial demand for combined heat and power. There are quite large numbers of small sites of urban wasteland, which would be suitable for new construction. When these have been used up, it may be necessary to have policies on higher levels of demolition.

The recommendation is that this interplay between regeneration, demolition, new green field developments and household type is examined more thoroughly by the Government.

**Merton Rule:** The Merton Rule already requires some on-site generation for most new housing developments and is in the process of being adopted by about half of English local authorities. The Government is weakening its support, presumably because of pressure from the construction industry. The Merton Rule provides the perfect stepping stone to zero-carbon homes and should be retained and strengthened over time.

The Merton Rule only becomes redundant when zero-carbon standard building regulations for all energy use are introduced in 2016 – before that, the building regulations do not cover all energy use in the dwelling, which the Merton Rule does. The Merton Rule, therefore, does result in additional carbon savings, beyond those that would be delivered by Government policy.

If the Government required all local authorities to adopt the Merton Rule, so that it applied to all new housing construction, this would mean that the construction industry would be gaining experience of low carbon buildings in all parts of the country. At the moment, about 10 per cent of energy has to be provided on site, under the Merton Rule. This proportion should be increased to 20 per cent in 2008, to prepare designers and builders for the 2016 building regulations.

**Definition of zero-carbon homes:** the Government has to ensure that the definition of zero-carbon is flexible enough so that it can be delivered, economically, in all types of developments. This is necessary both for the stamp duty rebates and for the Code for Sustainable Homes. There should be a strong emphasis on making the fabric energy efficient, before low- and zero-carbon technologies are considered. In Wales, all new homes are to be zero-carbon by 2011, so a similar requirement should be introduced in England.

**Code for Sustainable Homes:** it should be mandatory to have every new building assessed against the Code, to raise awareness amongst the construction industry and house purchasers. This would enhance the Government's intention that the Code for Sustainable Homes is seen as a mark of quality (DCLG 2006d, p6).

**ESCos:** The potential need for energy service companies (ESCos) links in with the type of developments that are built from now onwards and which sustainable homes level they comply with. An ESCo is more likely to be needed where a community combined heat and power scheme is installed.

**Energy saving:** The 3 million new properties to be built between now and 2020 will result in annual emissions of 1.7MtC from 2015 onwards from the domestic sector. These carbon emissions are additional and have to be offset by some other policies in order to achieve the flat line shown in Figure 2.1. After 2015, if the Government maintains its policies and timetables, there should be no additional carbon increases.

The Government is predicting that 1.1-1.2MtC will be 'saved' in the UK from zero-carbon homes policy by 2020 (Table 2.3) – all of this has to be saved between 2016 and 2020. This calculation assumes that the 240,000 homes pa are built, as planned, and that each of these 1 million homes is saving 1tC, in relation to what would have been the standard in 2006, ie they really are zero-carbon. This calculation appears fair, though in reality, it is better to think of them as no net additions, rather than savings. The figure is entirely dependent upon both forthcoming definitions and, critically, the way in which building regulations are enforced. A sophisticated, low-energy design, built badly, will emit carbon dioxide emissions.

**Standard Assessment Procedure:** The methodology for assessing the carbon impact of new homes should be extended to include all energy use, including lights and appliances. This is required to identify which homes are zero-carbon, which are complying with the Merton Rule, whether a home qualifies under level 6 of the Code for Sustainable Homes and, by 2016, for the Building Regulations. This is an urgent requirement and has been acknowledged by Government. The ideal approach would be for the new tool to be open-source, regional and flexible. It should be able to reflect actual consumption, not just a theoretical standard.

## Summary

Present construction methods are rarely delivering the energy efficiency standard specified in the design, so the purchaser is not getting the product they had bought. The carbon emissions are higher. The solution is to enforce the regulations through more building inspectors, pressure testing and prohibiting the sale of non-compliant buildings. The privatisation of building control is not helping. Proper enforcement will be essential if the Government's projection of a 1.1-1.2MtC saving in 2020 is ever to be achieved.

The Government is proposing some good policies on zero-carbon homes (ie properties that produce enough heat and electricity to match their overall energy demand), but the definition is crucial and has not been finalised. These homes are part of a process to transform new building standards between now and 2020. The Code for Sustainable Homes, stamp duty rebates on zero-carbon homes and building regulations are all important components. All zero-carbon homes will include some on-site generation.

It is excellent news that the Government is planning for there to be so many new buildings and for these to be both energy efficient and low carbon. These result both from an increased level of construction and from building to lower carbon standards, with zero-carbon being the planned standard for all homes by 2016.

These policies are beginning to provide a framework, for the next nine years at least, so the construction industry and developers can plan accordingly. Most of the additional costs will be borne by the house purchaser. The stamp duty rebate on zero-carbon homes appears to be a token policy, rather than a cause of serious Government costs.

These new policies imply several changed priorities:

- The rate of new construction being proposed for England is a 30 per cent increase overall.
- Properties for social renting will increase to 22 per cent of new construction, from the present 10 per cent level.
- In addition, 35 per cent of new homes will be affordable.
- Both of these commitments represents a much-needed re-emphasis and means that some low-income households can have truly low-carbon homes.
- By 2020, there will be 3 million new homes in England – with present policies, most of these will predate the zero-carbon standard, which is a missed opportunity. The zero-carbon standard should be introduced from 2011, as in Wales.

New homes are still additional, so the carbon 'savings' are in comparison to what would have happened if they had been built to a less demanding target. In the absence of a clear baseline, it is not possible to confirm the 1.1-1.2MtC saving being projected by the Government in the Energy White Paper 2007.

## CHAPTER 5:
# EXISTING BUILDINGS

The previous chapters have shown the reductions that need to be achieved in lights and appliances and the extra emissions coming from new buildings. However, the bulk of the problem is the existing housing stock and how to make it more energy efficient and the cause of less carbon emissions.

The legacy of British housing policy is that the stock is energy inefficient: even when the effect of the climate and the size of the houses is taken into account, the UK uses nearly twice as much energy for space heating as the Nordic countries in both new and existing homes (Lapillonne and Pollier 2007; Olivier 2001). Add to this, the powerful British love of their homes and architectural heritage and the result is a serious problem that combines the slow turnover of the housing stock with the need for substantial investment to prevent energy wastage. Most of the properties standing today will still be around by 2050 (25 million out of 25.8 million) and by then the rate of heat loss in these homes has to have dropped by at least half. The existing stock is by far the biggest challenge for housing and energy policy.

## Present situation

The energy efficiency of the present stock has been increasing, but this has not resulted in lower energy demand – householders are taking the benefit as extra warmth and space per person. There are numerous, cost-effective measures that could be installed in many, if not most, houses, but the building owners are not putting them in. For instance, in 2005, for England alone, there are over 9 million uninsulated cavity walls and 6.3 million lofts that have no insulation or are poorly insulated (DCLG 2007e, p28). These two measures are inexpensive and make the home much more comfortable. British Gas (2007a) has stated that:

> "As a result of poor insulation, £1 in every £3 spent heating homes in the UK is wasted – the current trend of focusing on the standards of new build housing fails to address this issue."

The energy efficiency commitment of the utilities has benefited over 10 million households. In total, half of all homes have received some form of energy efficiency measure from this and other Government programmes, such as Warm Front and Decent Homes (both targeted on low-income households). The 'measure' may have only been low energy light bulbs, so the effect on the household energy consumption would be difficult to demonstrate. It is now the Government's ambition to reach the remaining households by 2020 (DEFRA 2007b, paras 6, 88), though real improvements will only come when the 'measures' are substantial. In the Budget 2007, the Chancellor stated a much more ambitious target:

> "By the end of the next decade… where practically possible, all homes will have achieved their cost-effective energy efficiency potential."

The way in which this is to be achieved has not been defined by the Government.

## Tenure

Housing policy has to reflect a variety of dimensions, such as the:

- age of the housing stock
- age of the occupant
- householder's access to capital
- knowledge and awareness of both the occupants and the building trades
- type of construction (for instance house or flat)
- location (urban or rural)
- tenure.

The latter is important because it affects the policy options available. Owner occupation is the main tenure group in the UK (Table 5.1), with nearly a third of all households owning the property outright – the mortgage has been paid off. Just under a third of homes (30 per cent) are rented.

Present policies mainly focus on the needs of the fuel poor (chapter 7), with some additional assistance for the non-fuel poor from:

**Table 5.1**
**Tenure and housing stock, UK 2006**

| Tenure | Percentage | Number (m) |
|---|---|---|
| Owners | | |
| Own with mortgage | 40 | 10.1 |
| Own outright | 31 | 8.0 |
| Rented from | | |
| Private landlord | 12 | 3.1 |
| Local authority | 11 | 2.8 |
| Housing association | 7 | 1.8 |
| Total | | 25.8 |

Source: DCLG 2006b, Table 8.1

- The utilities' Energy Efficiency Commitment (£190 million pa for non-vulnerable groups until 2008, more after that) invests in appliances, heating systems and lighting, as well as insulation measures.
- Decent Homes – mainly aimed at making social housing achieve a minimum standard of thermal insulation, as well as improving kitchens and bathrooms.
- Low Carbon Buildings Programme requires that an existing home has to be fairly energy efficient (such as 270mm of loft insulation) to be eligible for a grant to install micro-generation technologies. However, this is such a small programme that the effect is negligible.

With these exceptions, the rate of improvement in the energy efficiency of the general housing stock is largely dependent upon the initiatives of the owners, with little assistance from Government.

The lack of Government support and encouragement for owners is perhaps one reason why the rate of energy efficiency improvements by this group is occurring more slowly than in social housing (Table 5.2). The Standard Assessment Procedure (SAP) is widely used by Government as an indication of energy efficiency. It has several problems, as already discussed in chapters 1 and 4, not least that it only reflects the energy costs of space and water heating accurately. Changes in SAP values, therefore, mainly reflect changes in the level of insulation, the airtightness, and the efficiency of the space and water heating systems. As a result of investment between 1996-2005, "social sector houses are now on average almost as energy efficient as private sector flats" (DCLG 2007e, p34), whereas houses are normally less efficient than flats, because they have more external walls.

The average SAP in England in 2005 was 48 points, up from 42 points in 1996 (measured on the same basis – DEFRA 2007f) – a slow rate of improvement overall.

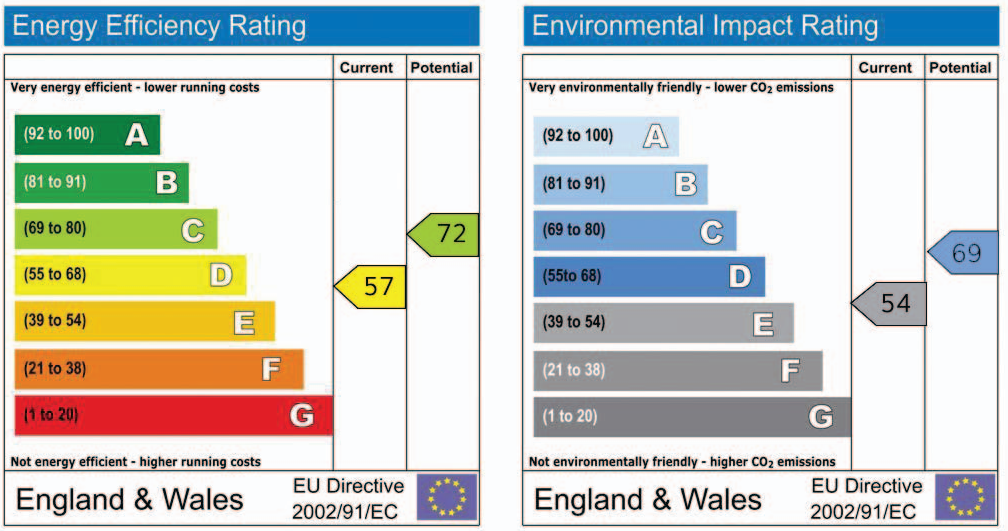
Apart from fuel poverty, the main Government policies are those funded by the utilities: the Energy Efficiency Commitment becomes the Carbon Emission Reduction Target (CERT) in April 2008. The change in name represents a change in focus from energy

**Table 5.2**
**Level of Standard Assessment Procedure in houses and flats, by tenure, England 1996-2005**

| | 1996 | 2005 | Upgrade |
|---|---|---|---|
| Private houses | 40 | 45 | 5 |
| Social houses | 41 | 53 | 12 |
| Private flats | 48 | 54 | 6 |
| Social flats | 54 | 62 | 8 |

Source: DCLG 2007e, p33

**Figure 5.1**
**Energy Performance Certificate for England and Wales**




Source: NHER 2007

Note: A similar certificate is available for Scotland

to carbon, which may not be of great significance. The main characteristic of the programme stays the same, as the benefits are estimated not measured. From 2011 onwards, this may change, depending on decisions about the Supplier Obligation. If this is, as in one of the proposals, defined by actual consumption, there could be a considerable improvement in its effectiveness. At the moment, there is nothing to stop the utilities simultaneously providing low-energy light bulbs and promoting exterior lighting: both reducing and increasing demand.

The Carbon Emission Reduction Target requires the utilities to spend about £1 billion a year from 2008-11 and this is expected, for instance, to include the insulation of 1 million cavity walls a year (DEFRA 2007a, p58). The Government has been planning for this level of escalation since at least 2004 (DEFRA 2004, p103).

The main policy of interest for this *Home Truths* report is the introduction of the Energy Performance Certificate.

## Energy Performance Certificates (EPC)

The Energy Performance Certificates (EPC) are being introduced by the Government, as part of the Home Information Packs (HIP) – the EPC itself is a requirement under the European Energy Performance of Buildings Directive. The tremendous potential that is being unlocked by the arrival of the EPC seems not to have been recognised by Government – it is as if the furore over the HIPs has been allowed to cloud this real advance.

An EPC (figure 5.1) shows the code for an existing dwelling, as it stands, both in terms of energy consumption and carbon emissions and provides information on the potential for improvements. Three- and four-bedroom owner-occupied homes are covered already and the Government has indicated that the remaining ones will be included from 1 January 2008, but this has not been confirmed. After 1 January 2008, the property can only be put on the market when the Energy Performance Certificate has been obtained, whereas beforehand it only has to have been commissioned. Eventually an Energy Performance Certificate will be required whenever any dwelling is sold or rented out to a new tenant (SI 991, 2007). New lettings on tenanted properties have to be included from October 2008, as do other sales, such as portfolios of properties, which require an Energy Performance Certificate, but not the whole HIP. A similar approach is occurring throughout the UK and the EU.

The certificate is issued by an accredited, independent assessor and has to be publicly displayed with the sales details by the vendor and estate agent. The information behind the 'potential' column is given in more detail elsewhere in the EPC (not illustrated) (NEF 2007). This identifies all the measures that would be cost effective – defined as paying back in seven years. The measures are ranked in a fixed order in the software, but the selection is specific to a property and will only be made if it increases the

**Table 5.3**
**Distribution of housing stock into Energy Performance Certificate bands, UK 2001**

| | Range (SAP points) | Band width (SAP points) | Present stock (m) | Theoretical fuel costs for 85m² house (£pa) |
|---|---|---|---|---|
| A | 92-100 | 9 | 0 | £80 |
| B | 81-91 | 11 | 0.02 | £187 |
| C | 69-80 | 12 | 1.65 | £294 |
| D | 55-68 | 14 | 8.86 | £427 |
| E | 39-54 | 16 | 10.59 | £587 |
| F | 21-38 | 18 | 2.87 | £811 |
| G | 1-20 | 20 | 1.03 | £1216 |
| Total | | | 25.78 | |

Source: Shorrock pers comm; Chapman, pers comm

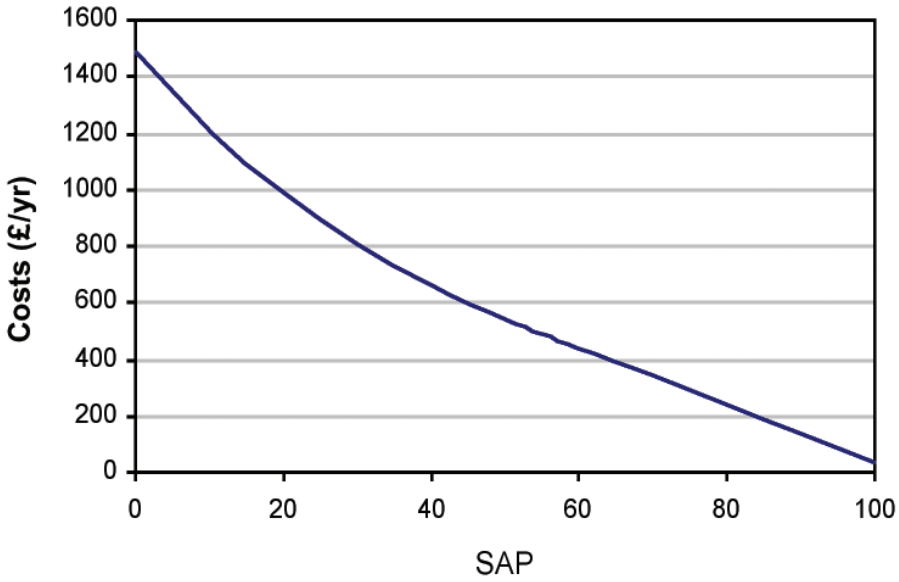
Note: SAP data have been converted from SAP 2001 to SAP 2005 and are derived from the 2001 English House Condition Survey

SAP rating by at least 0.95 points (or 0.45 in the case of low energy lights). Thus, loft insulation, cavity wall insulation, insulating the hot water tank, draught-proofing, low energy lights, adding controls and heating upgrades, will be recommended (if not already there) and in that order (BRE 2007b).

Further measures, beyond the cost-effective potential, are also identified. These cover the more expensive interventions, like double or secondary glazing, solid wall insulation, solar thermal water heating or photovoltaics. With neither the potential nor the further measures is the householder given an indication of the costs on which the calculation is based.

Only the expected, theoretical energy savings are shown, based on a warm home. There are no good, recent statistics for the temperatures in people's homes – the Government has stopped collecting them – but between 8 per cent and 42 per cent of households could be 'cold' depending on what temperature is taken and which area of the house. The 8 per cent is an estimate of those with the temperature below 16°C in the living room on a cold day and the

**Figure 5.2**
**Theoretical annual fuel expenditure vs SAP rating**




Source: Chapman, pers comm

42 per cent is the proportion with a whole house temperature below 18°C, both in 2006 (Moore 2003).

As shown in the example, it is possible for the property to have a different carbon rating to its energy band. This is because the fuels used in British homes have different levels of carbon intensity: for instance, a unit of electricity used in the home results in about twice as much carbon being released into the atmosphere (at the power station) as a comparable amount of gas, which is burnt in the home. In this report, the emphasis is on the energy data on the EPC. It would be easy to transfer the policy focus to carbon.

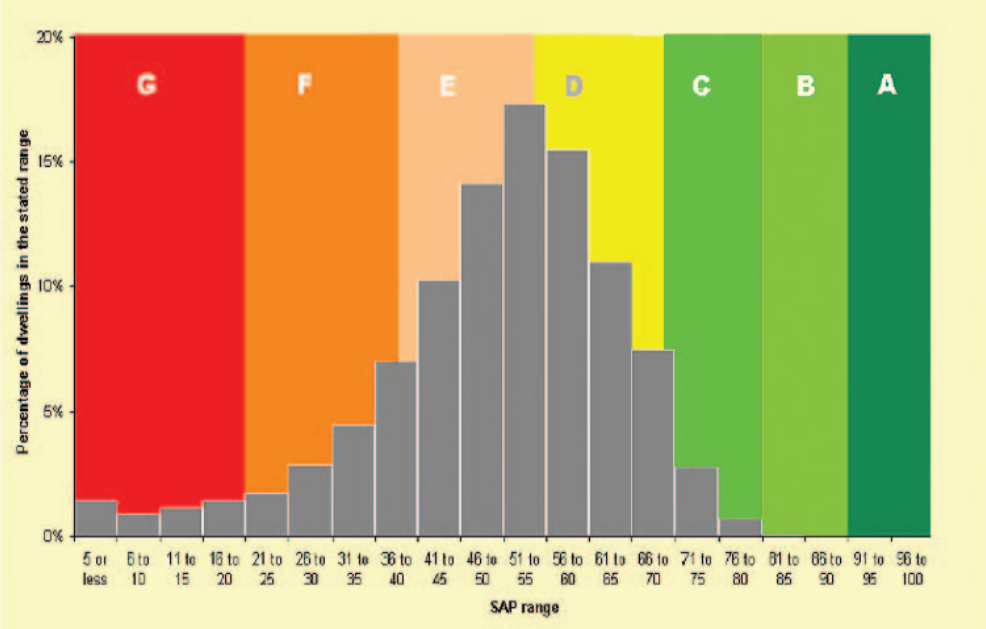
The design of the EPC replicates the now-familiar EU Energy Label that is on many household appliances, as it follows the colour coding of long and red for G and short and green for A. This is to aid recognition by householders and should result in a good understanding of the message. The bands are of diminishing width, based on SAP ratings, so that it gets progressively easier to move to the next band. Similarly, the greatest energy, carbon and cost savings result from moving from G to F and upwards. The approximate distribution of the UK housing stock, into these bands, is given in Table 5.3.

If all homes had an equal standard of warmth and other energy uses, the average fuel cost for a household in the G band is 15 times that of someone in A, or nearly three times the costs for a D-rated property. The same information is shown as a curve (Figure 5.2), which has the steepest gradient (that is the largest savings) at the lowest SAP values. This is a graphic demonstration of the penalties of being in an energy inefficient house (it is expensive to heat) and explains why those on the lowest incomes have no choice but to be cold. Because SAP is based on a theoretically warm house, the heating savings can be overestimated, in cold houses, by a factor of up to two (Chapman, pers comm). This is why Sorrell (2007) has warned about the dangers of ignoring the rebound effect in policy.

The combined effect of the bands and the number of dwellings is shown in figure 5.3. The average rating of properties in England in 2005 was 48 SAP points (DCLG 2007e, p28). A brand new property, built to comply with the 2006 Building Regulations, would come at around the B-C boundary. There are almost no properties with a SAP of 80 or more at present and an A-rated property will include some form of micro-generation.

Another aspect of the SAP methodology is that to calculate the SAP points, the total, theoretical household energy expenditure is divided by the floor area. This unduly favours larger houses, as it is easier to make a large property energy efficient than a small one. The advice on interventions only promotes three of the low- and zero-carbon technologies (solar thermal, biomass boiler and photovoltaics). It has to be clear to householders, particularly before they have obtained an EPC with recommendations, which measures do and do not improve the rating. Installing low-energy appliances, or even partially converting

**Figure 5.3**
**Distribution of the housing stock and EPC bands, UK**




Source: based on BRE (2007a)

**Table 5.4**
**Examples of how measures upgrade a property**

| | Detached house | | Semi-detached house | |
|---|---|---|---|---|
| | Band | Points | Band | Points |
| No insulation in cavity or loft | E | 57 | D | 61 |
| Install100mm loft insulation | D | 65 | D | 68 |
| Install 270mm loft insulation and fill cavity | C | 73 | C | 75 |

Source: Eurisol 2007

the lighting to low-energy, will not make any difference to the SAP rating of the property. Before too long, it is hoped that the Government will introduce a new system, based on more complete coverage (eg micro-CHP, wind turbines and heat pumps) and, additionally, one that reflects the actual energy use of the building.

The ease with which a property can be upgraded is demonstrated by two examples (Table 5.4). The cost of cavity wall insulation averages about £350 and saves £133 pa – paying for itself in two and a half years (DCLG, quoted on Eurisol 2007).

## The worst housing

The G band consists of appallingly inefficient properties that would cost a fortune to keep warm and are highly polluting. A wide-range of properties qualify as G-rated. For instance, in a terraced, solid-walled house, with a pitched roof, single glazing, virtually no insulation (even on the hot water tank) and hot water heated by electricity, the heating system could be electric storage heaters, open fires, gas fires or even gas central heating and still have less than 20 SAP points (Banks pers comm).

All of G-rated and much of the F-rated properties would fail the Housing, Health and Safety Rating System (HHSRS), under the thermal comfort criteria, as they pose a serious threat to health. This means that a low-income occupant would be suffering from fuel poverty (chapter 7). The original definition, under SAP 2001, was that SAP 35 or less qualifies as a Category 1 – Hazard for Excess Cold (DCLG 2006a, para 5.27). It is difficult to convert this directly into SAP 2005, but a conservative figure of SAP 30 has been taken. There are 3 million properties in the UK that have a 2005 SAP 30 or less, meaning they come into bands G and F.

The least efficient properties are, generally, the oldest – all types of pre-1919 – and any others that also have solid walls. Many of them are owner occupied and above average in value (DCLG 2007e, p31). Solid wall insulation is one of the more expensive measures and, if done externally on properties with a heritage value, can be perceived to be disfiguring. Even insulating the solid-walled back extension would be effective, as it is more than half the exterior wall surface of a terraced house and is not part of the streetscape. In parts of the UK, for instance in Wales, many solid-walled properties have a rendered finish, so adding external insulation could be accommodated without spoiling the appearance. Another group that has low SAP ratings are those in rural areas: 43 per cent of those that are less than SAP 30 are in rural areas. Here, the fuel for heating is the problem, with most homes using electricity, oil or coal (highly carbon-intensive fuels) and a change in both the fuel used and the heating system would be required. They are more likely to have an insulated cavity wall than city or urban centre homes (DCLG 2007e p35).

In the pre-budget statement in October 2007, the Chancellor stated that the Government will spend more than £4 billion over the next three years to help those living in sub-standard accommodation carry out renovations (*The Guardian*, 10 October 2007). It is not clear how much, if any, of this will be related to thermal insulation and energy use.

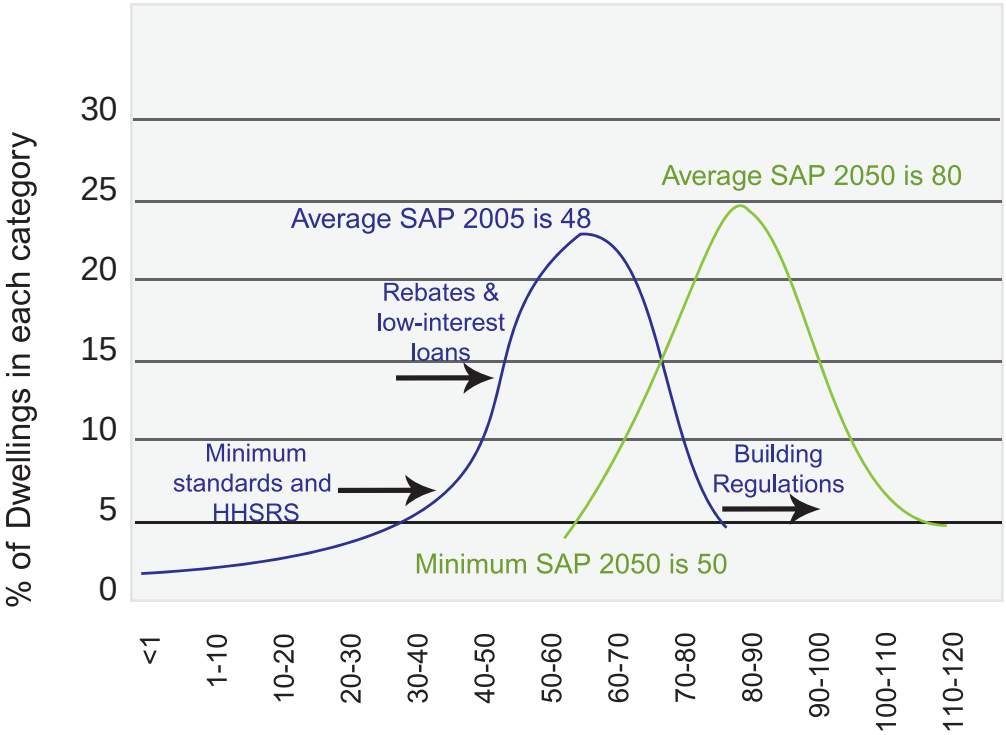
In reality, the energy efficiency of the housing stock varies by tenure. The proportion of properties that are less than SAP 30 is highest amongst the privately rented (16 per cent), then owner occupiers (11 per cent) and with few of the social renting (4 per cent) (DCLG 2007e, p32).

# RECOMMENDATIONS FOR THE LOW-CARBON STRATEGY

## Transforming the housing market

To achieve an 80 per cent cut in carbon dioxide emissions will require an entirely new strategy from the Government to transform the efficiency of existing houses. The Government's nine-year framework for

**Figure 5.4**
**Transforming the UK housing stock**




Note: the SAP 2005 scale stops at 100, but by 2050 properties may be exporting so much electricity, that they have exceeded the scale

new building provided by the Code for Sustainable Homes is admirable, but is not replicated in existing housing, nor is there a strategy for 2020-50, hence the need for a Low-carbon Strategy.

The advent of Energy Performance Certificates is an extremely important – and long overdue – policy. However, labels on their own have a limited effect. They do raise awareness and, through the information on potential improvements, will identify the most appropriate actions. Some people will respond. But, by far the greatest impact of EPCs will come from the way further policy is built around them, in a traditional market transformation approach. Hence, the following proposals for:

- A major education and awareness programme, demonstrating the benefits of moving up the EPC bands.
- Subsidised loans, stamp duty rebates and targeted investment to encourage the majority of householders to move up the EPC bands.
- A minimum standard progressively increased, initially building on the Housing, Health and Safety Rating System.
- Local authorities to have carbon targets for the energy used in the whole housing stock in their geographical area.
- Financial incentives for innovation, encouraging a learning process around new skills, techniques and products, which combine to exceed minimum standards.

The synergies that result from interacting policies are well understood. For instance, in recent evidence, the Energy Saving Trust stated that the combination of both an education and a subsidy programme (such as EEC) “could give us perhaps 50 per cent more activity. The cost of the advice programme is an order of magnitude smaller than the subsidy cost within the Energy Efficiency Commitment” (HC 88-II 2007, Q25). Recent research by the Energy Saving Trust revealed that energy efficiency is now an important consideration when buying a home for over two-thirds of those surveyed, with nearly 50 per cent saying that they would pay an additional £10,000 for an ‘environmentally friendly’ property (HC 88-I 2007, p24). Although there is a clear difference between willingness to pay and observed behaviour, the public mood appears ready for a clear, decisive framework.

This Low-carbon Strategy provides an entirely new rationale and perspective for society and for attitudes towards the energy efficiency of the housing stock. By 2050, as a minimum, the standard of the worst housing will be equivalent to today’s average (SAP 48) and the average will be the standard of today’s best

(SAP 80) – Figure 5.4. This transformation towards greater efficiency has been achieved by different policies acting on different parts of the distribution, some pushing and some pulling.

## Using the EPC

The Energy Performance Certificate is central to the housing policy being proposed. For the first time, a market transformation approach can be taken to the housing stock – it is possible to compare the energy efficiency of different properties. There is an x-axis. The A and B categories will gradually be filled by brand new homes, particularly if they are built to the higher levels of the Code for Sustainable Homes. This will begin to 'pull' the market towards the best ratings and increase consumer awareness of the range within the housing stock.

**Coverage of Energy Performance Certificates:** the first and critical recommendation is that the Government declare all properties will require an Energy Performance Certificate from 1 January 2008, for both sales and rentals. There are a large number of Domestic Energy Assessors now and they could easily cope with this rate of roll-out.

Public confidence in the EPC will be crucial to the whole process of transforming the housing stock. Everything possible must be done to ensure that the public retain confidence in the accuracy of the EPC and in the integrity of the assessors. One example of this relates to the way in which the information from the first EPC for the property is stored. All the details must be retained in an accessible archive and made available to subsequent assessors. It is essential that no householder believes that they have upgraded the property sufficiently to move it into a higher band and then finds that the EPC is at the same level or lower than the original coding, because of different decisions made by the two assessors. It is understood that the detailed data from a survey is going to be stored and made available for subsequent assessments, to ensure there is clear continuity between one rating and the next on the same property.

## Awareness and education

The energy efficiency of the housing stock – and your home – has to become a talking point. Bands A-G have to start meaning something to us. This will require a major Government-led advertising and awareness campaign so that everyone knows that investment in improving the home will improve its value and the ability to sell it, save money and help the environment.

**Public access to EPC information:** It will be important to make information on the EPC bands a matter of public record, at a minimum on a website. This may not be what is planned at the moment. However, as the EPC has to be publicly available, on the estate agent's details, this is not much of an extension. EPC ratings should be visible on all marketing material for maximum effect: the label needs to be constantly in the public eye, as it has become on white goods. If the label is not displayed prominently (it is tucked away in a surveyor's report) then its impact will be drastically reduced. Much wider publicity is required so that people can search to find:

- what properties are for sale in each specific band in their area of interest
- what properties in their street have already achieved, just as it is possible to find out what your neighbour's home has sold for (Net house prices, 2007). It cannot be tenable that the information on the energy coding is more sensitive than the information on selling price.

The ability to retrieve information about EPCs that have been issued has been recommended by the Energy Efficiency Partnership for Homes.

**Table 5.5**
**Estimated number of moves pa, UK 2005/6**

| Tenure | England (%) | UK (m) |
|---|---|---|
| Owner occupiers | 35 | 1.08 |
| Privately rented | 37 | 1.14 |
| Social rented | 16 | 0.47 |
| Household ceases* | 12 | 0.36 |
| Total (m) | 2.55m | 3.05m |

Source: based on DCLG 2006c, p53;

Note: * households cease when people die, or move in together. New household formation is included in the separate tenures

**Table 5.6**
**Length of residence by tenure, England 2005/6**

| Residence (years) | Tenure (%) | | | Average (%) |
|---|---|---|---|---|
| | Owner | Social sector | Renter | |
| <1 | 5 | 9 | 38 | 10 |
| 1-3 | 12 | 16 | 31 | 15 |
| 3-5 | 10 | 13 | 9 | 11 |
| 5-10 | 19 | 21 | 9 | 18 |
| 10-20 | 22 | 20 | 5 | 20 |
| 20-40 | 24 | 16 | 4 | 20 |
| 40+ | 8 | 5 | 2 | 7 |
| Mean (years) | 15.9 | 12.2 | 4.9 | 13.9 |
| Median (years) | 11.8 | 7.7 | 1.6 | 9.0 |
| Total number of properties (m) | 14.5 | 3.9 | 2.5 | 20.9 |
| Percentage of the housing stock | 69 | 19 | 12 | |

**Online calculator:** it should be possible for people to get a provisional EPC coding, for instance online, without incurring the cost of a full survey. The results must be reasonably accurate, so that they can decide what to do to make sure their home gets into a higher band.

## Energy Performance Certificates for the whole housing stock

The aim is to get an EPC for each house as rapidly as possible, in a similar way to the requirements for non-domestic buildings. If the process depends upon people moving, then it will be slow. The frequency with which people move around in the housing stock can be measured in a variety of ways:

- When a property is sold it is a transaction and there were 1.5 million in England and Wales in 2005 (DCLG 2006b, p91). This does not appear to include remortages, which are not subject to an EPC.
- With rental property, where there is a new tenancy agreement, this is defined as a letting, but no statistics are available of the numbers.
- There were 2.55 million household moves in England in 2005/6, of which only 0.9 million were owner occupiers (DCLG 2006b, p124).

The number of people moving, by tenure, is summarised in (Table 5.5). From this, it appears that 2.7 million Energy Performance Certificates would be issued. This may underestimate the amount of activity, if large numbers of people put their home on the market, incur the expense of acquiring a HIP and Energy Performance Certificate and then do not go ahead with the sale.

The biggest group of movers is private renters, despite this being only 12 per cent of the total housing sector. However, the impact on landlords will be muted, because, at the moment, the certificates can be reused, for up to 10 years. A further implication is that certain properties are not going to get an EPC for a very long time – over half of all owner occupiers live in their homes for more than 10 years (Table 5.6) and some people will still be in the same house in 2050. The different characteristics of the three tenure groups require separate policies.

Households that own their property outright (no mortgage) are by far the largest group of people that have lived in their homes for 20 years or more:

- 60 per cent of households that have been in the home for 20-40 years (all tenures) own the home outright
- 77 per cent of households that have been in the same home for 40+ years (all tenures) own the home outright.

There would still, therefore, be some properties that have not been coded, by 2050. Some of these households will receive help through fuel poverty programmes, such as Warm Front, others through utility-funded schemes, such as Energy Efficiency Commitment (EEC) and Carbon Emission Reduction Target (CERT). But many will stay outside the system, until the present occupant is old or infirm. This is a substantial problem and one that is going to get worse with increasing longevity: many of these hidden households are gradually slipping into fuel poverty.

**Acquiring an Energy Performance Certificate:** To spread EPCs through the housing stock as rapidly as possible, it is proposed that they are also obtained:

- Whenever a property is remortgaged.
- When planning permission or building regulations approval is sought. Various payments are required already at this stage, so that the cost of an EPC would not be a large additional burden.
- As an eligible activity by the utilities, under the Carbon Emissions Reduction Targets.
- When a property is treated under the Warm Front and Warm Zone programmes (chapter 7). They already have to be given a SAP rating, so it would be a simple process to convert these into an EPC.
- Others may have taken some action that results in them being incorporated into the coding system by obtaining a low-interest loan or releasing some of the equity in the property.
- And finally, it would become part of the responsibility of the local authority to complete the housing profile in its area, by not only collating existing data, but also ensuring that missing properties are surveyed. For instance under the Low-carbon Zones proposed (chapter 9).

The database has to be kept up-to-date, so this is a constant process. The changes allow the local authority to compare with the rate at which carbon dioxide emissions are actually reducing (chapter 9).

There are several reasons why a profile of the whole stock is required:

- The homes of the fuel poor have to be identified, so that they can be comprehensively treated and brought out of fuel poverty by 2016, under the Warm Homes and Energy Conservation Act 2000.
- To do this, local authorities need to build up a detailed profile of the housing stock in their jurisdiction with an address-specific database that contains the EPC band for every property. This links to the Government's new performance indicators (chapter 9).
- The enforcement body has to be able to identify that this specific property has already been rated and that it cannot be resold without improvement. It is already a requirement on local authorities that information on the Housing, Health and Safety Rating System is included in housing stock condition surveys (DCLG 2006a, para 5.2), so the system is already in place. It might also be appropriate to send reminders to the householder periodically, so the requirement is reinforced.
- Government policy and the new Climate Change Committee will need to be informed about the progress that is being made with the existing housing stock, as it is so central to all residential energy demand reduction.

**Address-specific database of EPC ratings:** It is an important and strong recommendation that this is assembled, by each local authority, as quickly as possible. The majority of properties should be in the database with a rating by January 2011 (including all tenanted properties), with full coverage by 2013, because of the 2016 fuel poverty deadline (chapter 7). The information can already be classified in this way, but is not available to local authorities with the present system.

**Sufficient assessors:** There needs to be confirmation that there are sufficient Domestic Energy Assessors to undertake this extensive programme, rapidly.

## Financial incentives – Government

Many energy efficiency measures have been cost-effective for households for many years, but they have not been installed. This is partly because households perceive the cost of insulation measures to be considerably greater than they are and they similarly underestimate the benefits (Oxera 2006; HC 88-II 2007, Q24). There is a real need for an accurate educational message on both the costs and benefits. The EPCs provide the Government with a way of repackaging the message and giving it added salience. In particular, it is important that Government identifies the levels and rates of improvement that have to be achieved and provides support for this process with financial incentives. There has to be a strong combination of carrots (financial incentives) and sticks (mandatory minimum standards) to ensure that the public understand that this transformation has to happen. The balance may need to be quite subtle, to ensure both public commitment and enthusiasm.

There are three main options for the financial support and inducements that the Government could provide: stamp duty rebates, low-interest loans and further VAT reductions. In both the former cases, there has to be a clear target for the amount of improvement undertaken. All of these measures are aimed at the middle-income groups that have sufficient money of their own to spend, they just need to be encouraged to invest in the energy efficiency of their property, and not just in the bathroom or kitchen.

**Stamp duty rebate on existing properties:** The aim of this policy is to encourage the new owner of a property to undertake improvements quickly. The Low-carbon Strategy recommendation is that a rebate is given on stamp duty, if the potential improvements (as listed on the EPC) are undertaken in the first year after a sale – this is similar to the proposal from the EFRA Select Committee (HC 88-I 2007, para 65). As with zero-carbon new homes, this rebate would be for a maximum amount of money. The lowest value properties (<£125K) do not pay any stamp duty and it increases to a maximum of 4 per cent on properties worth >£500K (ie £20,000+). The scale of stamp duty rebates would need to be designed to give a meaningful incentive for energy efficiency improvements across the range of possible property prices without giving unduly large pay-outs on the most expensive properties.

The stamp duty rebate on zero-carbon homes is limited to a maximum of £15,000. This is a high figure, but only 4 per cent of sales were of properties worth more than £500,000, the majority (70 per cent) of properties (old and new) on which stamp duty is paid are worth £125-250,000, and the amount levied on them averaged £1,875 in May 2007 (Land Registry 2007). It is therefore proposed that the full amount of the cost of the improvements is repaid from stamp duty, up to a limit of £5,000. This is to encourage the maximum number of householders to participate. In the last year, about 1.2 million householders had to pay stamp duty on the homes they purchased, and the assumption is that a third of them will take action in the first year and claim the rebate. This is an ambitious number, but householders are strongly influenced by the introduction of mandatory minimum standards. Hence:

The cost of this proposal is 400,000 households receiving an average of £3,500 rebate each year, that is a total cost of £1.4 billion pa.

This is a cost to The Treasury, but it would be offset by VAT receipts from home improvement works.

**Low-interest loans:** The objective of these loans is to encourage action independently of whether the home has been put on the market. The German Government is aiming to bring all pre-1984 dwellings up to the current German new build energy standard over 20 years, at a rate of 5 per cent of properties pa (SDC 2007b). Over the first nine years, a much slower rate has been achieved. As part of this programme, it provides subsidised loans (and occasionally grants) for householders that improve the energy efficiency of their existing home to a very high standard (better than a brand-new dwelling). The loans are at 3 per cent below market interest rates and cover 100 per cent of the costs, up to 250€ per $m^2$ (£175/$m^2$ or £14,000 for an 80$m^2$ house).

Whilst it is difficult to compare across countries, the German target is a reduction of 40kg$CO_2$ per $m^2$ pa (ie 11kgC/$m^2$/a). This is approximately equivalent to a 40 per cent reduction for a British home from the present average level of consumption of 19kgC/$m^2$/a and thus represents a useful improvement, in one go. The defined and significant carbon dioxide reduction is an important strength of this programme, rather than some open-ended aspiration. The target saving needs to be substantial to warrant the quite extensive administrative costs (Eurima 2006).

The scheme, known as the KfW $CO_2$ reduction programme, provides up to €50,000 (£35,000) as a loan at an interest rate of between 0-2.5 per cent. It started in January 2001 and was delivering an annual reduction of about 2-2.5Mt$CO_2$ (0.5-0.7 MtC) by 2005. This was less than half the anticipated saving, but the standard of refurbishment required is high and may imply quite substantial disruption.

In the UK situation, the size of the required improvement may be linked to the potential measures on the EPC, so that the home owner has to have a certificate and can show that a specified improvement has been achieved. This would be administratively easy and inexpensive, but would limit the amount of improvement, to say one whole band, as the listed potential measures do not always go beyond that.

The cost of this proposal is that there is a 3 per cent interest rate subsidy provided, by the Government, to householders who undertake an improvement of at least one whole band to their property. The maximum loan is for £20,000, over 10 years, but the average is £15,000. it is assumed that 5 per cent of owner occupiers will take one out, each year. This is 900,000 loans pa, building up to 9 million loans, over the 10 years and staying at that level. The cost to the Exchequer is £450 pa per loan, if this is a direct subsidy. If the loan is at a lower interest rate,

for instance if it could be borrowed through Treasury bonds, then the costs would be lower. The expectation is that the loan is handled through the normal lenders.

**VAT:** The recommendation is to get full equity between the VAT rate on the use of energy and on saving it, through energy efficiency improvements. At the moment, there is (rightly) only a 5 per cent VAT levy on the use of energy, but a 17.5 per cent levy on many energy efficiency measures – for instance, no double glazing installation carries a 5 per cent levy, it is always 17.5 per cent – and household improvements, that are not undertaken professionally. This anomaly is one of the signals that give utterly the wrong message to householders. The Government has to prove that it is supporting people over reducing the demand for energy and the resultant carbon emissions. The present high rate of VAT on some energy efficiency products gives the opposite message and the Government is working with the European Commission to correct this anomaly. It is assumed that about £2 billion pa is spent by householders on activities that will, in future, be levied at 5 per cent instead of 17.5 per cent VAT.

## Financial incentives – non-Government

Other forms of support for people improving the energy efficiency of their home could be provided by the market, through green mortgages (especially green remortgages) and council tax rebates (linked to the utilities' Energy Efficiency Commitment).

**Green mortgages and remortgages:** There are strong synergies between this proposal and the low-interest loans, depending on whether any subsidy comes from the Government, or from the lender. The Government, through Gordon Brown's last budget as Chancellor, has already let the lending market know that it expects the development of green mortgages. For whatever reasons, the building society or bank should encourage investment in energy efficiency through a lower rate of interest on the mortgage. This is different from the existing green mortgages, which include energy audits and carbon offsets for the carbon emissions and are not being proposed.

The Energy Efficiency Partnership for Homes (EEPfH 2007c) has defined a green mortgage as one that is either for a home with an above-average level of energy efficiency or where the owner commits to undertake an agreed list of improvements, for instance as identified on the Energy Performance Certificate. The latter approach, in particular, fits with the ethos of the Low-carbon Strategy.

The recommendation is that the Government and the lenders develop a standard definition for a green mortgage (probably linked to Energy Performance Certificates) and introduce these with wide publicity, promptly.

**Council tax rebates:** The utilities are required, under the Energy Efficiency Commitment to save a defined amount of energy, by getting certain specified measures into people's homes. British Gas has cleverly combined this commitment with the British dislike of council tax to provide an attractive way to motivate householders. Normally, the utility would identify a householder who wanted to have, say, subsidised cavity wall insulation – this is a quite surprisingly laborious process. With the council tax rebate, the householder pays the full amount for the cavity wall insulation, but is then given a council tax rebate equivalent to the original subsidy, via the local council, for that one year. The net cost to the utility is the same – in both cases the householder receives a rebate of about £50-100. With council tax rebates, however, the proportion of householders taking up the grant increases from around 15 to 60 per cent (HC 88-II 2007, Q26). In November 2007, 64 local authorities were operating this scheme (British Gas 2007b). It is likely to be developed further in the next round of EEC, which is Carbon Emission Reduction Target. This requires no extra central Government expenditure, although the local authority is free to increase the subsidy if it wishes, and a few do.

The benefit of a council tax rebate is that it is entirely independent of moving property and can apply to single, non-intrusive measures, such as cavity wall insulation.

## Mandatory and voluntary requirements

Every possible measure that can be incorporated into the transformation of the existing housing stock should be. There are three examples identified here: Building Regulations, a Code for Sustainable Existing Homes and a mandatory minimum standard.

**Building Regulations:** Previous attempts have failed to require energy efficiency improvements to the rest of the dwelling when a major alteration (that involves Building Regulation approval) is undertaken. There were problems in defining:

- The trigger for intervention – what is a major alteration?
- The threshold for the improvement – which part of the house has to be improved? The principle was that the standard should be sufficient to offset the extra energy being used in the extension, conservatory, or whatever.

- Who should enforce this, when there were no additional resources for new building inspectors?

The process has to be reasonable, so that it does not freeze all forms of action on the housing stock and is seen as appropriate by the householders. It has already been proposed above, that all applications for Building Regulation approval or planning permission require that an EPC is obtained. In which case, the householder will have a document that identifies the energy efficiency improvements that could be undertaken cost-effectively.

The Low-carbon Strategy is that there is a requirement to undertake cost-effective measures (such as cavity wall insulation) that have been identified on the EPC before or at the same time as other, substantial interventions, such as a loft extension. Even with the new building work, the house should have a smaller carbon footprint. The provision of the invoice, showing the energy efficiency work had been undertaken, together with the EPC, would be sufficient for the Building Regulations inspector, when approving the major alteration. In most cases, the cost of the improvements identified on the EPC will be a small proportion of the other investments.

**Code for Sustainable Existing Homes:** The Sustainable Development Commission has called for the prompt development of a Code for Sustainable Existing homes (SDC 2006). This would be similar to the Code for Sustainable Homes discussed in the previous chapter – setting tough, voluntary standards that are rewarded with a certificate of compliance. With the enhancement of the Energy Performance Certificates being proposed in the Low-carbon Strategy, there does not appear to be a need for an additional system, such as this.

**Minimum standard:** The most important measure, in the whole Low-carbon Strategy, is the introduction of mandatory minimum standards. This is justified both by the scale of the energy inefficiency in the existing housing stock and by the large numbers of properties that create fuel poverty for their occupants. Over time, the least efficient properties need to be improved and brought up to a higher, minimum standard of energy efficiency (Figure 5.4). The aim is that by 2050, all properties in the UK have a rating of 55 SAP points or more (a minimum of D band), approximately today's average, and that the average is at least 80 SAP points, the standard of a new home today. This rate of improvement is essential if the 80 per cent carbon reduction by 2050 is to be possible. In order to achieve this, the proposal is that, in planned stages, it becomes impossible to sell properties in the lowest bands:

- The code of a property is known when it is given an EPC for the first time. Before that, there is no objective information on how good or bad it is in energy efficiency terms.
- A G-rated property can be sold, the first time, but the new owner is clearly informed that it cannot be sold, as a G, a second time. It has to be improved, to at least ensure it is no longer a Category 1 Hazard for Excess Cold, under the Housing, Health and Safety Rating System. This means it has to have a minimum of an E rating, before it can be sold.
- This puts the onus on the new owner to improve the property, at some point during his/her ownership. Whether it is before moving in, gradually during occupancy, or just before reselling is their choice.
- The new owner will, therefore, expect to pay less for the property now that it has been identified as a G and requires substantial investment. The cost-effective work to be undertaken is indicated on the certificate and this will permit an assessment of the likely costs involved, some or all of which will be covered by the reduction in purchase price.
- The debate about selling price, between the seller and the purchaser will establish the message that inefficient properties are less valuable.
- The seller could choose to make improvements before actively selling the property, in order to keep the sale price high, but does not have to. This is in recognition that the seller may be in a hurry to move or be elderly or even deceased. There is a risk that the seller might undertake the improvements in a minimalist way, rather than doing a thorough job as the new owner can be expected to.
- It is assumed that the new owner is likely to decide to do the work as soon as the capital is available and therefore benefit from the improvements, whilst living in the dwelling.
- This scheme also permits the new owner to do-it-yourself with at least some of the work (such as loft insulation) and to invest in making the property achieve a higher ranking, for instance, a D.
- Financial assistance is available to smooth the transition, as discussed above.

The proposal is that this procedure is commenced in 2010, as the EPC system should be functioning properly by then. After 2010, no G-rated property can be sold twice. From 2013 onwards, the process will extend to F-rated properties and from 2016 to E-rated ones. The G and F groups are both relatively small (15 per cent of the stock in total) and in dire condition in terms of their energy performance. A programme to improve all the Gs and Fs coming onto the market

after 2010 would go some way towards meeting the policy of eradicating fuel poverty by 2016. Tackling E-rated properties from 2016 would require more than a doubling of activity in the refurbishment sector but, with sufficient advance warning from Government about the future of the minimum standards, industry will have a clear strategic pathway. Encouraging all owners to take action, soon, will also be an important part of the strategy – hence the need for financial incentives so that many homes that are E or F or G today will have been improved before they are put on the market or relet.

The process of eliminating the worst properties will be relatively slow, partly because of the length of occupancy. To speed up the process of improvement, it is proposed that not only can a G property not be sold twice, but when it is resold it has to be above the then-current minimum standard. Therefore, a G-rated property that is first sold in 2009 has to be a D-rated property if it is resold in 2020. This will be quite a challenge for many occupants and reinforces the need for substantial help and inducements. It also means that the list of 'potential' improvements on the Energy Performance Certificate has to be sufficient to identify the measures that would move the property up two bands. If an unimproved property is put on the market for a second time, the local authority will be required to intervene, purchase it and improve it.

These are the suggested standards for a process of improving the energy efficiency of the housing stock, towards 2050. It is clear that the reductions to be achieved by 2050 have to start today. For the longer-term, the level of the minimum standard will have to be constantly upgraded and comprehensively enforced, to ensure that all homes are both warm and low carbon.

**Innovation and service delivery:** There are real questions about how people find out what they want or, even, get what they want. There are several options already available for helping people, such as the Energy Saving Trust's Energy Efficiency Advice Centres and energy efficiency advice services provided by the utilities, though these provide general information rather than detailed advice. Home Improvement Agencies provide a valuable service, but do not focus strongly on energy efficiency measures (chapter 7).

New, innovative approaches are desperately needed. The Green Concierge scheme being developed in London is exactly the right sort of initiative to provide help and independent guidance to householders. Another route might be through Energy Service Companies (ESCos). As a senior civil servant from DEFRA has stated (HC88-II 2007, ev 365):

> "Often consumers are confused because they are subject to multiple messages coming from multiple sources and they do not have a framework for assessing the relative value and impact of different measures. Access to low cost finances is another issue, particularly for more expensive measures."

**Service delivery:** The recommendation is that a range of methods to help householders obtain high quality advice and work need to be confirmed and supported. The way in which the different methods provide a coherent framework should be clearly identified, ranging from initial advice to undertaking all the work.

## Demolition

As discussed in *40% house* (Boardman et al 2005), the present rate of demolition in the UK is low – resulting in less than 0.01 per cent of the stock being demolished each year and implying that the stock is replaced once every 1,300 years. The scenarios in that report increased the rate from 20,000-80,000pa, but this still results in only replacing the housing stock once every 400 years, by 2050. A further worrying aspect of the demolition rate is that only 20 per cent of those demolished were unfit, the remaining 80 per cent were apparently satisfactory dwellings (ODPM 2003, p86). As explained in chapter 4, the level of demolition assumed in the Low-carbon Strategy is 17,000 pa from 2011-50, partly in the absence of a clear policy from the Government.

The debate on the rate of demolition interacts powerfully with discussions about the use of greenfield sites for new construction. The substantial number of new homes that are being proposed, because of the growth in household numbers, could be accommodated on brownfield sites, in urban centres (Boardman 2007). There is a reasonable supply of small plots of vacant land, but in due course, more land will be needed. This could be made available, through the demolition of inefficient, unhealthy, existing homes. The new construction on these cleared sites needs to be at a higher density (more people) than what was there originally. In this way, the pressure on greenfield sites is relaxed. Of course, density has to go hand in hand with quality of design and liveability – there are no proposals for the development of dense new estates with inadequate infrastructure and amenities.

The one recommendation in relation to demolition is that the proportion of properties that are demolished, because they fail the Housing, Health and Safety Rating System, should be increased.

## Landlords and tenants

All landlords, because they are building owners, will be affected by some of the above policies, but additional policies are needed to cope with their special circumstances. With blocks of flats, where there are numerous leaseholders, there is a case for giving responsibility to the freeholder to improve all properties together. For instance, cavity wall insulation cannot be done one flat at a time. The development of green leases, which clearly specify the separate responsibilities of the landlord and tenant, would be an important step forward (Woodford 2007). At present these leases work best with new buildings, so that the construction standard and the responsibilities for running costs can be meshed together, as with the relationship between the tenant's heating bill and the standard of the external wall insulation, controlled by the landlord.

A major policy for the Government has been the Decent Homes standard, which applied to all social housing and the homes of "vulnerable households in privately owned housing, particularly those with children" (DCLG 2004). To be decent, a dwelling should be free of category 1 hazards (DCLG 2006a), that is no longer in bands G or F on the Energy Performance Certificate.

**Social rented houses:** This tenure group typically lives in fairly modern (mainly built since 1945) properties, a large proportion of which are flats. The owners are either Registered Social Landlords (otherwise known as housing associations) or local authorities, with 7 and 11 per cent of the housing stock respectively. Some social landlords have been getting whole sections of their properties assessed and given Energy Performance Certificates (Banks, pers comm). They are using the information to supplement their stock condition surveys for planning purposes and not waiting until the buildings are empty.

The Decent Homes standard has been applied to most of the social housing stock, and all have to be treated by 2010 (DCLG 2006a). The intervention point was, however, low – for instance the absence of 50mm of loft insulation. Equally, the standard that had to be reached if intervention occurred (SAP 65, band D) represents a low level of energy efficiency now that fuel prices have risen so much and is insufficient to take low-income households out of fuel poverty. In practice, 90 per cent of local authorities have done more than the minimum and by 2010, 3.6 million (95 per cent) of social housing will have been improved. One of the benefits of a Decent Homes standard is that it requires the landlord to take action, whether or not the tenant moves.

A second round of Decent Homes standards is proposed in the Low-carbon Strategy, to bring social housing (both Registered Social Landlord and local authority owned properties) up to a standard of a SAP 80 by 2017 (making it a 20-year programme). A SAP 80 implies high levels of energy efficiency, but also the provision of low- and zero-carbon technologies. This standard is set primarily to give the refurbishment trades experience of achieving a high standard of upgrade. It would also mean that there are exemplars in every local authority area with solar thermal, combined heat and power, photovoltaics and/or wind. By using the Decent Homes policy to provide the lead group, there is the opportunity to use public money to pioneer a new, high standard and to develop teams skilled at delivering that standard. FPAG (2007) has also called for the introduction of a second round of Decent Homes Standards.

The cost of bringing a property up to a 'decent' standard under thermal comfort criteria has been £2,225 on average across all tenures (DCLG 2007e, p23). So, it has not been expensive to bring dreadful properties up to a standard that makes them more affordable to keep warm. The process now needs to be completed.

## Privately-rented properties

One of the most difficult groups to influence is private landlords, who own about 12 per cent of the UK housing stock. In England, much of this is known to be energy inefficient (an average of SAP 46), in comparison to the rental properties owned by Registered Social Landlords (average SAP 57) (DCLG 2007e, p33). The proportion of non-decent privately-rented properties has, however, declined from 62 per cent in 1996 to 41 per cent in 2005, which is considerable progress, although it still leaves over 1 million non-decent, privately-rented homes in England (ibid p12).

The challenge is to ensure that the introduction of minimum standards related to Energy Performance Certificates will have a major influence on this group. With rented property, the Low-carbon Strategy minimum standard would not be delayed until the property is resold, but has to be implemented before it is relet. On average, tenants spend a relatively short time in each property: action will have to be triggered when the property is empty, prior to a new tenant moving in, not when the existing tenant stays in residence and gets a new lease extension.

**Energy performance certificates:** All private landlords are required to obtain Energy Performance Certificates for all their properties by 2010. This is

mainly to help identify the fuel poor: nearly a quarter of all private tenants are thought to be fuel poor.

To assist private landlords to cope with the mandatory minimum standards – and there is no proposal to relax the standards – there are two existing policy components that could be usefully brought together and reinforced. Most landlords are thought to link in with one of these two routes.

First, the Government introduced the Landlord's Energy Saving Allowance (LESA) in April 2006, which permits the cost of certain energy efficiency measures to be offset against income for tax purposes (up to a maximum of £1,500 pa per property). This appears to be an appropriate initiative, but is not widely known about. Activity, therefore, has been low. More intermediaries need to be involved in linking landlords with the LESA scheme. For instance, most landlords interact with an accountant, a letting agency and, now, a tenancy deposit scheme, all of whom could be required to discuss the LESA with the landlord. The LESA continues in existence until 2015 and should provide financial support to and encourage action by landlords, whether or not the property fails a minimum standard. It is appropriate to highlight that the LESA exists, but only for another seven years, to encourage landlord action as soon as possible.

Secondly, since April 2007, in England and Wales, the Tenancy Deposit Scheme requires landlords to protect their tenants' deposits by lodging them with an accredited third party (DCLG 2007g). This applies to Assured Shorthold Tenancies, which are the vast majority of new lettings. There are three main accredited agencies, which know when a tenant moves out and a deposit is reclaimed. Either one of these accredited agencies or a letting agency would be able to notify the regulatory authority that the landlord must take action and to prevent a reletting in an unimproved property. Unless a new EPC is obtained, showing a higher rating has been achieved, the property could not be relet (through a letting agent).

Some letting agencies, handling the properties of several landlords, may well offer insulation and energy efficiency packages, through their existing maintenance staff. Many of the interventions, such as cavity wall insulation or the replacement of communal boilers, can be undertaken to several properties (eg flats) without disturbing the present occupants. Other measures, such as window replacements or the upgrading of a flat roof, are more disruptive, but can still be introduced across several flats in one building, without too much problem.

**LESA:** It should be widely publicised, with a time-related taper, so that landlords are encouraged to apply quickly. The number of measures that it covers and the maximum amount of money should both be increased. The recommendation is that expenditure up to £20,000 per property pa would qualify, as identified on the Energy Performance Certificate. This is the only tax incentive available solely for landlords. As property owners they are eligible for low-interest loans, like any householder and have to comply with the mandatory minimum standards.

**Skills, etc:** There are numerous issues that flow from these proposals that will be important in making the scheme work, such as the availability of skilled craftsmen and accreditation schemes. These cannot be covered in detail here, despite their importance. The main objective of this report is to develop the framework within which additional analysis and policies can occur.

Other relevant issues are discussed in the next chapter on low- and zero-carbon technologies and fuels, on fuel poverty (chapter 7) and local authorities (chapter 9).

## Summary

The existing housing stock represents the biggest challenge to an energy and housing strategy: almost all of the existing 25.8 million homes will still be occupied by 2050 and the rate at which heat is lost in them will have to be halved over the next 42 years. Yet, this is an area where Government policy is patchy and limited and only looks at the period to 2020 – most activity is funded by the utilities. The Government has no overall housing and energy strategy and has not identified the policy issues for 2020-50.

The Low-carbon Strategy involves a range of policies to build on the Energy Performance Certificates and transform the housing stock. These include:

**Education:**

- wide publicity about Energy Performance Certificates
- a searchable website with results
- self-assessment tool, to estimate the rating for a home.

**Government financial incentives:**

- stamp duty rebate on existing homes, to encourage action when the property is sold. A maximum of £3,500 if work undertaken within a year, approximates to jumping one band

- low-interest loans for substantial improvements (more than one band) any time – 3 per cent subsidy on a maximum loan of £20,000 for 10 years
- VAT reduced to 5 per cent on all energy efficient products and installations, to equalise the rate on energy use.

**Non-government financial incentives:**

- Green mortgages, especially when remortgaging
- Council tax rebates, funded by the utilities, through CERT.

**Minimum standards:**

- from 2010, the least efficient homes cannot be resold. With G and most F-rated properties these would already fail the Housing, Health and Safety Rating System, as providing a Category 1 Hazard of Excess Cold
- Decent Homes 2, to bring social housing up to SAP 80
- Building Regulation approval requires cost-effective energy efficiency improvements to be undertaken with extensions.

When combined with the Government's proposal for new homes and the enhancements suggested for the Low-carbon Strategy, the average efficiency of the housing stock will have risen to SAP 80, with nothing below SAP 50, by 2050.

The Low-carbon Strategy provides a long-term framework for energy use in the existing housing stock and identifies the policies that will result in all homes becoming energy efficient and substantially reducing their demand for energy. The proposals in this chapter interact strongly with the two following chapters on introducing low- and zero-carbon technologies into homes and on the eradication of fuel poverty.

## CHAPTER 6:

# LOW- AND ZERO-CARBON TECHNOLOGIES AND FUELS

All UK homes use electricity and the majority have a second fuel for space and water heating, usually gas. Most UK homes now have central heating – less than 10 per cent of homes in 2001 had none. The traditional way of heating a UK home and providing hot water is with a gas-fired system (72 per cent) or electric systems that probably use off-peak tariffs (10 per cent). The remainder of homes use oil, coal or wood for central heating (Shorrock and Utley 2003). The biggest change in recent years has been that it has become mandatory, from April 2005, to install a condensing boiler, if the old gas boiler is being replaced. This regulatory requirement has transformed the market for condensing boilers.

The new carbon economy is both requiring change in this traditional picture and providing substantial opportunities. The fuels used in the home emit, at some stage of the process, very different quantities of carbon for a unit of energy delivered to the house (Table 6.1), so that a process of decarbonising requires fuel switching and, therefore, new equipment. At the present time, the task is to use less electricity as this is the most carbon-intensive domestic fuel. As more electricity comes from cleaner sources of power, such as renewables, this will change and there could be a switch back towards electricity, but this is unlikely before 2020 or 2030. Whether this becomes an appropriate policy for households partly depends on the extent to which electricity is required elsewhere in the system, for instance to provide hydrogen for cars.

A further complicating factor is the concern about the UK's growing dependence on imported gas and whether this could pose a threat to security of supply. Gas and coal are the dominant fuels for generating electricity, as well as gas being the main fuel in the home. So increased dependence on gas may not be a sensible policy either. The answers to all fuel supply problems are both to reduce demand as much as possible and to increase the amount that comes from renewable sources.

Another element in the debate about which fuels to use in the home is the effect on the household of having some responsibility for their own supply. Many of those who have invested in photovoltaics on their roof have done so in the knowledge that it is not cost effective due to high initial capital costs and the low value of any electricity generated. They just wanted to do 'their bit' for the environment (Keirstead 2006). And the final piece of this particular jigsaw is the price of domestic fuels. As shown in Table 7.1, gas and electricity prices have risen by at least 50 per cent between 2002-7. The wholesale price of gas is automatically linked to the price of a barrel of oil and this is continuing to rise. The rising price of oil and fuels is certainly focusing the debate for

**Table 6.1**
**Carbon emissions from main domestic fuels, delivered energy**

| Fuel | gC/kWh |
|---|---|
| Grid electricity | 115 |
| Anthracite | 86 |
| Oil | 72 |
| Liquid petroleum gas (LPG) | 64 |
| Mains gas | 52 |
| Renewable energy | 7 |

Source: DCLG 2007c, p8

Note: the figure for grid electricity, in practice, is higher than this because of the amount of coal currently being burnt. The UKDCM2 uses 137gC/kWh, declining to 100kgC/kWh in 2020 and from then onwards

**Table 6.2**
**Low- and zero-carbon technologies**

| | Heating only | Heating and electricity | Electricity only |
|---|---|---|---|
| Low-carbon | Heat pumps (ground and air) | Combined heat and power (CHP) | - |
| Zero-carbon | Solar thermal; biomass boiler or stove | CHP from energy using waste or biomass | Solar PV, micro-wind or micro-hydro |

householders and the uncertainties about gas supplies gives an emphasis to security of supply issues for the Government. Both demonstrate the need for more 'home-grown' solutions: there is a great deal that the Government could do to prepare the market.

## Low- and zero-carbon sources – what to choose?

The approach taken in this report is to consider the opportunities for household and community-level solutions, but also community combined heat and power (CHP). Large-scale sources, such as off and on-shore wind farms, tidal, wave and barrages are all dealt with separately in the carbon intensity of the electricity grid. In this report, the carbon content of electricity from the grid is frozen at a level of 0.1kgC/kWh from 2020 onwards. This is partly because of the uncertainties about the generating fuel mix for electricity from then on and partly because of a desire to establish what can be achieved in the domestic sector on its own. This has the effect of encouraging installations in homes and of showing real carbon savings when electricity is exported from the home to the grid.

There is some potential confusion about the difference between the phrases 'low- and zero-carbon technologies' and 'micro-generation'. There is one major difference – micro-generation does not include community-CHP, which is, in this report, part of the low- and zero-carbon solutions. In addition, it is only really correct to include in micro-generation those technologies that generate electricity, or perhaps heat. This would certainly exclude heat pumps, for instance. So, low- and zero-carbon technologies (LZC) is the preferred phrase in this report when referring to the full collection of technologies, as listed in Table 6.2.

Each of these technologies has different characteristics, which makes them more or less suitable in a specific situation. Low- and zero-carbon technologies can be accommodated into a building in a variety of ways, regardless of whether it is an existing or a new home. The changing sophistication of the technologies, the varying levels of demand (sometimes worldwide) and the resultant costs, all make the choice of technology, the quantity and date of installation highly variable. The following comments are given as general guidance:

**Heat pumps:** ground source heat pumps bury pipes in the soil and exchange heat between the water in the pipes and the soil. This provides heating in winter and can provide cooling in summer. Installing a heat pump in an existing house – and digging up the garden – is both disruptive and requires a garden. In addition, the pipes within the house are most effective if they are laid under the floor or are used with large, wet radiators. Heat pumps are most appropriate, therefore, in new build, though retrofitting can be successful. Heat pumps can only be powered by electricity, but they use the electricity so efficiently (getting three to four times more heat from the ground than the energy content of the electricity) that they are included in LZC.

Air source heat pumps transfer heat with the air, so they are similar to ground-sourced ones, but less efficient, especially in winter when the heat is needed. Some are still needed in the Low-carbon Strategy.

**Combined heat and power – sometimes called co-generation:** the household boiler is redesigned to provide both heat and electricity. At the moment, gas boilers provide heat but no electricity, whereas power stations generate electricity, but waste the heat in a cooling tower. Chp achieves both and increases the energy efficiency of the process, at either scale. The boiler can be sized for an individual home (micro-CHP) or at a community level, or use the waste heat direct from the power station. All types of CHP make use of the traditional water-based central heating radiators in the home, so can be used in an existing home relatively easily. All systems operate predominantly in winter when the household requires the heat for both space and water heating, so this is when most electricity is produced. As technology improves for individual and community boilers, the proportion of output that is in the form of electricity will increase from about 20 to 40 per cent. This will make the systems more useful, all year round.

Community level CHP can be powered with a variety of fuels, including waste derivatives and biomass. It supplies a network of houses with hot water, so the network can be extended as individual properties need less heat through energy efficiency improvements. The electricity is provided to the grid, not individual homes. Community level CHP is most suitable for dense urban areas, where the provision of the network is cost effective, but this is still costly and disruptive to install. The role of CHP is particularly important with flats, as these have insufficient roof or garden space for the solar technologies or heat pumps, lack the storage for individual biomass burners and are often not permitted to have individual gas boilers, for safety reasons.

Micro-CHP (schemes below 5kW electrical capacity) is being developed from existing gas-fired boilers, using a Stirling engine, so could eventually replace the gas boiler in the home relatively easily. The next generation is likely to use fuel cells, initially powered by gas, but eventually by hydrogen, provided that it has come from a low-carbon electricity source (2025+). Because the boiler is in the house, the electricity produced belongs to the householder and will be used in the house. When the electricity from the micro-CHP plant is not needed in the house, it will be exported to the grid. Micro-CHP is more suitable than community CHP, where the density of housing is lower (rural and suburban areas), and where the costs of a heat grid would be high.

**Solar power:** this includes both solar thermal (heating hot water) and photovoltaics (generating electricity). Both systems are placed, externally, on the roof and need to face towards the south to get the maximum benefit of the sunlight. Solar thermal installations are usually about 4m$^2$, whereas photovoltaics can cover the whole roof, so there may be some competition for roofspace. Both can be fitted relatively easily to an existing house, but are cheaper if installed in a new building.

Photovoltaics (pv) should only be used to provide electricity for lights and appliances. It is both too expensive and seasonal to be used for either space or water heating.

Solar thermal requires a large tank to store the hot water. It is most cost effective if there is a large demand for hot water (several people) and reduces the most carbon when it displaces electrically-heated hot water.

**Biomass stove or boiler:** An ordinary wet central heating system can be based around a boiler that burns wood chips or pellets. As supplementary heating, or in super-efficient homes, a single woodstove can be used. With careful plumbing, a woodstove can provide hot water as well as room heating. Both systems require on-site storage of the biomass, and a boiler requires an automatic-feed mechanism, so this is best if part of a community CHP scheme. This technology is most suitable in areas where biomass is readily available, such as for rural or suburban homes. There is growing competition for biomass, for instance with its conversion to biofuels for transport, but it is important that any biomass used in the home is sustainable.

**Wind turbines:** generate electricity from a position on the roof or gable of the house, or on a pole in the garden, if that is sufficiently high. The present technology has to be placed in a really windy (winds frequently above 10m/s) situation to justify its cost.

**Micro-hydro:** rarely appropriate as it requires a stream running quite steeply downhill on the property.

The maintenance requirements of these LZC technologies vary considerably. Heat pumps and CHP need regular maintenance, but many of the others just need regular monitoring, to make sure they are performing effectively (eg photovoltaics, solar thermal).

## Installation rates

There are few LZC installations in the UK: a total of 107,200 in 2005, including 25,000 households with community-scale CHP (table 6.3). Although the figures are for both the domestic and non-domestic sectors, nearly all of them are installed on homes (Eyre, pers comm) – ie a maximum of four out of every 1000 homes have any LZC. The majority (73 per cent) of these are solar water heating systems; very little electricity is generated from existing LZC installations. A few may have had to be installed (for instance because of regulations such as the Merton Rule), but most photovoltaics and micro-wind have been grant aided.

There has been a policy to provide grants to householders wishing to install LZC technologies for several years, most recently called the Low Carbon Buildings Programme (LCBP). The grant per recipient was a reasonable level, but the total money provided was wholly inadequate and resulted in some months (eg February 2007) with the allocation being used up in a few hours. As a result, the LZC industry (producers and installers) as well as householders have been disillusioned by the administrative problems of the LCBP. There are relatively few accredited installers, so this important resource is likely to have been alienated by the scheme. The grant was only available to those who had made their home more energy efficient, eg by installing 270mm of

**Table 6.3**
**Low- and zero-carbon installations, UK 2005 (all sectors)**

| Technology | Number |
|---|---|
| Solar water heating | 78,470 |
| Community combined heat and power* | 25,000 |
| Solar photovoltaics | 1,300 |
| Micro-CHP | 990 |
| Micro-wind | 650 |
| Ground source heat pumps | 545 |
| Biomass boilers (pellets) | 150 |
| Micro-hydro | 90 |
| Fuel cells | 5 |
| Total | 107,200 |

Source: based on EST 2005

*CHP, domestic only,

loft insulation, the present standard in the building regulations. This was a sensible focus to make sure the home was efficient first, before LZC are fitted.

The programme was relaunched in May 2007 with a budget of £18 million for households until 2009 (DTI 2007a, p89) – the majority of the expenditure is for larger developments, including local authority housing and social housing providers seeking to install micro-generation for low-income, hard to reach properties (DTI 2007a). The grant is now capped at £2,500 per household, which means that photovoltaics are not so viable. The Select Committee on Environment, Food and Rural Affairs is concerned that the on-off history of the scheme will result in householders losing interest and that more appropriate policies are needed, for instance targeted grants for people on low incomes and the use of tax incentives (HC88-I, 2007, para 125). The Scottish Executive has committed £18 million until March 2008 for grants to householders and communities for small-scale renewable technologies (DEFRA 2007b, para 85).

The installation of domestic micro-generation attracts a VAT rate of 5 per cent (the lowest possible) as an indication of the Government's support for technologies which generate cost-effective carbon savings (DEFRA 2007b, para 81). However, this does not appear to have made a difference to the amount of LZCs taken up.

The aim of the European Commission is for 20 per cent of European energy (not just electricity) to come from renewables by 2020. The UK is completely failing to achieve its contribution – in 2004 only Malta and Luxembourg produced a lower percentage (CEC 2007a). The UK Minister for Energy stated (Hansard 15 October 2007):

> "DTI projections in May 2007 indicated that by 2020, on the basis of existing policies, renewables would contribute around 5 per cent of the UK's energy consumption."

This is not because of a lack of opportunities – the UK has the best resources in Europe for technologies such as wind and wave power. Under the requirements of the Climate Change and Sustainable Energy Act 2006, the Government has to monitor the development of the market and assess future trends for the potential for LZC and to adjust policy accordingly. The first report is due shortly and, if an honest appraisal, should be damning.

The abysmally slow rate of LZC installations in the UK results from several interlocking causes and the low rate of payment for exported electricity is undoubtedly one of them. The cost of electricity to the householder is about 10p/kWh. If someone produces electricity in the home, from photovoltaics, wind or CHP, and does not use it, the amount they receive varies: the utility might pay 8p/kWh, but it could pay nothing. Some fortunate and well-organised households do receive up to an additional 9p/kWh for all the electricity generated (whether it is used in the house or exported). This is their share of the value of the Renewable Obligation Certificate (ROC), for

photovoltaics, as pioneered by Good Energy. This situation could be transformed into a real opportunity, by the use of a feed-in tariff (FIT).

## Feed-in tariffs

A recognised and influential method of encouraging the installation of electricity from micro-generation is to provide the householder with a guaranteed price for exported kWh that reflects the true cost of installing the equipment. These feed-in tariffs have been used extensively in Germany and Spain and have resulted in supporting a substantial growth in the amount of capacity installed (Mitchell et al 2006). The price given in a feed-in tariff is quite high, for instance 30p/kWh for photovoltaics, less for CHP, to provide the householder with a return on the capital invested. As the cost of the technology drops, so does the level of the feed-in tariff given to new installations. The extra cost of the feed-in tariff is distributed across all domestic consumers, so increasing the price of a unit of electricity sold to the average residential householder. If the majority of the micro-generation is installed by better-off households the increase is paid by all households, including the poor. A feed-in tariff does represent a transfer of funds from the poor to the rich and this has to be compensated for elsewhere in the system, perhaps by a reverse tariff, or by supporting the purchase of renewables with a grant. The size of this impact will depend upon the extent to which households respond to the feed-in tariff.

The development of a feed-in tariff in the UK has been recommended by the Town and Country Planning Association (TCPA and Lock 2007, p15; World Future Council 2007) and by the Environment, Food and Rural Affairs Select Committee (HC88-I, 2007, para 131):

> "The current system of Renewable Obligation Certificates (ROCs) is too unwieldy for micro-generation, and risks losing citizen engagement. We recommend the Government replace ROCs and export payments with a feed-in tariff with a single fixed rate per kWh, varying according to the type of generation."

Ofgem is mildly supportive by quoting a European Commission report that showed "the RO was the most expensive and least efficient method of support" (Ofgem 2007, p3). There are considerable financial and organisational issues that link to the amount of small-scale generation on the system (Mitchell 2007).

The Government might be able to introduce a feed-in tariff under the Climate Change and Sustainable Energy Act 2006, though there is some debate about whether this does confer powers on the Government to modify supplier licences to force them to offer tariffs for exported electricity – these powers came into force in August 2007 (DEFRA 2007b, para 82). The reason the UK does not have a feed-in tariff, at the moment, is partly because of the financial advantages with the present system, for the existing suppliers who "are selling at 10 pence and they are buying at one [pence]" (HC 88-II 2007, Q60). The difference is to cover the cost of getting the electricity from the power station to the home; what is unclear is whether the householder should contribute to these costs, when the electricity is generated in the house. The Government states that: "We have a fully liberalised market where government dictating the price of electricity essentially is not something, you know, not a road that we should go down". As Keirstead (2007) demonstrates, this is only a partial truth, as an opposite view might be taken in relation to nuclear power.

The utilities would prefer to continue with the present, centralised system of generating and distributing power, but they also argue that customer prices should not be increased. Much of the debate about support for LZC technologies is a debate about the type of electricity system that the country wants in the future (Mitchell and Connor, 2004).

The real benefit of a feed-in tariff is the positive signal it gives to householders that their investment in micro-generation technology will be recognised by the utility for the whole life of the equipment. There are also long-term security benefits for the country as the householder is providing some of the electricity capacity that the country needs, without the need for imported fuel. A feed-in tariff has a further benefit. It encourages the householder to have the most efficient electrical equipment in the home, so that the maximum amount of electricity is exported.

The German feed-in tariff for small photovoltaic installations is equivalent to 10 times the wholesale price for electricity (HC 88-II 2007, Ev 374):

> "once a renewable electricity plant is installed, the minimum feeder tariff valid for its first year of commissioning typically applies for a 20-year period. The fixed minimum tariffs are degressive, reducing annually for new installations, to encourage capacity to be brought forward quickly. For solar pv, the annual reduction is 5 per cent."

## Potential

A study of the potential for renewables by the Energy Saving Trust (EST), for the Department of Trade and Industry suggested that micro-generation

**Table 6.4**
**Appropriateness of low- and zero-carbon technologies**

| | New buildings | Existing buildings |
|---|---|---|
| Solar thermal | Yes | Yes |
| Community CHP – fired by waste or biomass | Yes | Yes |
| Micro CHP | No – heat demand too small | Yes – soon, especially suburban areas |
| Photovoltaics | Yes – if a feed-in tariff | Yes – if a feed-in tariff |
| Ground sourced heat pumps | Rarely – heat demand too low | Rarely – too disruptive and need garden |
| Microwind | Rarely – maybe if for whole development | Rarely with present technology, unless rural and exposed |
| Woodstoves | Yes – if space for storing wood | Insufficient for whole house |

could reduce household carbon emissions (from electricity and heat) by approx 15 per cent by 2050, whilst providing 30-40 per cent of all UK electricity from micro-generation in the domestic sector alone. These are percentages of existing demand, without reducing it. In the EST study, the main technologies likely to be adopted are micro-CHP and micro-wind (HC 88-II 2007, Q56). However, the top three LZC recommendations on the new energy performance certificates are solar thermal, photovoltaics and biomass boilers – a rather different selection. To help householders, the EST is setting up a Sustainable Energy Network (SEN) of advice centres (HC 88-II 2007, p13).

The choice of technologies depends on whether it is a new or an existing building, urban, suburban or rural, and whether a heat network has been developed or not (Table 6.4).

In reality, the potential also depends on expected developments in technology and the likely future costs if demand increases. These costs decrease substantially if the LZC have to be installed, because of regulations. This is partly because it reduces the advertising and outreach costs of the LZC industries and gives them the confidence in on-going demand. Regulation reduces their risks and allows them to plan a structured future.

## New buildings

In new buildings, the advent of the zero-carbon homes policy, the Merton Rule, Code for Sustainable Homes and tougher building regulations means that many of these LZC technologies will shortly be installed by developers, anyway. This assumes that the Government's stated aims, for instance of all homes being zero-carbon from 2016, are retained. Nor should there be any dilution of the Merton Rule, as this is an essential stepping stone towards a focus on all energy use meanwhile.

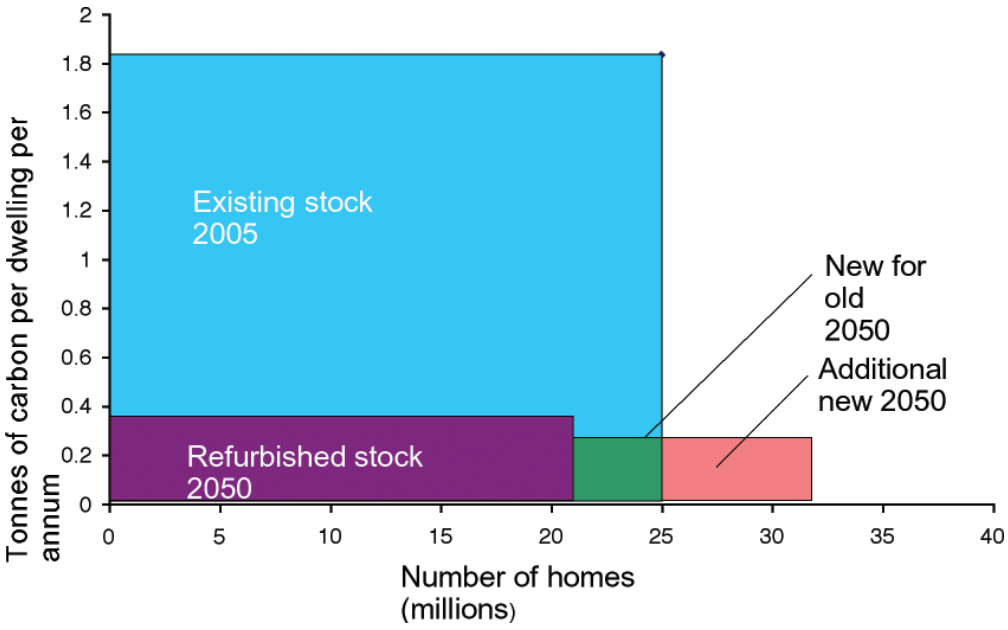
The low level of heating required in these new homes means that most of the focus will be on electricity generation, or hot water. Solar thermal, biomass-fired community CHP and woodstoves look like good choices, and photovoltaics. CHP will be particularly important in the new ecotowns (TCPA and Lock 2007, p15). There are up to
10 million new homes to be built between 2005 and 2050 (chapter 4), many of which will have to be zero-carbon, requiring one or two LZC technologies per house. The exact mix and output is difficult to predict.

The inclusion of LZC into new housing means that they need to be integrated into the design at the earliest stage (Cyril Sweett 2007). The orientation of the building and the size and shape of the roof are particularly important in determining the amount of energy that can be obtained from some of the LZC technologies (Boardman 2007a).

## Existing buildings

The importance of installing high levels of LZC in the existing housing stock cannot be emphasised too strongly. Even when demand has been reduced as much as possible, through energy efficiency improvements to the fabric, heating system, lights and appliances, this is insufficient to deliver the 80 per cent carbon saving. Because of both the numbers and the level of demand, the LZC installed is disproportionately in the existing housing stock. The result of this

**Figure 6.1**
**Carbon dioxide emissions from the housing stock, UK 2005 and 2050**




Source: RCEP 2007

interplay between the level of micro-generation installation, energy efficiency improvements and rate of demolition, is shown in figure 6.1, for a 75 per cent reduction. The large blue block of emissions has been reduced in existing homes to the purple block and to the green block, where the home has been demolished and replaced. The proportions are virtually the same in the Low-carbon Strategy.

In existing buildings there are no Government policies (beyond the £18 million grant) to encourage the installation of LZC. The best hope in the near future comes from the obligations on the utilities to extend the Energy Efficiency Commitment. The Government benefits from utility schemes, as the costs are spread across the utilities' customers, not paid for by the Government, out of taxation.

The Carbon Emission Reduction Target (CERT), that will replace EEC2 in April 2008, is likely to allow the utilities to install micro-generation technologies and the expectation is that over the three years, a total of 121,000 LZC will be installed in existing homes (DEFRA 2007a). The final decision is subject to the results of the consultation process. About 51,000 of these will be provided at nil cost in suitable homes of the priority group (ie low-income) – half the cost comes from the utility and the other half from the housing provider, so all of these are expected to go into local authority or RSL properties. The remaining 70,000 will go into private homes with a 20-30 per cent subsidy from the utility, as the home-owner has to find the rest of the money (DEFRA 2007a, Appendix, p6). The three major technologies will be solar water heaters, biomass boilers and heat pumps, in that order (p33). From 2008-11, the utilities will more than double the existing quantity of LZCs in the housing stock (Table 6.5), if they install 40,000 pa. However, the rate of growth is nowhere near sufficient to achieve a 60 per cent, let alone an 80 per cent carbon emissions reduction by 2050, even over 42 years. To do that, 600,000 LZC installations have to be added each year – a 15-fold increase over the expected rate in the next three years.

The Government has confirmed that some form of obligation to achieve carbon reductions will be imposed on the suppliers until 2020. When CERT

**Table 6.5**
**Low- and zero-carbon installations in existing houses, UK 2005-2050**

| | 2005 | 2011 | 2050 |
|---|---|---|---|
| Total number of LZC installations | 107,200 | 228,200 | 25 million (one in each of 25 million existing homes still lived in by 2050) |

ends in 2011, this is likely to take the form of a Supplier Obligation, which is also waiting on the results of a consultation process. One of the options is that the suppliers will be required to reduce the total carbon emissions that result from the use of fuel by their customers. This would be similar to the AUCH programme (Fawcett et al 2000, p75) whereby the average utility carbon per household has to be reduced each year. There is too much uncertainty about the form and the impact of the Supplier Obligation to estimate the effect on low- and zero-carbon technologies in people's homes.

These potential developments after 2011 would be unfortunate if they resulted in less of a focus on priority households. LZC help to insulate low-income families against future fossil fuel price rises, carbon taxes and to enable them to benefit more extensively from personal carbon allowances, if they are introduced. Low-income households, by definition, have no capital with which to invest in their own LZC and, if they are in rented accommodation, no right or wish to do so. Under CERT, the plans are that the priority group receives 42 per cent of the LZC installations – a reduction on the 50 per cent of investment occurring in their homes under EEC.

## RECOMMENDATIONS FOR THE LOW-CARBON STRATEGY

In the Low-carbon Strategy, after demand has been severely reduced, by 2050 the LZC technologies provide 85 per cent of the remaining heat needed and 100 per cent of the electricity. Every house has at least one of the LZC technologies. This is higher than the recommendations made by the ECI to the Royal Commission on Environmental Pollution (Palmer et al 2006). Demand has been reduced to a minimum, because the policies on lights and appliances, on new buildings and on existing homes already include the maximum, or nearly the maximum, that could be achieved. It is only the policies on LZC that can be made more extensive – the more ambitious the UK's carbon target, the more that has to be delivered by low- and zero-carbon technologies.

### Low-carbon Zones

One solution, proposed here particularly to help the fuel poor is to progressively parcel up the country into Low-carbon Zones, focused initially on areas with a high proportion of the fuel poor. The measures installed would include LZC as well as insulating the fabric of the house. It is always preferable to reduce the use of energy first and then supply the remainder with LZC. Otherwise some of the LZC outputs are expensively wasted in inefficient uses. The proposal for Low-carbon Zones is made partly to ensure that low-income householders do have low carbon homes to live in and to make sure that they do not become the prerogative solely of the non-poor. The other reason is to achieve this policy as cheaply and quickly as possible by reducing the costs per treated home through the economies that come from bulk buying and large projects. The details are given in chapter 9.

In the Low-carbon Strategy, there is a generous grant to convert all existing homes that have electric water heating to solar thermal. This would save around 0.2tC pa per treated house previously using electricity and 0.1tC pa per house that was on gas. For households in rural areas, who have to use the most carbon-intensive fuels, a combined grant for solar water heating and to install a wood stove would be appropriate. There are 4.36 million rural properties in England, with an average energy efficiency of 42 SAP points, whilst 22 per cent of them have a SAP of 30 or less – nearly double the national average level for these inefficient properties, partly because only two-thirds of them have gas central heating (DCLG 2007e, p36, 59). The 1.4 million who do not have gas central heating are assumed to be eligible for such a grant first.

### Green gas

There are several green electricity tariffs, but no green gas tariff, nor a renewable heat obligation. One, if not both, of these is probably needed. There are several problems with the present accreditation scheme for green electricity (Boardman et al 2006) which the Government needs to address, for instance the lack of accreditation and that electricity from renewables is double counted: it appears in both specialist tariffs and in the information given to consumers about the average mixture that they assume they are buying (Boardman and Palmer 2007).

It would be appropriate to develop a green gas tariff (zero-carbon gas), both for CHP and for gas cooking in zero-carbon homes. To qualify, this would be gas that has come from anaerobic digestion (eg farm-based), waste treatment or landfill gas somewhere in the country and put into the gas network. An equivalent amount can then be sold as green gas, to householders, in exactly the same way as green electricity. This limits the need for large quantities of biomass to be used in combined heat and power, which may have unfortunate international environmental effects or just be impractical in many British homes and in city centres.

At the moment the greatest source of potential green gas is gas from landfill sites. In the UK this is predominantly used to generate green electricity, with less than 1 per cent used to generate heat in 2006 (BERR 2007d). Although in other countries this gas is cleaned up and put into the gas network or used to fuel vehicles, in the UK it is used on or near the landfill site to generate electricity. As landfill gas currently provides 24 per cent of UK renewable electricity (BERR 2007d), deciding to use the gas as a heating fuel instead would reduce the amount of renewable electricity available.

While in the short term, more landfill gas electricity generation schemes are expected to come on stream, in the longer term there is likely to be less landfill gas available as waste management policy discourages the disposal of organic waste to landfill. Organic waste seems most likely to be diverted primarily into routes which do not generate methane, eg aerobic composting and incineration, rather than routes which do, eg anaerobic digestion.

Green gas would have the benefit of providing an important route for local authorities disposing of their municipal waste as well as, perhaps, contributing to the development of a CHP network. At present, each local authority has to pay millions of pounds to send waste to landfill – even a relatively small London Borough, such as Merton, creates 85,000 tonnes with disposal costs alone around £50 per tonne, plus the costs of collection, transport, landfill tax, etc, and these costs are rising. By disposing of this waste through an alternative route, which provides green gas, the system would pay for itself, particularly when the sale of heat and power is factored in. Methods that require the householder to separate out the waste, for instance for anaerobic digestion of kitchen waste, get a low rate of buy-in by householders. A centralised system for disposing of the collected household waste, such as pyrolysis or bio-mechanical treatment, is more effective, although rarely used at present.

One of the benefits of a green gas initiative is that it solely requires the rebranding of some existing gas sources – such as from landfill sites – initially. Once the concept is established and encouraged through other legislative proposals, for instance the zero-carbon homes initiative, then local authorities and others could extend the system rapidly.

The recommendation is that the concept and economics of green gas are examined, to establish whether it will deliver carbon savings compared with, for instance electricity generation on-site at landfill sites. It may be that the importance of green gas links to other policies, for instance zero-carbon new homes or a renewable heat obligation in existing homes.

**Renewable heat obligation:** A new initiative being investigated by the German Government would complement the development of green gas and other LZC technologies and that is a renewable heat law. Under this scheme, a certain proportion of the heat in each individual home has to come from renewable sources, defined as solar thermal, biomass, CHP, heat pump, anaerobic digestion or landfill gas. The use of green gas would comply as well. The combination of green gas and a renewable heat obligation would enable CHP (both community and micro systems) to play a major role in the mix of household heating systems in future. This raises the question as to whether the renewable heat obligation is placed on the household, the utility (like the renewables obligation) or the local authority (through carbon reduction targets – chapter 9), or even some combination. As an interim suggestion the obligation is put on householders, pending further debate on the advantages and disadvantages of the different routes.

In the Low-carbon Strategy a renewable heat obligation is brought in, for existing homes, through the next round of the building regulations in 2010. From the onwards, every householder obtaining a new boiler will have to ensure that at least 10 per cent of the households heat for space and water comes from a renewable source. The proportion will be increased in each successive upgrade of the building regulations, linked to the development of micro-CHP. This will result in a substantial increase in solar thermal installations – which would provide the required amount of heat, on their own – woodstoves and to energy efficiency improvements that lower the total demand.

## Community combined heat and power

Government support for community CHP seems to be diminishing rather than growing: the EST managed the Community Heating programme for the Government, but this was closed in March 2007 and no new scheme has been proposed. As explained above, CHP provides an easy transition with existing wet central heating systems, whilst being more energy efficient and providing electricity when it is really needed (eg on a winter's evening). What is required now is to initiate local CHP schemes, from which extensions can grow into other appropriate areas, such as Victorian terraced houses. The first part of the heat network may be at a hospital, around the local authority waste disposal scheme, or one of the new zero-carbon developments. The latter is particularly likely if it contains a lot of flats, as is the trend, as a

CHP scheme fired by green gas or directly by biomass would be the most obvious way to make a block of flats zero-carbon. If even a third of the 10 million new homes that could be built by 2050 are flats, this represents a small heating demand for each of 3.5 million new homes – a substantial load.

Another spur to action would come from requiring any new power station to provide waste heat for the nearby community. For power stations greater than 50MW, this could be achieved through the Government's Power Station Consents policy, under S36 of the Electricity Act 1989 – all new power stations have to have the Government's consent before development. The Danes provide a good example, as the Danish Heat Law requires all power generation over 1MW to be in the form of CHP (TCPA and Lock 2007, p15). Even the most efficient gas-fired power station, using a combined cycle gas turbine, is only producing electricity at about 50-52 per cent efficiency, whereas with CHP this can be increased to 85-90 per cent.

**Micro-CHP:** the take-up of gas condensing boilers has only accelerated since regulations required them for all new installations and replacements. Micro-CHP is not yet commercially viable, but a Government announcement that this will be the next mandatory minimum standard for domestic installations in, say, 2013, would help to confirm the market for boiler manufacturers. Initially, the standard would apply to Stirling engines, then proceed to gas-fired fuel cells and finally to low-carbon hydrogen fuel cells.

By 2050, in the Low-carbon Strategy, 50 per cent of all homes have one form of zero-carbon CHP or another all fired by green gas, biomass or hydrogen:

- 20 per cent have community CHP,
- 5 per cent have still got a Stirling engine, micro-CHP,
- 25 per cent have micro-CHP with fuel cells.

The remainder have woodstoves (and virtually no heating need), heat pumps, gas boilers or nothing.

**Feed-in tariff:** In the Low-carbon Strategy a generous feed-in tariff is developed, promptly, to encourage the take-up of LZC by the domestic sector. The costs of the feed-in tariff are internal to the utilities and their customers, with no call on the Treasury. The feed-in tariff is only paid on exported electricity, so does not offset the higher cost of the electricity used in the home.

**Grants to install low- and zero-carbon technologies:** the rate of installation of LZCs in UK homes has fallen to a mere trickle (Hansard 23 July 2007, col 904-7), as a result of the fiasco over the Low Carbon Buildings Programme being overspent, then cut, re-introduced at a low level and due to end in June 2008. The Government – and the Department of Business, Environment and Regulatory Reform in particular – has to recognise that support for householder action on LZCs is critical if the UK is to meet its carbon reduction targets.

The annual rate of installations in the existing housing stock needs to rise to 600,000 pa and to achieve this the full panoply of policies will be needed. In the Low-carbon Strategy there are feed-in tariffs, the renewable heat obligation for householders and carbon reduction targets for local authorities (chapter 9). In order for the market transformation approach to work effectively, there are also grants, at least in the first 10 years, until each technology has reached 20 per cent of its potential market share.

The relationship between the different policies depends upon the relative objectives. A feed-in tariff spreads the cost across all of the utility's customers and requires the household to have sufficient capital to invest. A grant is more equitable, as it reduces the quantity of capital to be found. However, a loan may be the most beneficial, if the policy is to benefit low-income households, but may transfer the cost from the utility to the Treasury. There are several permutations of these policies. In the Dutch system, there is a substantial grant, followed by a feed-in tariff, so the householder has an overall profit, for the lifetime of the equipment. The extent to which householders should be rewarded for providing part of the electricity supply, as the utilities would be, is another difficult component of the debate.

For the Low-carbon Strategy, the Low Carbon Buildings Programme is revised – and renamed – and provides an average grant of £2,000 for up to 600,000 households each year to install low- and zero-carbon technologies. The exact number depends on the interaction with other policies, such as the Low-carbon Zones. The new programme will start to build up from January 2008. The framework is there, and many of the accredited installers are, or were, there. There has been considerable over-application in the past, so there are many disappointed householders. BERR has experience of the scheme, so knows what has caused problems in the past and can quickly redesign a more fluent system. This would be an extremely popular step and would confirm the Government's serious commitment to carbon mitigation.

An early focus should be to provide solar hot water panels and biomass heating to low-income homes in rural areas. This should replace the present policy of providing oil-fired central heating to homes beyond the gas grid through Warm Front and CERT, as a means

of reducing fuel poverty. In all households, replacing all oil-fired boilers with biomass alternatives could save 2.5MtCpa (HC 88-II 2007, p477) – one of the benefits of using renewable heat. Heat pumps are also an early candidate. Later, the grants would be mainly for the newer technologies, such as micro-combined heat and power, or for connection to the developing local authority heat networks. From 2030 onwards, the emphasis shifts to solar photovoltaics and fuel-celled CHP to reflect their increasing cost-effectiveness.

**Innovation:** The development of technologies, such as photovoltaics and fuel cells, needs to be focused on speed to market, low cost, integration with household systems (eg new heat storage technologies), interaction with the external energy system (physically and in regulation) and reliability. Whilst improvements are occurring, there is considerable uncertainty about the likely delivery dates, so that planning is difficult. The change that is required is to have a strategy that delivers, ensures that the householder benefits and has a firm timetable.

The recommendation to Government is that clear, firm routemaps are drawn up and costed for these emerging technologies, and then supported. The routemap includes both the technologies and the policies. Some of these are being developed, at least in relation to the technology, by the UK Energy Research Centre.

## Future supply mix and grid

As the electricity supply mix varies over time, the appropriate technologies in the home (for both heat and electricity) and the tariffs through which the electricity is purchased, also vary. For instance:

- Combined heat and power (centralised and home-based) are appropriate in the short term (eg until 2030) because the price of selling peak electricity will be high. Micro-CHP disproportionately contributes electricity when the maximum load is on the system, in early evening on a winter's day.
- As more wind-generated electricity comes on stream (with a winter peak supply), CHP becomes less appropriate for households and heating with heat pumps fits better with the system. More photovoltaics will also be needed, as there is less wind in summer. This will be particularly true if there is a growth in electricity use for air conditioning (even in non-domestic buildings).

The system will have to integrate demand and supply in a far more positive sense as the proportion of renewables increases (Mitchell 2007). At the moment, the household and other users are treated as passive participants. In future, the type of demand may determine the type of supply, as well as vice versa. Part of this balancing will be achieved through the use of appropriate tariffs to encourage users to shift their consumption patterns and alter the technologies they purchase. This is already part of the debate about smart meters.

**Further issues:** There are numerous other issues, such as planning permission and installer skills, which have not been addressed. The latter are particularly important if the policies are to deliver high quality installations, quickly. Proper accreditation standards, to protect householders, and the immediate introduction of training programmes, are both essential. Planning for the introduction of low- and zero-carbon technologies into existing homes is the responsibility of local authorities, but has to be strongly supported in the Government's planning policy statements.

## Summary

An 80 per cent carbon reduction by 2050 requires every home to have at least one of the low- and zero-carbon technologies, but at the moment only about 4 homes in 1000 do. This is an area where a seismic shift in policy is needed. The level of take-up will be enhanced by policies for new housing and by investments by the utilities in people's homes. This will still leave a need for 25 million installations in the existing housing stock in 42 years. This is a huge challenge and none of the Government's proposals come anywhere near to achieving this. On the plus side, it is comforting to remember that 42 years is nearly three boiler replacement cycles, so that major changes are feasible and foreseeable.

Seven major technology choices provide either electricity or heat or both. These are already known about, but could be brought to market more quickly if there is expenditure on innovation, particularly photovoltaics and fuel cells. As half the cost of introducing these into an existing house comes from on-site labour, there is a need for innovative delivery methods, as well as improved technology.

An extensive, market transformation approach is adopted in the Low-carbon Strategy, so that 600,000 LZC installations occur each year, 15 times faster than even the enhanced rate proposed under CERT. The policies include a renewable heat obligation, feed-in tariffs and a much-enlarged grant programme. The latter two interact: a £2,000 grant to encourage take-up would be supplemented by the appropriate level of feed-in tariff, so that the householder has a profit over the lifetime of the equipment. People should be rewarded for helping reduce the country's carbon emissions.

There are several priorities, for instance:

- It is particularly important is to make sure that LZC ownership is inclusive – low-income households must not be left in poorly insulated, high-carbon emitting properties. The policy of installing oil-fired central heating in rural, low-income homes should cease immediately.
- Solar hot water heaters are the most cost-effective LZC and should be installed, now, in rural areas where there is no gas supply, to replace the existing carbon-intensive heating systems. No home should be using electricity to heat hot water, when at least 50 per cent can be provided, across the year, from sunlight. These would help to reduce the carbon footprint of about 1.4 million rural homes, in England alone.

A renewable heat obligation, requiring each household to use a proportion of all its heat from LZC sources, could provide the unifying thread between solar water heaters, CHP, heat pumps and green gas. It would be instigated whenever the existing boiler is replaced and would mean that all homes have at least some proportion from these sources in 15 years time (the average life of a gas boiler).

The low-interest Government loans, described in chapter 5, could require not only a high standard of energy efficiency improvements, but also the installation of LZCs to provide a certain proportion of the household's actual energy use. If the requirement is defined as 50 per cent of energy has to come from low- and zero-carbon technologies, this ensures that a high level of energy efficiency is combined with low carbon supply, in an existing house, just as the Merton Rule does for new homes. The administrative costs are also reduced if one policy tackles both aspects of low carbon homes.

What is certain is that the required carbon reductions by 2050 are dependent upon the large-scale development of LZC, including extensive community CHP. Every time one option fails to materialise, other, perhaps more expensive ones, have to be used.

## CHAPTER 7:

# FUEL POVERTY

Fuel poverty occurs when a household is unable to afford adequate warmth and other energy services for 10 per cent of its income (Boardman 1991, p227). It affects about 15 per cent of households in the UK in 2007. There is a strong focus on fuel poverty in this report, to ensure that climate change policy recognises the needs of today's low-income households living in Britain, as well as those of future generations and of the disadvantaged living in the developing world. This reflects a long tradition (Boardman 1990). The existence of extensive fuel poverty has a strong influence on the policy choices open to Government. For instance, carbon taxation in the domestic sector would be difficult for a Labour Government to introduce until fuel poverty is eradicated.

The primary cause of fuel poverty is the inefficiency of homes and heating systems: the fuel poor have to buy expensive warmth, despite the fact that they are on low incomes. Fuel poverty is the primary example of the greater importance of capital investment over short-term income and pricing effects.

## Progress on fuel poverty

The Government has a legal obligation under the Warm Homes and Energy Conservation Act 2000 (section 2) in England and Wales to ensure that "as far as is reasonably practicable, persons do not live in fuel poverty" by 2016 in England and 2018 in Wales. This is widely interpreted as 'eradicating' fuel poverty. There is similar legislation in Scotland and Northern Ireland, both with 2016 as the end date.

As a result of the Act, the Government published a Fuel Poverty Strategy (DTI 2001) for the period up to 2016. The Strategy differentiated between vulnerable households (those containing children, older people, disabled and long-term sick), who should be dealt with first, and the remaining fuel poor. The vulnerable should be permanently removed from fuel poverty, by 2010.

The Government demonstrated its real concern by putting access to 'affordable warmth' as one of the four main objectives of the Energy White Paper 2003 (DTI 2003). However, there has been less emphasis on fuel poverty in either the Energy Review (DTI 2006) or the Energy White Paper 2007 (DTI 2007a). This is surprising as, in two different stints, the Minister for Energy has been Malcolm Wicks, a long-time researcher and campaigner on fuel poverty (eg Wicks 1978).

The focus in the Energy Review was vague, without specific actions and only referred to (DTI 2006, para 2.104):

- getting details of the help that is available to those who need it most
- exploring further ways to reduce a household's energy bills via energy efficiency measures
- the energy a household consumes is competitively priced
- households who are eligible for benefits are claiming them.

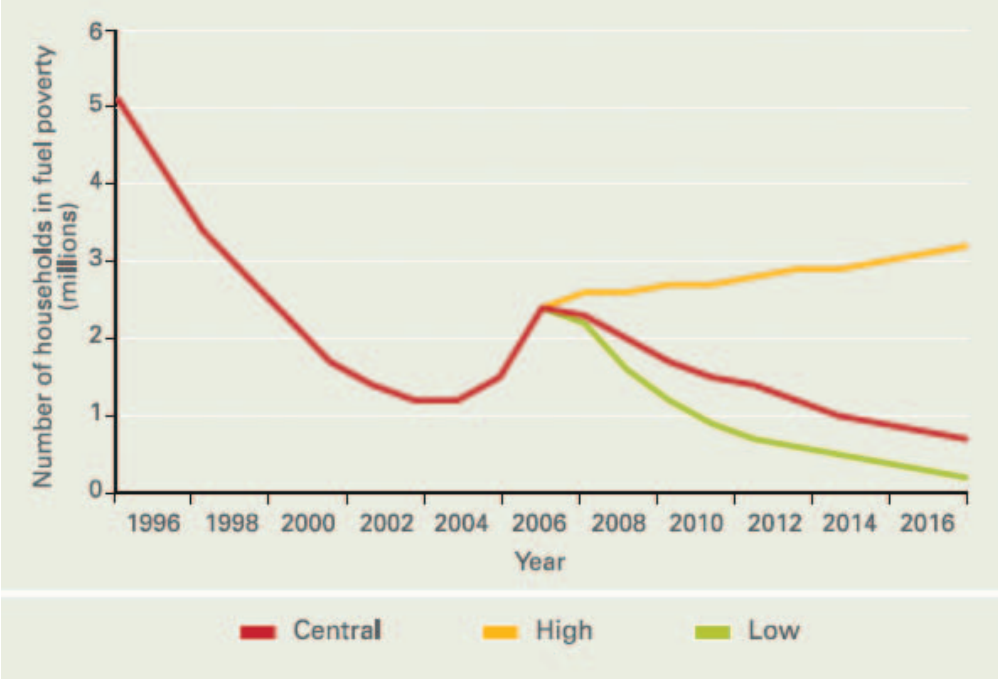
According to the Fuel Poverty Advisory Group, "The Energy Review was extremely disappointing with very little on fuel poverty" (FPAG 2007, p2). Indeed, it even had an incorrect definition of fuel poverty, implying the 10 per cent refers to heating only – a common Government mistake (para 2.95). If this were true, it would be for a maximum of 6 per cent of income.

The Review did identify that the numbers of vulnerable households, alone, could rise to 2 million in England in 2006 equivalent to around 2.35 million vulnerable households in the UK. There are three years, to bring them out of fuel poverty, at a rate of at least 750,000 a year. Despite this, there was no mention of further Government expenditure on energy efficiency improvements; incomes and fuel prices were seen as more important (para 2.116).

In the 2007 Energy White Paper: "Our goal remains to ensure that every home is adequately and affordably heated" (DTI 2007a, p23). No new measures were announced. The latest publication, the UK Energy Efficiency Action Plan (DEFRA 2007b) had only four paragraphs on fuel poverty out of 100 pages.

In between, the amounts of money being spent on the fuel poor have been rising, as discussed below, but the Government is not demonstrating a conviction that fuel

**Figure 7.1**
**Households in fuel poverty, England 1996-2016**




Source: DTI 2007a, p77

poverty can be eradicated, nor even that this is still a primary objective of energy policy.

## Effect of prices

The 10 per cent definition has stayed fixed, despite very substantial variations in fuel prices. It was originally based on fuel prices in 1988, when the average household paid 5 per cent of income on fuel and 8 million households were deemed to be in fuel poverty. At times of low prices, when fuel was typically 2-3 per cent of average weekly expenditure, then a payment of over 10 per cent represented extremely harsh conditions. Even in 2006 it was only 4 per cent, so that the Government continues to exert downward pressure on the numbers of sufferers, by taking a fixed definition, despite changing circumstances.

The numbers in fuel poverty quickly reflect fuel prices, because a price change affects all users, immediately. Before 2002, the real price of fuel had been dropping, which led to a decrease in the numbers of fuel poor households (Figure 7.1).

Since 2002, residential gas prices have increased by 65 per cent and electricity by 44 per cent (Table 7.1) and this explains the increase shown in Figure 7.1. The price of heating oil has risen more (DTI 2006a, p18). The Government's future projections are based

**Table 7.1:**
**Index of residential gas and electricity prices, UK 2002-6**

| Year | Gas | | | Electricity | | |
|---|---|---|---|---|---|---|
| | Price Indices | Annual Increase | Total effect | Price Indices | Annual Increase | Total effect |
| 2002 | 100 | 0% | 100% | 100 | 0% | 100% |
| 2003 | 101.8 | 1.8% | | 100.9 | 0.95% | |
| 2004 | 109.3 | 6.8% | | 107.0 | 6.02% | |
| 2005 | 125.4 | 12.8% | | 118.4 | 10.60% | |
| 2006 | 165.4 | 24.2% | 165% | 144.1 | 21.70% | 144% |

on the cost of a barrel of oil being low ($20), medium ($50) or high ($80) (DTI 2007a, Table B1). As the price of a barrel of oil in October 2007 is approaching $100, it looks like even the Government is expecting the numbers of fuel poor to rise continuously to 2016, instead of eradicating the problem.

There was an expectation of some slight price reductions in 2007, however the prices in Q1 2007 were higher than in Q4 2006, so an optimistic estimate is that the average price rise since 2002 is brought down to about 50 per cent. The long-term expected trend is for domestic gas and electricity prices to rise, particularly as the price of oil directly affects the price of gas, and the price of gas indirectly affects the price of electricity, as it is one of the major generating fuels. Every 1 per cent price increase in household fuel prices puts about 30,000 households into fuel poverty in England, so since 2002, about 1.5 million more households are in fuel poverty in England, as shown by the Government's figures in Figure 7.1. In Scotland, increases in domestic fuel bills since 2003 have resulted in fuel poverty doubling to a current level of 600,000 households. In total, this probably means that at least 3.5 million and perhaps 4 million households will be in fuel poverty in the UK by the end of 2007. Some estimates take it as high as 3.7 million households in England in the first quarter of 2007, equivalent to 4.3 million in the UK (EEPfH 2007b, p14), but the figure of 4 million has been used in this report. With vulnerable households representing about 80 per cent of the total (DWP 2007), this would be equivalent to 2.8-3.2 million in the UK by the end of 2007.

With fuel prices still having such a strong effect, the numbers in fuel poverty are subject to rapid changes. When the cause is international energy costs, then the problem is out of the Government's control.

During the period of these very substantial price rises, domestic consumption of gas fell by only 3.2 per cent and for electricity it went up by 1.7 per cent. As fuel poverty doubled, these average consumption figures probably result from a substantial reduction in use in low-income homes, offset by a considerable rise by better-off households. The effect of a fuel price rise is inevitably an average of greater deprivation for those on tight budgets and nil or limited response from other households.

The legal obligation to eradicate fuel poverty by 2016 was always a challenge for Government and is made more difficult with the recent price rises. The recent Energy White Paper proposals will take an additional 200,000 households out of fuel poverty by 2010 (DTI 2007a, para 2.1.28). A small dent in the 4 million households now thought to be in fuel poverty and only sufficient to offset a 7 per cent rise in fuel prices. The worse the problem gets, the less the Government seems to do.

## Benefits and energy efficiency

The other major reason that households have been taken out of fuel poverty has been increased benefits take-up and, therefore higher incomes (FPAG 2007). Between 1996-2003, the reduction in the numbers of households in fuel poverty was attributed to (DWP 2007):

- 61 per cent from extra income
- 22 per cent to lower fuel prices
- 17 per cent to energy efficiency measures.

Improved energy efficiency has had a minimal effect and yet it is the reduced need for energy that is the most permanent solution to the problem, as confirmed by the Government (DTI 2006a, para 5.10):

> "The most sustainable way to eradicate fuel poverty is to 'fuel poverty proof' the housing stock, which means that a dwelling will be sufficiently energy efficient that regardless of who occupies the property, there is a low probability that they would be in fuel poverty."

There has been substantial investment in the energy efficiency of the homes of the fuel poor, although the results are disappointing (Boardman 2005):

> "Despite expenditure of around £765 million, the first phase of Warm Front (June 2000-May 2005) will have lifted about 150,000 vulnerable households out of fuel poverty. …An abysmally low number."

In 2007/8, at least £640 million will be spent on trying to reduce fuel poverty in England alone (Table 7.2). As indicated, about a third of this comes from the utilities through the Energy Efficiency Commitment (EEC). Under EEC1 and 2 (which ends April 2008), half of all measures had to be installed in the homes of the priority group (similar to vulnerable households). Some utilities have stated that in future, EEC should not include targets for measures to be undertaken in the homes of the vulnerable (HC88-II 2007, p464, para 11). Carbon Emission Reduction Target (CERT), the name for EEC 3, will require the utilities to double the amount of carbon their measures save and only 40 per cent will have to be delivered in the homes of the priority group. The justification for the focus on poorer households is both that they are the ones without capital and that they have contributed, through their electricity and gas bills, to the cost of EEC. This

**Table 7.2**
**Expenditure on fuel poverty eradication, England 2007/8**

| | Expenditure (£m) | Percentage |
|---|---|---|
| Warm Front – central Government | 350 | 54 |
| EEC – utilities | 190 | 30 |
| Decent Homes – central and local Government | 100 | 16 |
| Total | 640 | |

Source: FPAG 2007, p11

contribution is disproportionately high for low-income families, as a percentage of weekly income, so they should receive a higher share of the expenditure.

Warm Front is the most recent scheme to provide grants for specific measures, up to a defined maximum amount of money per household. There are similar approaches in all the devolved administrations. The coverage was originally just for draught-proofing and loft insulation, but has been extended over the years. The most recent addition has been the installation of oil-fired central heating where there is no gas, which is both expensive and carbon intensive. This policy should cease immediately and be replaced with biomass-fired systems and woodstoves (chapter 6).

Over 50 per cent of Warm Front grants lifted a treated home up by less than 10 Standard Assessment Procedure (SAP) points, and for 20 per cent of homes there was a SAP improvement of 1 SAP point or nil (NAO 2003, para 3.13). The latter households only received draught-proofing or a couple of low energy light bulbs. The Scottish scheme of installing central heating is more effective and results in an increase in several SAP points. However, for most fuel poor households, even having the measures installed under these programmes is insufficient to lift them out of fuel poverty. Hence the assessment that only 17 per cent of the benefit to the fuel poor from national schemes comes from energy efficiency measures.

In recognition of the problems of identifying the fuel poor and that there are often concentrated pockets of deprivation, a policy of Warm Zones was introduced in 2000 as an area-based approach. These have been more successful, partly because they are tackling every property in a given area. This permits – and requires – a careful, detailed approach, both to energy efficiency improvement measures and to supportive measures, like benefit checks (that is, is the household obtaining all the benefits to which they are entitled). There are now 14 Warm Zones. Kirklees is the biggest with over 175,000 homes (NEA 2007). Funding is supported by the local authority, but usually comes mainly from the utilities, partly as new money, partly through channelling their energy efficiency commitment funds into the area. Well over a quarter of households in a Warm Zone can be in fuel poverty: it is estimated to be about 27 per cent in Newcastle Warm Zone, highest in local authority and private rented properties (Connor pers comm). All households are offered a fully-integrated service, with free or heavily subsidised insulation and heating measures, benefits assistance and energy efficiency advice. It is only the total package that succeeds in lifting households out of fuel poverty, because of the depths of deprivation – the energy efficiency measures alone are rarely sufficient.

The implications are two-fold: the present scale of capital investment at £640 million is inadequate and far too slow. Secondly, to bring about the rapid reduction in fuel poverty now required implies a campaign on benefits take-up, so people have more money with which to keep warm in their leaky homes, quickly. This in turn implies more energy consumption and carbon dioxide emissions in the short-term and therefore bigger adjustments by the non-fuel poor. An equitable approach to climate change poses its own problems.

The Fuel Poverty Advisory Group, in its Fifth Annual Report (FPAG 2007), concluded that for England:

> "In broad terms, programmes of £1 billion pa are required to 2016. …to be supplemented by other measures, especially benefit take-up and special price discounts for some low income customers."

It is important to remember, that this money has to be spent anyway, independently of any actions under the Climate Change Bill, because of the existing legal obligation to eradicate fuel poverty. And the Government knows that the FPAG report has identified this need and already put in a claim for this amount of money. It is not a new claim. The real benefit of expenditure on energy efficiency improvements for the fuel poor is that it both reduces a social evil and contributes to an environmental benefit, permanently.

**Table 7.3**
**Tenure of households spending 10 per cent or more on fuel, England 2004/5**

| | Number of households (thousands) | Proportion (%) |
|---|---|---|
| Own outright | 429 | 38 |
| Buying with mortgage | 155 | 14 |
| Social rented – council | 219 | 20 |
| Social rented – housing association | 138 | 12 |
| Privately rented | 175 | 16 |
| Total | 1,116 | 100 |

Source: DCLG 2007h, p125

The fact that low-income homes are cold is the primary concern, but for a carbon reduction policy it causes problems: these households are going to take more of the benefit of an energy efficiency improvement as warmth, than a family that is already warm. The real benefits accrue once the home is super-efficient and provides affordable warmth.

## Who are the fuel poor?

The numbers in fuel poverty have varied so much in the last few years, that getting a clear description of who the fuel poor are, that is consistent across the years and surveys, is difficult. In addition, the picture in England does not necessarily describe those in fuel poverty in the Devolved Administrations. Again, their numbers vary, but at times, the proportion of households in fuel poverty in Scotland has been twice that of England. The situation is bad in Northern Ireland as they have traditionally had some of the lowest incomes and highest fuel prices.

Before the effect of recent price rises, the tenure distribution was as shown in Table 7.3. Having to pay more than 10 per cent of your income on fuel clearly identifies that you are both in an energy inefficient home and on a low income. For someone on a good income living in an appallingly inefficient home, the necessary expenditure would be less than 10 per cent of expenditure and, anyway, they are likely to spend capital on improving the home to make it more comfortable. These households are in fuel poverty. The high proportion of households that own their properties outright is important – these are often single pensioners, who are capital rich and income poor.

Some of the other characteristics of the fuel poor in England, 2004/5 (DTI 2006a, Annex 4A):

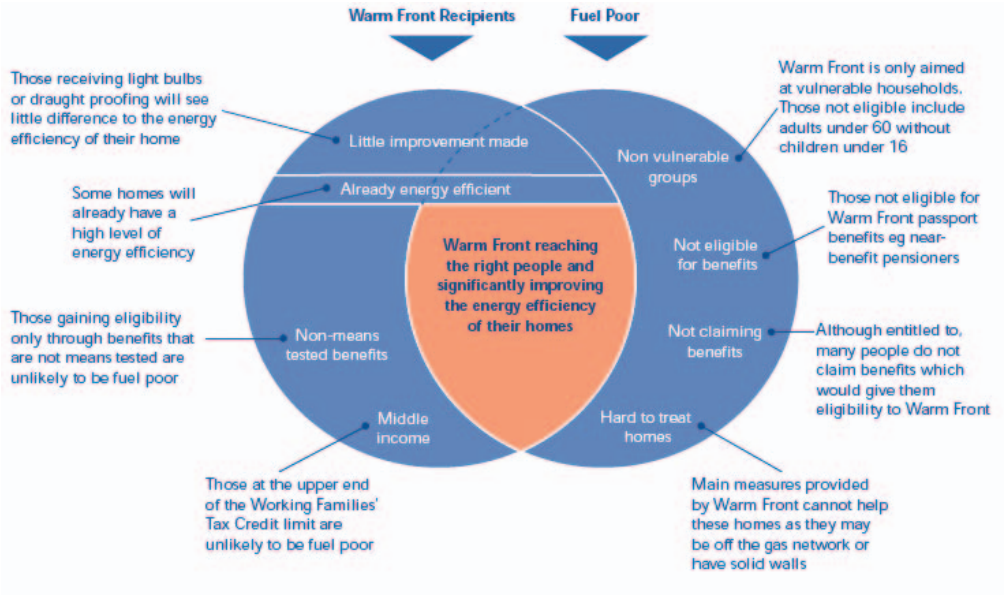
- Around half contain at least one person aged over 60.
- 74 per cent contain just one adult (ie only one source of income).
- 48 per cent were under-occupying their home (this proportion is increasing).
- 74 per cent are relatively small in area, being in council tax bands A-C.
- 43 per cent contain someone with a long-term disability or illness.
- 12 per cent (145,000) contain one or more children.
- On average the household had an income of about £6,000 pa, mainly derived from pensions and benefits.
- The average property had a low SAP, usually below 30 points, in comparison with the national average of 48 points.

The 20 per cent of households with the lowest incomes spend about £500 a year on fuel. If they were to be adequately warm in their unimproved homes, it would be at least twice this amount. This illustrates the policy problem: the low levels of existing incomes and the poor levels of energy efficiency of their homes means that lifting these households out of fuel poverty through higher incomes would be extremely expensive. Additionally, an income approach requires recurring annual expenditure. Although capital expenditure can appear to be large, it is at least one-off.

## Targeting

As will be clear from the above, defining the fuel poor is difficult. Identifying them, particularly on the doorstep, is even more difficult. As a result, many

**Figure 7.2**
**The factors affecting the effectiveness of Warm Front**




Source: NAO 2003, p4

of the general intervention programmes are poorly targeted. Around 45 per cent of fuel poor households are not in receipt of the benefits that are used as a 'passport' to grants (Connor pers comm). Conversely, a similar proportion of households in receipt of these benefits are not in fuel poverty, because their properties are sufficiently energy efficient. The problems were encapsulated in 2003, by the National Audit Office (Figure 7.2) in relation to the delivery of Warm Front grants. For many of the recipients (the left hand circle), the grant made little difference, or they were not in fuel poverty to start with. Whereas many of the fuel poor (the right hand circle) were not eligible or the interventions they needed were not available through Warm Front. Whilst some of the details have changed, the general message is still correct: identifying the fuel poor is a complex process and their needs are variable.

As shown earlier, under the Housing, Health and Safety Rating System (HHSRS), a SAP 30 or below identifies that a home would fail the Category 1 hazard of excess cold. It should therefore trigger action by the local authority. Declaring a house as failing, under the HHSRS, can be an effective intervention, with limited costs to the local authority. The London Borough of Newham, which issues more compulsory purchase orders than all the other London boroughs, found that (NRFC newsletter 2007, p14-15):

> "There are properties in Newham that have lain empty for some time and are blighting the local neighbourhoods. But in 90 per cent of cases, owners will get them back into use without [us] taking the property from them (Ian Dick, Housing and Public Health Manager)."

Once identified, it is difficult to be certain about the level of improvement that should occur in the energy efficiency of the home. For Decent Homes, the figure of SAP 65 was assumed to be sufficient to ensure a household would not be suffering from fuel poverty, but that was before the recent, substantial price increases. And SAP 65 was only accurate if the fuel poor were in receipt of all the benefits to which they were entitled and therefore had the anticipated level of income. For households failing to obtain this level of benefits and, therefore, with lower incomes, the SAP level would also have to be higher than SAP 65.

There are two main problems with the present system: identifying the fuel poor and the level of expenditure required to bring a household out of fuel poverty. Fuel poverty results from a combination of low income and energy inefficiency that requires considerable detail to identify accurately.

## Resumé of evidence

Evidence from this and other chapters of special relevance to fuel poverty include:

- Fuel poverty is again rising, in line with the increases in the costs of domestic fuels. As many as 4 million households could be in fuel poverty in the UK, in 2007.
- A total of 3 million existing homes are below SAP 30, indicating they would fail the Housing, Heating

and Safety Rating System, Category 1 hazard for excess cold. This standard should trigger mandatory action by the local authority. The overlap between low SAP and fuel poverty is not absolute, but there is a strong correlation.

- A large group of fuel poor are outright owners, typically single pensioners, who are capital rich, but income poor.
- Targeting interventions on the fuel poor continues to be difficult, so some of the £640 million annual expenditure is on the wrong homes.
- The Government has a legal obligation to ensure that people are not living in fuel poverty by 2016. The requirement to eliminate fuel poverty amongst vulnerable people by 2010 is probably impossible to achieve now.
- The Fuel Poverty Advisory Group has identified that expenditure should rise to at least £1 billion pa until 2016, by when all fuel poverty should have been eradicated.
- Some of this additional expenditure will come from the utilities, between April 2008 and March 2011, under the Carbon Emission Reduction Target (CERT). However, the proportion of this (greater) expenditure that is to go on the priority group has been reduced from 50 to 40 per cent. In addition to energy efficiency measures, the utilities are expected to install 51,000 low- and zero-carbon (LZC) technologies in the homes of priority groups in social housing. It is not known how these will be prioritised, or even how easy it will be to achieve this target as half the cost has to come from the housing provider.

Some of the beneficial solutions being proposed by the Government include:

- The construction of new social housing is doubling immediately to 40,000 pa and by 2012 will be 50,000 pa. Much of this is designed to cope with the backlog of households on waiting lists, as well as new household formation. It will have a minimal effect on enabling people to move out of their existing, poor quality homes;
- New construction funded through the Housing Corporation will be at Level 3 on the Code for Sustainable Homes from 2008 – a higher level of energy efficiency than the current building regulations and two years ahead of the 2010 building regulations.
- By 2010, there will be 70,000 new affordable homes a year. If these are largely for sale, they may help first-time buyers, who are not generally the fuel poor.
- For 2007-8 only, the Government made £7.5 million available through the Community Energy Efficiency Fund (CEEF), to bring together EEC and Warm Front, as mini-Warm Zones. The programme supports local area-based approaches that have clearly defined targets. The only problem is that they have to be delivered in one year (DTI 2007a, para 2.2.11). This is a good idea, implemented in a cavalier fashion that fails to understand the practicalities for local authorities and practitioners work. No-one wants to build up a good team, just for one year.

## RECOMMENDATIONS FOR THE LOW-CARBON STRATEGY

Parts of the Low-carbon Strategy developed in earlier chapters are important components in the fight against fuel poverty:

- No G-rated property can be resold after 2010, no F-rated property after 2013 and no E-rated property after 2016. All of the G and most of the F-rated properties pose a serious health threat and would fail the Housing, Health and Safety Rating System, as a Category 1 hazard for excess cold.
- Private landlords cannot relet low-rated properties either.
- All landlords have to obtain an Energy Performance Certificate for their properties by 2010.
- There should be a second Decent Homes standard to bring properties to a SAP 80 minimum, to reflect the impact of higher fuel prices (chapter 5).
- Small flats should be built in urban centres to provide a supportive administrative environment for older people and offer an attractive alternative to the family home.

An urgent task is to be able to identify the fuel poor, so that they can receive the help to which they are entitled. This means developing an address-specific database of the energy efficiency of every home in the UK (chapter 5). As identified, many households stay in their homes for 20-40 years or more and some of these may be slipping into fuel poverty, as real incomes decline and if the property cannot be properly maintained. Both identifying and helping households such as these presents a delicate policy problem. The existing Home Improvement Agencies (HIA) help people ‘stay put’ through ‘care and repair’ schemes (Foundations 2007). Normally, these are focused on necessary adaptations and accessing grants, rather than energy efficiency improvements. There are 250 HIA and these are accessible by 90 per cent of the UK population.

**Home Improvement Agencies:** It is recommended that this excellent service is extended and given a

mandate, to include helping the householder obtain an energy-efficient home, including providing them with information on available new properties in the vicinity. This may require Government financial support. In chapter 4, it is recommended that there is a strong focus on flats in urban centres that would be attractive to older people and make it easier for them to move out of the family home. The HIA would be informed of these developments and be able to discuss them with their clients. The householder must not feel coerced, but nor should they be deprived of the opportunity to have affordable warmth.

Once the database exists, it will be possible to identify those properties that come into the lower bands, especially G and F, and where many of the fuel poor are likely to be living. Then the task is to improve their homes to a sufficient level at a sufficient rate. If it is confirmed that SAP 80 would ensure the occupant can be adequately warm and have other energy services for less than 10 per cent of income, then this is the standard required for all interventions. To lift 3 million households up from less than SAP 30 to SAP 80 and a further 1 million from SAP 40 to SAP 80 in the next nine years is an enormous task. It implies treating 444,000 homes a year.

There are two aspects to dealing with fuel poverty. Ensuring that everyone in the UK has affordable warmth is the major challenge. But equally, it is important to make sure that the homes of low-income households are 'future-proofed' and have access to low- and zero-carbon technologies. Hence, the proposal in chapter 9 for Low-carbon Zones, which is where the costs are examined. This takes an area-based approach, rather than one linked to tenure.

## Summary

Recent fuel price rises have at least doubled the number of households in fuel poverty to 4 million in the UK, despite the Government's legal obligation to eradicate this scourge by 2016. An urgent task is to be able to identify the fuel poor, so that they can be helped. This requires an address-specific database of the energy efficiency of every home in the UK, incorporating data from the Energy Performance Certificates and other national schemes.

It is clear that increasing domestic fuel prices cause additional hardship. Price rises alone cannot be relied on to deliver the desired change in lifestyle. Since 2002 the average household bill has risen by at least 50 per cent, yet energy demand continues to increase (although current energy efficiency measures are restraining this rate). It is evident that relying on price alone to mitigate climate change impacts would need an increase of a magnitude which would result in unacceptable social and economic detriment. Once fuel poverty has been eradicated though, then the Government is free to discuss whether introducing either carbon taxes or personal carbon allowances for the whole population would be the most appropriate mechanism. A decision that might not wait for 2016.

For elderly households that stay in their homes for 20-40 years or more, the existing Home Improvement Agencies (HIA) would be given a new mandate and finances to be able to help the householder obtain an energy-efficient home. This would include providing them with information on available new properties in the vicinity, especially where these provide supportive services. The householder must not feel coerced, but nor should they be deprived of the opportunity to have affordable warmth.

The proposed minimum standards for existing homes will reduce the stock of homes likely to cause the occupant to be in fuel poverty and the HIA will help those already in poor quality accommodation. Action on private landlords and the second Decent Homes standard will both help.

If it is confirmed that SAP 80 would ensure the occupant can be adequately warm and have other energy services for less than 10 per cent of income, then this is the standard required for all interventions. To lift 4 million households out of fuel poverty, permanently, it implies substantial investment on 444,000 homes a year until 2016. The homes of low-income households have to be 'future-proofed', by having access to low- and zero-carbon technologies. This would fulfil part of the Government's legal obligation; the commitment to eradicate fuel poverty for vulnerable households by 2010 now looks to be unachievable.

The Government has not identified any carbon savings to come from fuel poverty programmes by 2020, presumably because of an assumption that it has been eradicated. Nor are there any identified policies to help make low income homes be low carbon ones. Instead, as 2016 approaches, even the Government's rhetoric is getting weaker, at exactly the stage when policy should be more powerful.

## CHAPTER 8:

# PEOPLE, AWARENESS AND BEHAVIOUR

Even when lights, appliances and buildings are efficient and low- and zero-carbon technologies (LZC) are installed, it is still up to people how they use their homes and whether they adopt low carbon lifestyles. There are many influences on their behaviour, but they can be helped, or hindered, by the framework within which they live. Two aspects are considered here: the interface with the utility through tariffs, bills, meters and monitors, and secondly, how to accentuate personal and community responsibility and whether this means personal carbon allowances are needed. An interim assessment is that at least a third of the carbon savings in the residential sector will have to come from day-to-day behavioural changes (Hillman and Fawcett 2005), as opposed to effective use of new technology or fuel switching. People are the important resource – they are the only agents who can invent, adopt, ignore, reject, adapt or subvert technologies.

## Householders and the utilities

The way that the utilities interact with households affects their awareness of energy and carbon, as well as helping to reduce, or exacerbate, fuel poverty.

There is considerable current discussion about the role of smart meters, so there is the potential to ensure that new developments by the utilities are more supportive of householders and the environment. The changes are required by May 2008 by European legislation, the Energy End-Use Efficiency and Energy Services Directive (2006/32/EC), as this requires member states to:

- Remove incentives in tariffs that unnecessarily increase the volume of energy sales.
- Ensure that meters measure accurately and frequently customers' actual energy consumption; and that billing is informative, frequent enough to enable customers to regulate their consumption, and based on actual energy consumption.

The Government is consulting on fulfilling its obligations under the Directive (BERR 2007c) and by funding research into improved billing and metering. The Energy Demand Reduction Pilot started in September 2007, with several of the utilities funded by BERR and DEFRA to trial new types and combinations of monitors, meters, billing, other types of communication (such as TV, online) and financial incentives. The co-funding is costing the Government nearly £10 million (50 per cent of the total) and 40,000 households will be involved. The trial and most of the attention is focused on the use of electricity, but gas monitoring has to follow, to comply with the Directive. The report on the trials is due at the end of 2010, but several policies are going ahead anyway.

The focus on meters and billing brings to the fore the role of Ofgem (the gas and electricity regulator) and the extent to which its remit and practice support both environment and social objectives. The Sustainable Development Commission (SDC 2007) has stated that there is a lack of alignment between the Government's goals for a low-carbon economy and the way in which regulation is practised:

> "Ofgem's institutional culture and approach do not reflect the imperative of sustainable development, particularly climate change".

Similar concerns have been expressed by the fuel poverty lobby (NRFC 2007):

> "Recent reports from Ofgem do not give much confidence in the Government taking strong action to ensure that fuel suppliers provide suitable products for low income and vulnerable households."

This is particularly because of the multiplicity of departments involved in social and environmental concerns.

Evidence from around the world demonstrates that householders respond to better information by saving energy (Darby 2006). There is evidence that the savings can easily be 10 per cent, because many of us respond to a mental prompt (such as a monitor in the kitchen, a bar chart on the bill) by thinking about what we do and changing our habits. In same cases, these are real reductions, sometimes they are reductions relative to the rate of growth by other (uninvolved) households. The Government is assuming that the actual reduction in carbon emissions from these

metering and billing proposals will be 0.4MtC by 2010 and 0.5MtC by 2020 (DTI 2007a, para 2.73). The former is about a 1 per cent saving from both gas and electricity, which is cautious, but to achieve even this by 2010 is ambitious, as so little progress has been made on monitors that work with the gas supply.

**Monitors:** There is an important difference between smart meters and monitors (or displays as they are often called). It is monitors that display the real-time energy use, required in the Directive, hopefully in an easily-accessible format. There are appropriate monitors on the market – for example, the keypad electricity meter, used by about a third of all households in Northern Ireland, can be used to display information on real-time and historic consumption. The monitor should certainly be positioned where the householder can read it easily, so it can have an influence. Real-time energy use may be interpreted as just the actual power demand at that moment (kW), but recent consumption (kWh) should also be available. In the Energy White Paper (DTI 2007a, para 2.69), the Government requires monitors to be put in, for free, if consumers request them, from early 2008 until March 2010, but it is not clear how householders are going to be made aware of this opportunity. It is important that monitors are installed into people's homes as quickly as possible, so the two-year timeframe is appropriate. This will enable the growth in householder awareness and for the energy savings to start to occur. The Government's estimate in the Energy White Paper of a 0.4MtC reduction implies a very rapid distribution of these display devices, which will not result from the present arrangements.

The process of developing monitors for gas consumption has to be substantially speeded up, to comply with the Directive and to support the UK's carbon reduction targets.

**Recommendation on monitors:** All homes have informative monitors for both gas and electricity provided and installed, for free, by the utility, by 2010. This will enable each household to have a method of calculating the carbon emissions they produce from their gas and electricity use. Carbon awareness in the home has to be increased and this provides an obvious route. The standard of this equipment has to be defined, by Ofgem, and enforced, to make sure that the monitors are robust, accurate and provide the relevant information, for instance the carbon content of the electricity being provided by this supplier – the annual figure, as required for electricity disclosure (see opposite).

**Smart meters:** The benefits of new, smarter meters can be quite separate from the role of monitors. A smart meter may include a separate monitor, or it may link up with one that had previously been provided. The two most significant functions to be provided by these smart meters are that they can be read remotely and they can record data on the time of consumption (paving the way for time-of-use tariffs to assist electricity load management). They will remove the need for home visits by meter readers and enable householders to receive accurate bills. The Government's ambition is for smart meters to be in every home within 10 years (DTI 2007a, para 2.64), though there is ambiguity about whether this applies to gas, or only electricity.

**Meters and micro-generation:** The development of smart meters will help to facilitate the introduction of micro-generation. If there is electricity generation in the home (from photovoltaics, combined heat and power or micro-wind), this requires there to be electricity meters for three separate functions:

1. A meter to record the amount of electricity bought from the grid. At present this costs 10p/kWh.
2. A new meter to identify how much electricity is generated in the house. If this is collected together (by a third party, such as Good Energy) to purchase Renewable Obligation Certificates, the household receives about 4.3p/kWh or 9p/kWh for electricity from photovoltaics.
3. A third meter to identify how much of the electricity, that is generated in the house, is also exported to the grid. Most utilities that pay for this exported electricity, give the household about 3p/kWh, though there is a considerable range.

A fair payment system to the householder results from the combination of these three elements. With the present system, it is important that the householder uses as much as possible within the house, as the export price is so low. With the feed-in tariff proposed under this Low-carbon Strategy, a generous payment for exported electricity would encourage householders to reduce their own consumption through energy efficiency improvements.

**Recommendation on smart meters and micro-generation:** That the design of new smart meters clearly facilitates the installation of low- and zero-carbon technologies and links to the provision of a feed-in tariff. "It is important that smart meters interact intelligently with microgeneration" (DTI 2007a, para 3.42).

**Accurate and informative bills:** these are another important contributor to raising consumer awareness. At the moment, householders get estimated bills for most of the year, with a bill based on actual

readings about once a year. As the consumer group, energywatch have stated (HC88-II 2007, ev420-1):

- quality information is a necessary precursor to change people's understanding and use of energy
- consumption information currently provided to households is inaccurate, unappealing, arcane and outdated.

As a backward step, at least one company (Scottish and Southern) are proposing to issue more accurate bills, but only every six months. More informative bills would be monthly and have a bar chart, or similar, to show historical consumption over the last 13 months or more. Then householders can see if they are using more than a year ago and begin to work out why and adjust their behaviour.

The Environment and Rural Affairs select committee has stated (HC88-1 2007, para 89):

> "Better billing must be in place within the next 12 months. This must incorporate not only energy consumption in kWh, but how this relates to cost, carbon dioxide emissions, and with individual historical usage to help consumers make informed decisions about energy use reduction and efficiency savings."

**Carbon awareness:** The electricity disclosure requirements, stemming from the European Energy Liberalisation Directive, should mean that every household has information provided regularly on the carbon content of the electricity they purchase. This is being poorly adopted and enforced within the UK. As a result few households realise that they could save up to 42 per cent of the carbon in their electricity use, just by switching between the six main suppliers, independently of any green tariffs (Boardman 2007). There are several other necessary amendments, for instance to prevent electricity from renewable sources being double-counted: electricity from renewable sources is sold both separately, as a green tariff, and counted in the information given to consumers, implying that it is in the general mix they are buying.

**Recommendation on electricity disclosure:** That Ofgem produces a clear, informative leaflet, identifying the carbon content of all the main sources of domestic electricity, and that the utilities are required to distribute this with every bill to every one of their domestic customers.

**Tariffs:** With gas companies, the cost of the gas used in the home decreases, as more is consumed. This encourages the profligate use of energy and as such is no longer permitted under the Energy Services Directive. Reversing the tariff structure, so that the first units are cheaper than later ones should discourage excessive use, and help with both environmental and social objectives. Economic, social and environmental benefits can be achieved by 'rising block tariffs', as they are called, in a cost-effective way (Thumim et al 2007). This would help the energy suppliers reduce their carbon emissions, as may be required under the Supplier Obligation.

**Recommendation on tariffs:** The Government requires the utilities (via Ofgem) to introduce rising block tariffs that primarily protect the fuel poor, but also reduce carbon emissions, as was the intention of Labour MP Alan Simpson's private members bill: Energy Markets (Carbon Reduction and Warm Homes) Bill.

**Payment methods:** One further aspect of the utility: consumer interface is the cost of prepayment meters. Many low-income households choose to manage their money and reduce the risk of debt by having prepayment meters. They may feel forced to do this, because of the inadequacy of the present quarterly (often estimated) bills. The cost of using electricity through a prepayment meter in 2006 was £120 a year more than for someone with a direct debit – an increase from £75 in 2004 (FPAG 2007, p9). The average low-income household only pays £250 a year on electricity, indicating the real benefit that they would receive if there is parity between the different payment methods. This is an example of where Ofgem have failed to support careful, low-income householders who are trying to live within their budget.

**Recommendation on payment methods:** The financial penalty imposed on prepayment meter users should be eliminated, as has been achieved in Northern Ireland with keypads.

## Utilities and energy efficient homes

For the last several years, the utilities have had to invest in energy efficiency measures in people's homes to obtain specified levels of theoretical savings. For instance, each compact fluorescent light bulb given to a family is assumed to save 600 kWh (£60) over its lifetime. The initial programme was called the Energy Efficiency Standard of Performance (EESOP) and latterly became the Energy Efficiency Commitment (EEC). The next stage, from 2008-11, will be called Carbon Emissions Reduction Target (CERT) and then there is discussion about a Supplier Obligation from 2011 onwards. These are all part of the same continuum, but the important change between EEC and CERT is that the former is measured in energy and the latter in carbon reductions.

By 2020, the Government expect the Supplier Obligation to be contributing 3.0-4.0MtC in savings, representing 53-64 per cent of total residential savings, as shown in Table 2.3. The Supplier Obligation has been out to consultation (DEFRA 2007f), but the Government's response is not known, although there will be some form of requirement until at least 2020.

Activity on low- and zero-carbon technologies under CERT is found in chapter 6. The Energy Saving Trust have stated (HC 88-II 2007, Q20) that CERT will require:

> "a step change of insulation in domestic properties from round about 400,000 properties each and every year to a minimum of a million properties".

At least 40 per cent of the carbon savings are to be in the homes of the priority group (mainly low-income households), which is a drop from the 50 per cent in EEC. The benefits accrue to treated households, but the cost is borne by all domestic customers through their electricity and gas bills. The cost of CERT, if passed on in full to customers, is estimated to be around £97 over the three-year period (DEFRA 2007a, p3). This is further evidence of why the programme should focus heavily on low-income households.

**Supplier Obligation:** The Supplier Obligation, as presently designed, would require the utilities to reduce the carbon content of the electricity they supply to all their residential customers. It is a substantial improvement on the EEC as it unites both the ordinary sales and the programmes to reduce demand: they both become part of the same approach, rather than, as at the moment, separate. This means that the utility is less likely to invest in energy efficiency measures, whilst promoting more consumption. Another interesting aspect of the Supplier Obligation is that it is likely to be verified through reductions in actual consumption, whereas EEC was based on estimated savings from specific measures. This could represent a real challenge to the utilities.

Householders are unlikely to respond to exhortations from the suppliers to reduce demand because, understandably, they are suspicious of the motives of a utility that tries to get them to consume less. The utilities themselves may be reluctant to take on a responsibility that assumes they will change consumer behaviour, without there being a concomitant responsibility on private individuals. If householders just go out and buy additional appliances and continue to use energy in a profligate way, then the utilities will not achieve their obligations. The way in which householders are facilitated in taking personal responsibility is discussed next.

## Personal responsibility

The individual householder is always an extremely important component in the use of energy, but normally contributes fairly passively to increasing demand. Now what is needed is for the individual to be actively – and happily – engaged in reducing demand. There have been several occasions when reference has been made in this report to the need for greater carbon literacy, changed behaviour and lifestyle changes, as households. Some of these changes relate to daily occurrences. Others, towards the end of the list below, are rare events in most people's lives:

- install compact fluorescent lamps and light emitting diodes soon
- refuse to buy unnecessary appliances
- reduce standby
- use energy carefully
- respond to the electricity monitor and read the meter
- spread carbon and energy awareness
- respond to the Energy Performance Certificate and improve the home, so it moves up a band
- install low- and zero-carbon technologies
- move into a smaller property, instead of under-occupying the present one
- move into a brand new, energy efficient home.

All of these can be encouraged by policy, for instance on prices, information, energy labels, but householders cannot be forced to act. For instance, standby may have been reduced to a minimum by regulation, but someone still has to turn the appliance off. Whilst technology has a major role in reducing demand, it is not a panacea. Hence the need for manufacturers to stop producing unnecessary equipment – chapter 3. This approach has been adopted in Australia, where all new appliances have to get governmental clearance, before they can be sold. This removes individual responsibility for a problem not of the individual's making.

People need a framework that provides them with guidance on appropriate levels of energy use and carbon emissions, if demand is to be reduced. At the moment, there is nothing to guide people, so they realise the urgency and importance of reducing demand. They need to invest in low carbon technologies and not purchase profligate equipment. There are major savings to be made from more careful

behaviour and these need to be facilitated, both through monitors, informative bills and progressive tariffs, but also by identifying what is 'sufficient' in terms of carbon emissions.

To tackle climate change and achieve an 80 per cent reduction in carbon emissions, there are two main choices: either carbon is restricted by price or by quantity.

**Taxation:** The first route would require high levels of taxation for households. Much of the reduction in demand from high prices comes from low-income households enduring further deprivation. Price rises are less influential at changing the behaviour of better-off households, as they can afford to pay the extra costs and may not alter their lifestyle or equipment. As it is hard to predict how people will respond to high prices, it is difficult to guarantee levels of reduction through taxation. The price increase of 50 per cent in domestic gas and electricity prices, between 2002 and 2007, have not been effective at reducing average household consumption (Chapter 1), although they have doubled the numbers in fuel poverty. Thus, whilst taxation is a known policy tool, for carbon reductions it has problems with both equity and certainty.

## Personal carbon allowances

The alternative route is to curtail the quantity of carbon used by issuing personal carbon allowances (pca). Each adult is given a free, annual allowance of carbon, on a plastic card, and this is used up with every purchase of gas, electricity, petrol or flights. When the free allowance has been exhausted, the individual has to buy extra on further purchases, to reflect the cost of carbon. For below-average energy users, typically the poorest people, they would have surplus to sell, as 26 per cent of households do not own a car (Brand and Boardman, in press) and 50 per cent of people do not fly in a year (Cairns and Newson 2006). Thus, for household energy use, personal carbon allowances are progressive. One of the benefits of introducing a trading element, as the EST have stated, is that the cap can be set at a lower level than with a cap only scheme and this could result in "more significant environmental benefits" (HC 88-II 2007, Q15).

The Government has confirmed that it believes "the current system of taxation strikes the right balance between protecting the environment, protecting the most vulnerable in society and maintaining sound public finances…" There are "questions about whether a personal carbon allowance scheme could be proportionate, effective, socially equitable and financially viable…The Government is therefore undertaking a programme of work intending to look into these issues in more detail" (DTI 2007a, p61). It may be that utilities will only accept the Supplier Obligation, which restricts the growth of carbon emissions from all their activities, if there is a parallel constraint on householders, for instance through personal carbon allowances. It would be difficult for the utilities if they are busy providing householders with insulation, if the benefits are just offset by the purchase of additional consumer electronics.

The Climate Change Bill would allow the introduction of personal carbon allowances. The Joint Committee have stated (HL paper 170-1 2007, para 61):

> "As for personal carbon trading schemes, while these would appear to have important potential, the major impacts that they might have on the economy and people's personal circumstances mean it is essential that these should only be introduced through primary legislation."

Various personal carbon schemes exist, with subtle variations. These are well described in both Fawcett (2007) – the adjacent article in this publication is on the comparable Irish proposal, cap and share (Howard 2007) – and by the Centre for Sustainable Energy (Roberts and Thumim, 2006). The proposal here is largely based on the research being undertaken at the Environmental Change Institute (ECI) as part of the UK Energy Research Centre.

Very little is known about the effectiveness of personal carbon allowances – there are few appropriate precedents. That is why the ECI is proposing a substantial trial, to establish how people respond to an 'allowance', and who would find the scheme difficult or beneficial (Fawcett et al, 2007). The idea certainly has considerable public support. The BBC radio programme, *You and Yours*, asked its listeners for their views on "The barriers stopping you from reducing your own personal carbon allowances". This elicited one of their largest responses – 500 emails and 200 phone calls. "The vast majority of listeners who contacted us were enthusiastic about reducing their own greenhouse gas emissions," said a spokesperson from the station (HC88-II 2007, ev 500-6).

If personal carbon allowances are ever to be brought in, the developments discussed earlier in the chapter, on monitors, billing and electricity disclosure will all be important precursors. They are part of making society more carbon literate. The combined effect of reading the meter and having a carbon reduction target can be very powerful, as demonstrated by the Hutchinson family in Teesdale, on the *Money Programme*. They reduced their electricity consumption by 55 per cent in one week, with no capital investment, just as a

result of education, awareness and being motivated to be careful.

Another important part of any progression towards personal carbon allowances is the development of community-wide activities. In many parts of the country, there are transition towns, carbon reduction action groups (CRAGs) and a host of other, embryonic groups making their contribution to reducing the threat of climate change (CSE 2007b).

It is difficult to predict the amount of energy 'waste' there is in society and the extent to which behavioural changes will reduce consumption. However, it seems perfectly possible that there could be quite substantial energy savings, made easily and quickly by households, providing a rapid first response to personal carbon allowances. If this is true, then the ideal trajectory would be the fixed percentage reduction, as adopted for the Low-carbon Strategy. The quick reduction in the numbers of allowances issued would assist in maintaining the value of carbon credits, as not too many would come flooding onto the market in the first few years. Only the actions that are linked to the home are discussed here, but in reality reducing flights and driving more efficiently or less far are two other major options for quick responses by households.

A major benefit of personal carbon allowances is that the Government controls the amount of carbon permits that are issued and reduces the quantity each year to reflect national and international targets, as well as the way society is responding. This fits neatly with the ethos of the Climate Change Bill, with five-yearly budgets, and provides the government with certainty about the level of the UK's carbon dioxide emissions.

People and personal responsibility need to be incorporated into the Low-carbon Strategy both firmly and quickly. Many of the reasons for the failure of policies to deliver real energy savings can be traced back to the failure to involve people – apathy, inertia, rebound, excessive and wasteful energy use all occur when householders have not understood the full context to their actions. People are worried about climate change and want to know what to do. The concern about standby consumption demonstrates how even tiny steps, like turning off the television, can grab the public's imagination. This desire to be involved has to be harnessed and personal carbon allowances are one of the best ways for people to have a clear framework to their decisions. It gives them the capacity to act effectively, it gives them urgency. Such major reductions in carbon emissions cannot be achieved by technology and regulation alone.

**Recommendation on personal responsibility:** The introduction of personal carbon allowances is seriously considered as an essential component of policy in order to identify for people the scale of the challenge and to reinforce this message, gently and consistently, every year. Householders will be informed, will demand information from retailers and utilities and will become a major force transforming the market for energy-using equipment. They may need to be introduced, in parallel with the start of the Supplier Obligation, in 2011.

The first task should be to undertake a substantial trial in 2008 to establish how people respond to an allowance over time.

## Summary

The involvement of the general public is critical to the successful development of a Low-carbon Strategy. It is people that buy equipment and switch it on and off, leave windows open and shut doors, and, in a host of other ways, affect the amount of energy used in their homes. Reducing energy demand and carbon emissions cannot be left solely to technology and Government regulations, although both have important roles to play. A complete change of perspective is required by the Government, so that 60 million individuals are seen as a major opportunity, rather than as a part of the problem.

The utilities have an important role – that is often missing – in enabling people to understand their energy use and to have the right incentives and information to aid demand reduction. There are important developments occurring in relation to monitors, meters, informative and accurate billing, tariffs and environmental information, all of which could be supportive of environmental and social progress, or not. The utilities could do a great deal more to help people understand their energy use and become more carbon literate. Without this awareness, the householder is directionless.

The Government is relying on the utilities to deliver a substantial amount of carbon savings, in the home. The 3-4MtC to be saved by 2020 from the Supplier Obligation is the major part of the residential sector's savings. The way in which the utilities will respond to this is difficult to predict, but if the resultant price rises are not to make fuel poverty worse, there has to be a strong and continuing focus of both CERT and Supplier Obligation on low-income households.

Other measures to reduce the extent of fuel poverty would include eliminating the extra cost of prepayment meters and introducing a reverse tariff system,

whereby there is a ‘block’ of low cost energy provided to everybody. Beyond this block, the tariff rises and for high consumers is fairly punitive. Both of these are important preparations for an era of ever-higher fuel prices and carbon constraints.

The move to tracking actual emissions, as proposed in the Climate Change Bill, makes the link with consumption. It also requires policies that produce rapid, equitable reductions. Personal carbon allowances appear to provide both a more certain and a more equitable solution than increased carbon taxation. Personal carbon allowances could increase consumer carbon-literacy whilst providing people with the choice of where and how to reduce their emissions. They may also reduce the rebound effect, where people save money from one energy use and then spend it on some other energy-using item or activity. A trial of the effectiveness of personal carbon allowances is urgently needed to establish their potential policy impact.

What is certain is that the householder has to be engaged in the task of reducing carbon emissions and provided with a framework for his/her actions. Personal responsibility has to have a number attached to it, to provide guidance and direction. Otherwise, in ignorance, people will continue to waste energy, buy unnecessary equipment and still believe they are doing sufficient, because they recycle.

An effective level of climate change communications is one that engages people and often this means that it has a local link. This is already happening through a wide-range of self-generating community actions, which could be harnessed together with local authority targets.

## CHAPTER 9:

# THE ROLE OF LOCAL AUTHORITIES

The importance of the link between individuals, communities and local government has been emphasised in the Joint Committee's report on the Climate Change Bill (HL paper 170-1 2007, para 76):

> "We agree with the overwhelming view of submissions from local government and regional government bodies that, whether in the Bill or elsewhere, the Government must give far higher priority to addressing the issue of individual behaviour change, and the role of local government in achieving this in its capacity as a major community leader."

Local authorities (LA) bridge the gap between people and central Government. They both understand the importance of local conditions, but also recognize the need to deliver national and international commitments. Local authorities already have a range of responsibilities in relation to energy and housing, for instance they:

- give planning permission, so can require the installation of on-site generation, for instance through the Merton rule
- are responsible for the enforcement of the building regulations, together with private companies
- have responsibility for enforcing the Housing, Health and Safety Rating System and for acting on homes that fail the standards
- with housing associations, have responsibility for social and affordable housing
- can introduce local energy networks, for instance combined heat and power or, as in Woking, private wires
- have access to all householders (such as through the distribution of council tax demands, or linked to the electoral role) so can distribute information and know that it has been received by all residents
- have responsibility for waste disposal, so can introduce anaerobic digestion, pyrolysis, or, better still, mechanical-biological-separation (Jardine et al 2004, p48). These provide green gas
- issue council tax rebates.

## Reports on the energy efficiency of the housing stock

The Housing Act 2004, that brought in the Energy Performance Certificates, states (clause 217):

> "The Secretary of State must take reasonable steps to ensure that by 2010 the general level of energy efficiency of residential accommodation in England has increased by at least 20 per cent compared with the general level of such energy efficiency in 2000."

This is an important obligation that is only two years away and can only be fulfilled by implementing some of the changes proposed in the Low-carbon Strategy, particularly the immediate need for a comprehensive, accurate, address-specific database. Because of the emphasis on energy efficiency, it can best be answered by Standard Assessment Procedure-based information, rather than actual consumption.

An important responsibility that local authorities already have is the preparation of annual reports on the energy efficiency of all the housing in their geographical area, all tenures, under the Home Energy Conservation Act 1995 (HECA). These existing reports have become meaningless, as there is a multiplicity of software programmes, so that comparisons or combinations across authorities are impossible. In addition, the report only covers those homes that existed in 1995, any new construction is omitted. Worst of all, the energy consumption, that is taken as the baseline, is a theoretical one assuming that all homes are warm, as with SAP and the Energy Performance Certificates. Therefore, the reductions in consumption (as a result of insulation measures being installed) are largely fictitious. As a result, LAs are showing (sometimes major) reductions in energy use in their areas, whilst the national statistics show rising energy consumption (DEFRA 2006a).

The good thing about HECA is that it has required each LA to have at least one person with responsibility for housing and energy data. This could be the kernel of a new, more powerful department. In some cases the LA has instigated sophisticated monitoring and

modelling procedures, so they are well on the way to a proper assessment method.

The Government has announced that HECA is to be revised (DEFRA 2007e). This links in to both performance indicators (below) and would be an easy outcome of the Low-carbon Strategy for a constantly updated, address-specific dataset based on the Energy Performance Certificates – details in chapter 5. The legislative base is already there as the Sustainable and Secure Buildings Act 2004 requires two-yearly LA reports on the building stock. The Act also requires that local authorities will keep a register of appropriate documents, which should apply to Energy Performance Certificates.

## Performance indicators

The Government has recently proposed bringing together many of the local authorities' responsibilities: 198 indicators are being discussed as part of a new local government performance framework on environmental protection (DEFRA 2007c). One of these is the "percentage $CO_2$ reduction per capita in the community":

> "This reflects the role of LAs leading and acting as an exemplar in communities to reduce carbon emissions via their service delivery and community leadership role. This includes emissions from housing, local business and public sector organisations, community organisations and local transport. Action by Local Strategic Partnerships led by LAs, should take joint accountability for initiatives to drive $CO_2$ reduction in the community."

And another is on fuel poverty:

> "To measure progress in tackling fuel poverty through the improved energy efficiency of households inhabited by people claiming a defined set of income-based benefits. Energy efficiency would be measured using the Standard Assessment Procedure (SAP)."

In October 2007, the Government announced that these 198 indicators will replace all other measures of local authority performance, with up to 35 of them reflecting national priorities. These indicators will be introduced in 2008 and the associated funding levels will be announced in November 2007 (Treasury 2007, para D6.9-10). The details of how to measure both of these are still to be decided by the Department for Communities and Local Government (DCLG).

Many local authorities are ahead of the Government on carbon dioxide emissions. Over 250 local authorities in England and Wales have already signed the Nottingham Declaration on climate change. This is a voluntary pledge committing the authority to take action on mitigating the effects of and adapting to climate change (EST 2007).

Government statistics already exist for both $CO_2$ per capita (all uses) and, separately, per capita $CO_2$, from energy use in the home, for each of the 436 UK local authorities (DEFRA 2006c). These appear to be based, somehow, on actual consumption, across the whole local authority area. Generally, access to detailed data on household energy consumption is either prohibitively expensive or impossible. As with the Government's present proposals on the Energy Performance Certificates, the reasons for such secrecy over household energy patterns is incomprehensible.

The fuel poverty indicator fits well with the proposals in the Low-carbon Strategy for an address-specific dataset, based on the energy performance certificates (which use SAP). This dataset would provide the basis for monitoring compliance with the performance indicator.

The level of reduction required in the $CO_2$ indicator should be expressed as a percentage of actual emissions, as these already vary substantially: Teesdale is two and a half times more polluting than the London Borough of Camden, in terms of household carbon dioxide emissions per capita (DEFRA 2006d).

Those local authorities that are already well along this route (eg Merton, Kirklees, Woking, Newark and Sherwood) could be encouraged to undertake voluntary commitments earlier. The provisional incentive might be to allow them to sell their carbon savings on the carbon trading market, or for the Government to reward them with a similar value. If the savings had not occurred, then the Government would have to pay a penalty, under Kyoto or later targets. Hence, it is in the Government's interests to reward local authorities who are proactively reducing their carbon emissions.

London is taking a lead with the Climate Change Action Plan and the Mayor believes that a 60 per cent reduction in carbon dioxide can be achieved by 2025, over 1990 levels (London 2007, p7) and a 20 per cent reduction by 2016 (p9). Major contributions come from household behavioural changes, such as using low-energy light bulbs everywhere (25 per cent), higher standards from new buildings (5 per cent) and improvements to existing buildings (20 per cent). Changes to the carbon

intensity of grid electricity come from local combined heat and power, use of biomass and waste, and some building-integrated micro-generation.

The London Borough of Merton is planning to cut $CO_2$ emissions by 15 per cent by 2015, over 1990, particularly through energy use in buildings, some transport and all municipal activity. A major component of this will be a combined heat and power system, using green gas from waste (eventually). It will be linked to the development of an English Partnership site (Rowan School) and will be a condition of planning permission. Once the heart of the system is installed in this way, extensions can be added to provide existing housing and incorporating new sources of renewable heat.

There are several parallels between the local authority accepting responsibility for carbon reductions and the role they already have in relation to household waste. With the latter, the local authority gets penalised if a certain level of reduction has not been achieved, as a devolved responsibility under the European Landfill Directive. As a result, the local authorities have instigated major changes in recycling systems and recognised the need to change householder behaviour. A similarly innovative approach would be required for carbon.

## RECOMMENDATIONS FOR THE LOW-CARBON STRATEGY

There are two recommended components in the Low-carbon Strategy for local authorities and both are extremely important. First that they should have clear carbon targets and secondly, that there should be a sequence of Low-carbon Zones focusing on eradicating fuel poverty. In both cases, central government would have to make sure that the local authorities had the appropriate level of funds and relevant powers. But this is a clear example of the principle advocated by the Stern Review (Treasury 2006) – it will be cheaper to invest now, rather than wait and respond to the problems created by climate change. Delay will be expensive.

In recognition of these additional responsibilities and the need to initiate a heat network linked to community combined heat and power, each local authority is given an annual budget of an additional £6 million.

### Targets

It is proposed that each local authority with housing responsibility (436 councils in the UK) should be given an annual carbon reduction target, which declines to mirror the Climate Change Bill and is based on its historic emissions. The achievement of this would be reflected in an annual carbon statement and confirmed through the Audit Commission's Comprehensive Performance Assessment (CPA) – an annual process of checking the local authority's progress against defined standards and awarding 0-4 stars. Using a CPA approach ensures that the whole council is involved in the policy, not just one separate department. All Chief Executives are aware of the number of stars their local authority has, as it is a matter of collective pride.

A local authority carbon target could eventually be extended to a variety of energy uses, but the most important issue for this report is that it is introduced rapidly and covers all energy use in all housing tenures. It may be appropriate to introduce the responsibility in stages, but the end point (full responsibility) must be clear. It takes time for the local authority to adapt to new legislation, although this process should be minimal as it builds on the existing HECA reports. The stages the local authority has to go through include the need to:

- Understand, at a corporate level, and to introduce a meaningful carbon strategy. For instance, that the Merton Rule is both adopted and properly implemented; that there is an educational co-ordinator responsible for getting carbon literacy taught in schools.
- Introduce carbon reduction targets for its own buildings, which will require a team of energy specialists to be established. As a result, there is in-house knowledge of what is required to reduce carbon emissions in practice, expertise is developed in when and where renewables are appropriate and the local builders have experience of delivering low-carbon construction.
- Extend this expertise to housing management and to the implementation of the necessary policies and interventions.

As a result of having this target, the local authority would bring together many of the recommendations in the Low-carbon Strategy:

- Assemble the address-specific database – including incorporating residents who rarely move.
- Identify where the fuel poor live and ensure that their homes are improved to SAP 80.
- Ensure that properties that fail the Housing, Health and Safety Rating System, because they are a Category 1 Hazard for Excess Cold are identified and are not resold without major improvements.

- This links to the application of a minimum standard that affects G-rated properties from 2010, F-rated from 2013 and then E-rated properties from 2016. If improvements are not undertaken and there is an attempt to resell the property, the local authority has to intervene, purchase the property, get the upgrade undertaken and can then sell an energy-compliant building.
- Strongly enforce the energy efficiency components of the building regulations by employing more building inspectors and bringing more enforcement in-house.
- Encourage the development of supported housing for older people, particularly flats in urban centres.
- Work with the Home Improvement Agencies in their new role of helping their clients have affordable warmth, including moving into new low carbon homes.
- Negotiate with the utilities to get energy efficiency and low- and zero-carbon technologies into social housing, through both CERT and Supplier Obligation funding. With some measures, for instance low- and zero-carbon technologies, the utilities are expecting half the funding to come from the local authority.
- Establish the first part of a heat network with combined heat and power, perhaps linked to green gas from waste disposal. This provides the nexus for community heating in Victorian terraces, new blocks of flats, etc. This may also involve the local authority, or its representatives, setting up an Energy Service Company (ESCo).
- Give annual reports under the Sustainable and Secure Buildings Act.
- Set up local energy advice shops, in conjunction with the Energy Saving Trust's sustainable energy network and energy efficiency advice centres, possibly with accredited installers or workforce, as the Home Improvement Agencies have.

## Low-carbon Zones

The local government already has responsibilities under the Housing, Health and Safety Rating System to identify and treat the worst homes (DCLG 2006a, para 6.22). With G- and F-rated properties that would fail the Housing, Health and Safety Rating System thermal criteria, there will have to be strong liaison between the local authority and the owner. Technically, the local authority should intervene as soon as the property is identified as G or F, but the size of the problem means that they will have to take an incremental approach. Action, by the building owner, must occur, within a given timescale, otherwise the local authority has to intervene.

To confirm that fuel poverty is being properly targeted, the Low-carbon Strategy proposes that local authority responsibility is reinforced, by an area-based approach, which builds on the experience of Warm Zones. The problem of identifying the fuel poor, particularly on the doorstep, is eliminated, as all homes in the area have to be visited and, if possible, helped. The Warm Zones are defined around areas of known poor-quality housing and low-incomes, so there is a concentration of households in, or near to, fuel poverty. The benefits of this approach have been recognised by the Government, through the temporary Community Energy Efficiency Fund.

What is proposed in the Low-carbon Strategy is for the Warm Zones approach to be extended to include the provision of low- and zero-carbon technologies, rather than just energy efficiency measures. Each local authority would identify a Low-carbon Zone to include about half the fuel poor thought to live in their area – about 5,000 properties per local authority. The Low-carbon Zones would have to be identified in the first five-year tranche of the Climate Change Bill (2008-12). Within a declared Low-carbon Zone, the first stage would be to get every house to have an Energy Performance Certificate, to understand the depth of the problems in that zone.

The Low-carbon Zones approach combines past experience of 'enveloping' in Birmingham (Boardman 1991, p66) and the legislative base of the Clean Air Act 1956 (Boardman 1991, pp14, 101). With the enveloping approach, the suggestion is that the external envelope (roof, walls, windows) of the houses in a whole street is upgraded at the same time. This is relatively non-disruptive. The work is certainly co-ordinated by the local authority, if not actually carried out by them. The objective is to raise every house to at least SAP 80 and possibly Level 6 of the Code for Sustainable Homes. A team of installers works down the street, regardless of tenure, and improves the outside envelope (roof, pointing, windows) to ensure that it is in sound condition, as well as installing loft and solid wall insulation and solar technologies. The cost savings from a bulk approach would be considerable, for instance because the scaffolding only needs to be assembled once. In order to achieve the required reduction in fuel poverty and because it might facilitate other developments, it is proposed that many streets have community combined heat and power installed as well. Victorian terraces provide an ideal level of demand, even after they have been insulated, as the houses are close together.

**Table 9.1**
**Estimated cost, per household, in Low-carbon Zone**

| Measure | £ |
|---|---|
| Solar thermal, including scaffolding | 3,000 |
| Solid wall insulation, marginal cost only, as scaffolding there | 1,900 |
| Connection to an existing community combined heat and power scheme | 1,000 |
| Insulating the loft, repairs, some double glazing – a nominal | 1,600 |
| Total | 7,500 |

Source: based on costs from Energy Saving Trust

The Clean Air Act 1956 identified smokeless zones, but left it to the individual to act, within a specified five-year time frame. Grants were available to convert the fireplaces to smokeless fuel, but there was no local authority programme of interventions. Under this Act, successive areas were declared smokeless, working from the worst first. This is the principle behind the Low-carbon Zones: a succession of them are declared, with gradually lower levels of fuel poverty, until the whole local authority area is covered.

A number of regional and local government bodies have already put together detailed low carbon and fuel poverty strategies and may know where fuel poverty is concentrated. For other local authorities, the identification will be assisted by the use of the Centre for Sustainable Energy's Fuel Poverty Indicator (now online) to help identify the appropriate wards and those areas most affected by fuel poverty (CSE 2007a).

Once identified, most of the properties within the first Low-carbon Zone would have to be removed from fuel poverty during this first tranche. If there are 4 million households in fuel poverty in the UK and 436 local authorities with housing responsibilities, then, on average, the local authority will have the duty to take 9,200 households out of fuel poverty by 2016. In the first tranche, they have to tackle at least 50 per cent of the fuel poor in their district, that's a minimum of 5,000 households by 2012. This allows for some churn – people moving into fuel poverty.

During the second tranche of five years (2013-2018), the remainder of fuel poor households, who would be scattered around, would have to be tackled. This will require the local authorities to have a complete, address-specific database of the energy efficiency of the houses in their area by that time (discussed under Energy Performance Certificates – chapter 5). The databases will be required to deliver the carbon-based performance targets, anyway.

The economies that come from the scale of treating a whole street are substantial and reduce the required contribution from private homes, making a full opt-in more likely. A householder can dissent from the process, but this may mean higher expense at a later date, for instance to comply with the minimum standards linked to Energy Performance Certificates. A cost of £7,500 per house has been used to estimate the expenditure on this scheme (Table 9.1). The aim is that each house treated is brought up to a SAP 80 and that this is sufficient to ensure the occupant is no longer in fuel poverty. This package of measures is purely indicative, but is designed to be undertaken with the householder in residence, because the work is mainly to the 'envelope' and does not disrupt daily living too much.

These zones would deliver low-carbon, warm homes as a result of doing whole streets at a time and should halve the incidence of fuel poverty by 2012 and eradicate it by 2016: a total of 4 million households will have been removed from fuel poverty. This is a substantial challenge, but has the advantage of both reducing fuel poverty and carbon emissions. It does, in the best sense, 'future proof' these households.

## Summary

In the Low-carbon Strategy, local authorities have major responsibilities: they have a carbon reduction target for the whole of the housing sector in their geographical area. This is an enhanced version of a Government proposal. In addition, local authorities identify a sequence of Low-carbon Zones, gradually covering their entire area. The first one includes at least half of the fuel poor in their area.

Both these two major recommendations contribute to a systematic, comprehensive approach to fuel poverty and climate change. They are mutually reinforcing. They are best delivered through the local authority system as they build on existing responsibilities and

permit the necessary flexibility to local conditions. They both form part of a long-term, new focus for local authorities.

The local authority will have to be adequately funded to undertake these roles, but both the carbon reduction targets and the Low-carbon Zones are delivering Government commitments – to climate change and on fuel poverty respectively – and under the proposed Climate Change Bill. Part of the cost would be offset if it means that the UK does not have penalties from failing to deliver our international climate commitments.

## CHAPTER 10:

# DELIVERING THE LOW-CARBON STRATEGY

This report has investigated the policy framework to get an 80 per cent reduction by 2050. The Government has already announced provisional policy proposals for 2020, mainly for appliances, the utilities and for new homes. The primary focus here is on the existing housing stock generally and the eradication of fuel poverty – the major challenges – and on the whole period to 2050. The Low-carbon Strategy proposals have been listed in some detail in the individual chapters and are combined here, with a special emphasis on the first reporting period under the Climate Change Bill: 2008-12. In total, these represent a considerable legislative and administrative challenge, but the expectation is that momentum will build up, so that the whole framework and public response starts to gel and becomes mutually reinforcing. When Government and the public have understood the scale of the task and the economic, social and environmental benefits and behaviour starts to change, the whole process of creating a low-carbon society should develop with greater ease. Generally, with energy efficiency, the more you do the more opportunities are discovered.

The recognition of the scientific imperative to reduce the threat of climate change is the main reason for prompt, substantial action, particularly by the developed countries. The next five to ten years are crucial in limiting the UK's – and the world's – carbon emissions. The timid introduction of limited policies has to be replaced with a clear, quantified, ambitious programme and message. This is urgent, real and requires all sectors of society to work within a united framework.

A market transformation approach provides the core to this report. The focus is on improving product efficiency, through a series of inter-related actions and policies: labels, minimum standards, fiscal incentives, education. The result is a powerful strategy that achieves major savings as a result of interactive policies, as has been shown to be possible with appliances. The philosophy has been extended here to cover the whole housing stock and it builds strongly on the introduction of Energy Performance Certificates.

Another benefit of a clear strategy is that the actions can be sequenced appropriately. For instance, as a result of the past, low levels of investment, there is insufficient support and infrastructure in place, particularly skilled personnel. This will become more acute with a major extension of powers in building regulations, the need for strong enforcement, the management of policies linked to Energy Performance Certificates and the challenge for the construction industry of delivering low-carbon homes and refurbishments. Forward planning for demographic changes, such as the numbers of single elderly households, will require the construction of new, smaller dwellings in urban centres that provide a supportive environment. Appropriate preparation for future policies makes them easier to introduce and more acceptable to the public.

## GOVERNMENT'S EXISTING PROPOSALS

In the Energy White Paper 2007 (DTI 2007a), the Government outlined the policies to achieve carbon reductions through energy efficiency in the residential sector. These are summarised in table 10.1, together with a synopsis of the findings from the respective chapters of this report. There are considerable questions attached to each policy, particularly about the Government's detailed prescriptions. For instance:

- The results of the Supplier Obligation consultation have not been announced.
- The Government is only introducing Energy Performance Certificates very slowly, under the Energy Performance of Buildings Directive. At present, they only cover homes with three or more bedrooms.
- The detailed definition of zero-carbon homes, which is crucial, has not been finalised.
- Real time displays or monitors have to be requested by householders, the utilities do not have to tell them that they are available and free.

In addition, policies often fail to achieve the expected savings, partly because of inappropriate detail, but also because the reductions were not there in reality: if people are cold, then they are going to take the energy efficiency improvements partly as extra warmth,

not wholly as lower energy bills. This is known as the rebound effect. In total, there has to be serious concern about whether the Government's proposed policies will be sufficient to achieve the projected, maximum 7.6MtC saving and, yet, this is necessary, in full, for the 26 per cent reduction in carbon emissions required in 2020 by the Climate Change Bill.

There are no overt policies in this list, beyond the Supplier Obligation and Energy Performance Certificates, aimed at the existing housing stock, although other policies such as Warm Front and Decent Homes do exist. By 2020, the Government is not expecting further savings from fuel poverty policy: it is obviously assumed to have been successfully eradicated.

The Government's expectation that its policies will deliver up to a 26 per cent saving on 1990 by 2020 are optimistic. All policies require a united team to deliver and for the Government to be absolutely firm with the utilities, house-builders and major retailers and Brussels. In addition, a generous assessment of energy consumption and carbon emissions from the residential sector is that they have stabilised over the last 10 years, so a radical change in direction is required to get the UK onto a clear, downward trajectory. For every year of inaction, the gradient for the remaining years to 2050 gets steeper. For these reasons, a cautious approach is to plan for programmes that over-provide, to ensure adequate carbon reductions in practice.

## THE LOW-CARBON STRATEGY

There is a strong policy focus on both reducing the demand for energy and on providing a low-carbon supply of energy and heat, on-site. These policies interact and reflect European targets for a 20 per cent reduction in emissions and 20 per cent of energy to come from renewable sources by 2020.

**Existing housing stock:** In 2050, 85-90 per cent of today's housing will still be occupied, but by 2050 it will be low-carbon, because each property has been well insulated and is generating some, if not all, of its own electricity and heat.

- By 2050, the average efficiency of these existing homes will be 80 SAP points (today's best) and all of them will be better than 50 SAP points (today's average).
- The Energy Performance Certificates show the energy efficiency of the home in bands A-G and are the foundation for the transformation of the housing stock.
- There are low-interest loans, stamp duty rebates (on existing houses), green mortgages to enable and encourage householders to finance the improvements to move their properties into a higher band. Landlords benefit from an enhanced Landlord's Energy Saving Allowance (LESA).
- Minimum standards are introduced, over time, so that G, F and E properties can only be sold once. They have to be improved before they can be resold.

**Table 10.1**
**UK residential carbon savings from energy efficiency in 2020, Energy White Paper 2007**

| Policy | Energy savings (MtC) | Likelihood of achieving |
|---|---|---|
| Supplier obligation (post 2011) | 3.0-4.0 | Same level of output as CERT, over 10 years, but measured, not estimated |
| Energy Performance of Buildings Directive* | 0.2-0.7 | Label alone unlikely to achieve; no other policies specified |
| Zero-carbon homes | 1.1-1.2 | Could be achieved by firm policy, if rigorously enforced |
| Billing and metering | 0-0.2 | For both, would expect a stronger response when first introduced |
| Real time displays | 0-0.3 | |
| Product policy* | 0.4-1.2 | Could be saved from lighting alone |
| TOTAL | 4.7-7.6 | |

Sources, DTI 2007a, pp 75, 283-4

*estimated allocation for residential sector

- The price of houses will gradually reflect their energy efficiency: more efficient properties will increase in value more than the less efficient ones, reinforcing the incentives for householders.
- Grants and a feed-in tariff to promote microgeneration.

**New houses:** The Government's proposals for the standards and numbers of new homes are assumed to be sound, pending further details and providing that they are properly enforced. Many new buildings are not delivering the planned reductions, because of low construction standards.

- New construction will be in urban areas, at increased densities, to reduce the need for greenfield sites, to encourage the use of combined heat and power, reduce the need for private transport and generally enliven the community centre;
- New properties will often be flats providing a supportive environment for older people moving out of the old family home.

**Helping the fuel poor:** Tackling climate change has benefits for everyone – especially the poorest households – as policies to address the worst housing will help both climate change and the fuel poor. By 2016, as required by legislation, fuel poverty will have been eradicated.

- Priority is given to treating those of the 3 million G and F-rated homes that are a health hazard and that fail the Housing, Health and Safety Rating System for thermal comfort. Many of these are the homes of the fuel poor.
- A second Decent Homes standard will ensure that all privately-rented and social housing has a minimum of 80 SAP points.
- When the tenants change, landlords upgrade their properties, with support from the Landlord Energy Saving Allowance. The latter is extended beyond 2015 and widely publicised, but the amount available is tapered, to encourage prompt action.

**Low- and zero-carbon technologies:** Every building, particularly low-income homes, will have low- or zero-carbon technologies (LZC), so that the carbon content of the fuels used is reducing:

- There will be a solar installation on nearly every roof, and half the homes will use combined heat and power.
- Every home will have low- and zero-carbon technologies supplying heat and electricity, particularly low-income households, to future-proof them against rising fuel prices.
- The external appearance of buildings of architectural heritage will be sacrosanct, although many will have low-carbon heating technologies, for instance heat pumps or combined heat and power.
- Grants to install solar hot water equipment will be available to all households with suitable roofs, currently using electricity, oil or coal to heat their hot water.

**Lights and appliances:** Some of the most certain savings come from action on lights and appliances, reversing the present trend to higher energy consumption in this equipment.

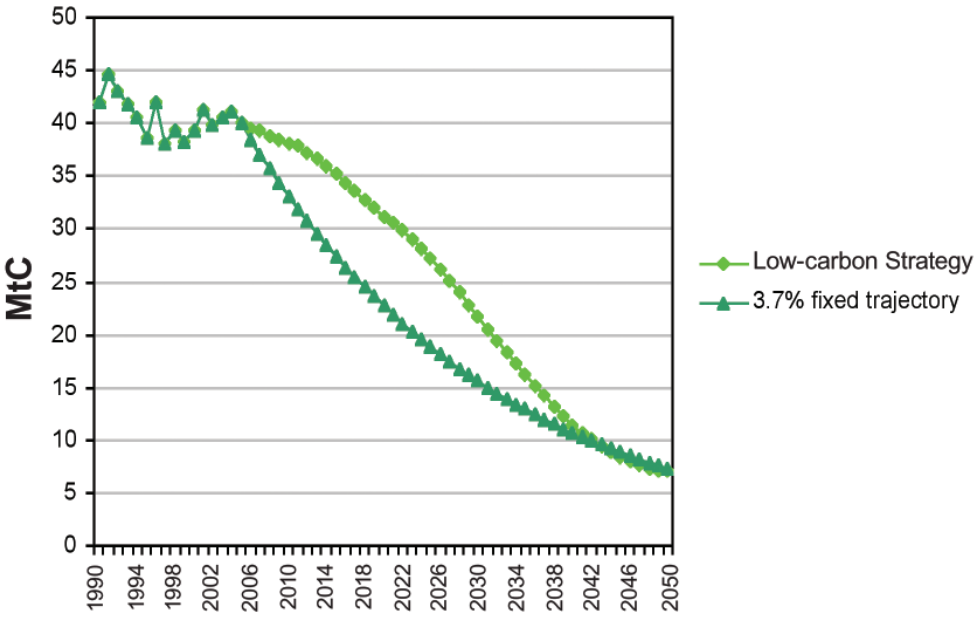
- A saving of 10TWh is achieved in 15 years from phasing out incandescent and halogens bulbs, saving each household £60 pa. No other policy could save as much carbon, with as much certainty.
- The Low-carbon Strategy undertakes the process of changing first to compact fluorescent lamps and then to light emitting diodes more rapidly than the Government's voluntary agreement.
- The Government provides high-level support for the European Commission's plans to introduce mandatory minimum standards for appliances and does everything possible to accelerate the process.
- A voluntary agreement is undertaken with the major retailers to promote sales of efficient appliances, both white goods and consumer electronics. If they only stock low-energy goods, this would have a powerful effect on both manufacturers and customers.

**Personal responsibility:** The positive enrolment of people in delivering a low-carbon future is essential to achieving the reductions:

- Households will understand the level of their carbon emissions through informative monitors and utility bills.
- National targets are expressed through personal carbon allowances.
- The temperature in the home has not increased above 21°C when the heating is on.
- Appliances are used less, because the household contains less people.
- The number of appliances has saturated at about today's level, though many are both more energy efficient and smaller.
- Hot water consumption is about today's level, per household.
- Reducing the carbon emissions from the home has become a national commitment, partly because it adds value to the home.

The carbon reductions are achievable, without compromising people's living standards. The individual

**Figure 10.1**
**Low-carbon Strategy vs fixed trajectory for residential carbon emissions, UK 1990-2050**




Source: UKDCM2

in 2050 will be warmer, can have more space, more hot water and slightly more appliances, than in 2007. Not excessively more, but certainly not less.

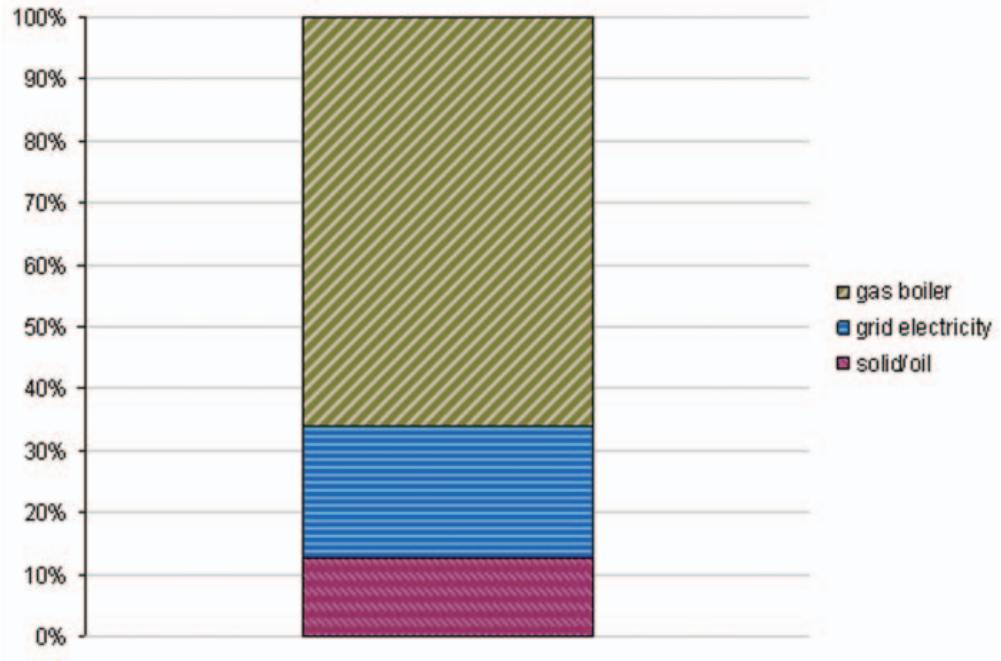
**Local authorities:** have a pivotal role in co-ordinating and steering local actions:

- Local authorities will have a clear responsibility to ensure that the carbon emissions from all energy use in all housing in their geographical area are reducing. This will be a performance indicator, to replace the Home Energy Conservation Act requirements.
- Local authorities will declare Low-carbon Zones, initially to cover areas where there is a concentration of fuel poor households. Improvements to the building envelope will be undertaken for whole streets at a time, to include solid wall insulation, solar hot water, photovoltaics and/or combined heat and power. After this, no home will still be in fuel poverty.
- Low-carbon Zones will be rolled out across the whole of the local authority's area, in the same way that smokeless zones were. Householders will be required to take action, within a defined time period.
- Local authorities will co-ordinate data collection on the energy efficiency of each dwelling, with data from Energy Performance Certificates, Warm Front, the Energy Efficiency Commitment and other schemes. Where data are missing, because a household has not moved, the local authority may fund an energy survey, but should complete the database of all properties by 2013, so that all fuel-poor households can be identified and removed from fuel poverty by 2016.
- May set up an Energy Service Company (ESCo) to deliver LCZs, generate and distribute green gas, CHP and set up low-carbon homes advice centres.

**Societal benefits:** there are considerable benefits for the whole of society from this combined housing and energy strategy:

- The residential sector is a net exporter of electricity from 2040 onwards, and is not using any coal or oil. Gas has dropped from providing 65 per cent of all energy used in the home in 1998 to 50 per cent in 2050, most of which is going into combined heat and power. All of these developments add to the security of the supply system in the UK and reduce the need for imports.
- The value of the housing stock is preserved and the homes provide a warmer, healthier environment, reducing the costs for the National Health Service.
- There is considerable additional employment with increased revenues for the Treasury.
- The UK has enhanced its expertise in low- and zero-carbon technologies, so that they could provide export opportunities.

**Figure 10.2**
**Residential fuel use, delivered energy, UK 1996**




Source: UKDCM2

## TRAJECTORY

The policies proposed in the Low-carbon Strategy have been modelled in the Environmental Change Institute's housing model, the UK Domestic Carbon Model (UKDCM2). Whilst the model is sophisticated, some of the assumptions are relatively crude and simplistic. It is extremely difficult to identify with precision the ways in which people are going to respond to these initiatives and what the resultant carbon emission reductions will be. However, the result is shown in Figure 10.1. The Low-carbon Strategy does achieve over an 80 per cent reduction in 2050 – the emissions of 7.3MtC from the residential sector in that year are only 18 per cent of the 42MtC from the residential sector in 1990. The trajectory does not mimic the scenario identified as ideal in chapter 1 – the fixed reduction curve (in darker green) – but does end up with the right 'snapshot' result in 2050. The proposals do deliver the 2020 target in the Climate Change Bill: when residential sector emissions are 31.2MtC, which is almost exactly the minimum 26 per cent reduction on 1990 emissions of 42MtC required. Good, but not perfect.

Further reductions could be made, in specific time periods, to close the gap between the Low-carbon Strategy and the fixed trajectory. There are several other options within the residential sector, depending upon policy and funding priorities, for instance:

- The rate of demolitions of old, inefficient homes could be increased from the proposed rate of 17,000 pa.
- Both photovoltaics and fuel cells for combined heat and power could be introduced sooner, if there is financial support to advance the technologies and make them cost-effective earlier.
- The carbon intensity of the electricity grid could be reduced from now on more than the Government project. This is most important between now and 2020, as after that the growth of home-generated electricity makes the carbon intensity of grid electricity of decreasing importance (in carbon terms) for the residential sector. In the Low-carbon Strategy, electricity has a carbon intensity of 0.136kgC/kWh in 2006, reducing to 0.12kgC/kWh in 2020.

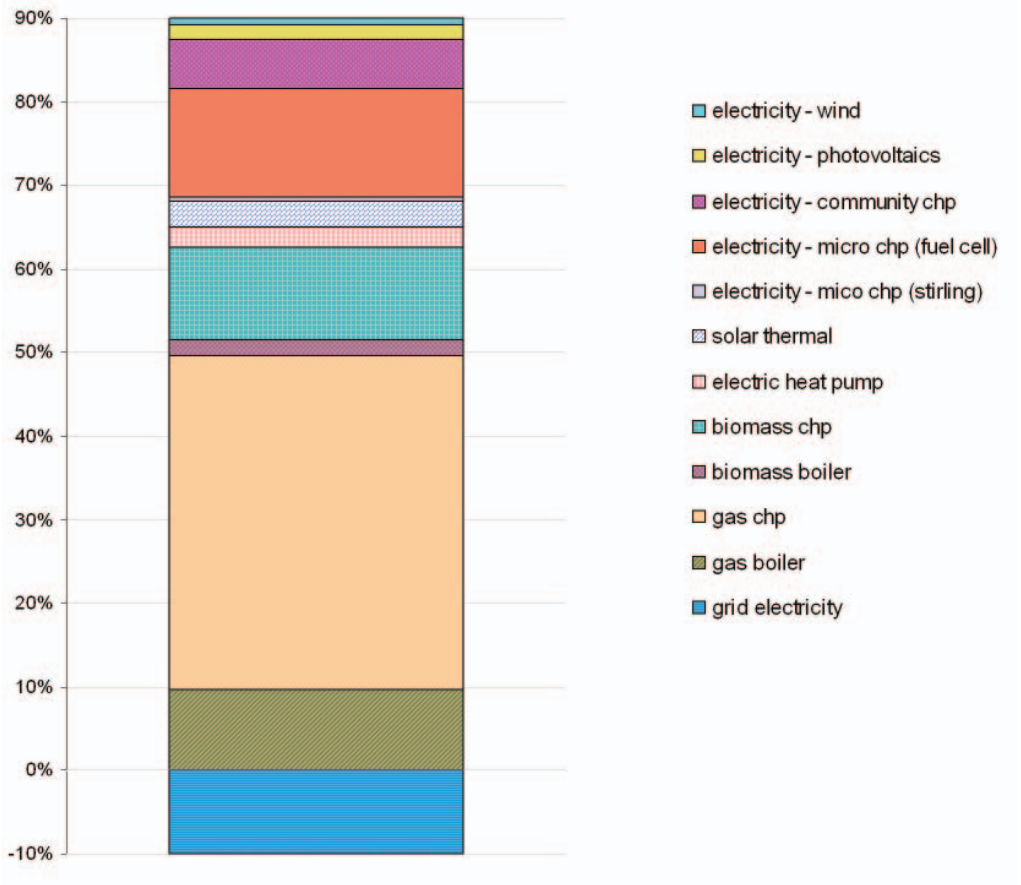
Alternatively, other sectors compensate. This is the Government's expectation, as the EU Emissions Trading Scheme is projected to contribute 42-59 per cent of all UK savings by 2020 (DTI 2007a, p283).

One of the interesting results of the Low-carbon Strategy is the dramatic change in the mix of fuels used in the home. In 1996, gas, electricity from the grid and other fuels, such as oil and coal, provide the total inputs (Figure 10.2) – the UKDCM model does not go back to 1990.

By 2050, several major changes have occurred:

- the residential sector is producing excess electricity for export, beyond its own needs – hence, in Figure 10.3 the bar goes below 0, to signify these exports. From 2040 onwards the residential sector is a net

**Figure 10.3**
**Low-carbon Strategy, residential fuel use, delivered energy, UK 2050**




Source: UKDCM2

exporter and by 2050, about 10 per cent of the electricity produced by the residential sector is exported to the national grid, with the remaining 90 per cent of energy used in the home. There are no net imports from the electricity grid to the house.

- Nearly half of all energy use is still gas (some of which could be green gas), which is delivered, in the traditional way, through pipes to the house.
- The majority of the gas is being used to provide combined heat and power and is thus producing electricity as well.
- Solid fuel and oil use has ceased entirely.
- The contributions from electricity generated in the home are sufficient to power all the appliances and heat pumps.

## SPECIFIC RECOMMENDATIONS FOR 2008-11

There needs to be a strong commitment from the beginning, to swing the UK away from the present trajectory: neither carbon emissions nor energy use are declining, so a major change is needed to get the 3.7 per cent pa carbon reduction required. The country needs to know that tackling climate change is more than turning off stand-by and recycling plastic bags.

The aim of the proposals is to make it cheap and easy for the householder to become low-carbon, whilst making it expensive and difficult to continue polluting.

This is a clear new policy direction and should be introduced with a flourish, showing how local authorities, consumers, utilities, retailers, manufacturers, construction industry are all involved, with both new responsibilities and opportunities. An atmosphere of genuine partnership needs to be created, with benefits for all – lower bills, employment opportunities and, best of all, showing leadership on climate change. It is critical that this new momentum is created. The climate science is unequivocal that the next 10 years are of vital importance, there is increasing concern about the price and quantity of the UK's supplies of gas and oil, and the numbers of fuel poor are rising. With each of these issues, every year that passes makes the task more challenging.

The first tranche, under the Climate Change Bill, has an immensely important role as it must provide the foundations for future achievements, for instance through assembling databases, defining standards and future timetables. The following are the 40 main recommendations in *Home Truths*.

## Nil cost to Government

### Energy Performance Certificates

- Roll-out the requirement to have an Energy Performance Certificate on all sales from 1 January 2008, and make it mandatory for privately-rented landlords to get Energy Performance Certificates for all their properties, within the next couple of years.
- Require householders to obtain an Energy Performance Certificate whenever they apply for building regulation approval for work to an existing home, apply for a mortgage or remortgage.
- Ensure that all improvements to the home are accompanied by obtaining an Energy Performance Certificate, for instance through Warm Front, Carbon Emission Reduction Targets, Warm Zones.
- Confirm that no G-rated property can be resold after 2010 and no F-rated after 2013. This can be monitored when all Energy Performance Certificate information is provided centrally;
- Confirm to private landlords that these minimum standards apply to them, when reletting their properties.
- Give a formal role to letting agents and the tenant deposit agencies to ensure that private landlords comply with both obtaining Energy Performance Certificates and in upgrading their properties to the required level.

### Appliances

- With the European Commission, identify tough minimum standards for the energy consumption in major energy-using equipment, up to 2050, agree with other Member States, incorporate into the daughter directives under the EuP Directive and publicise for manufacturers.
- With the European Commission, discuss the re-issue of the Labelling Directive and base the new system on absolute consumption (kWh pa) not relative use (kWh/ unit of service). This will start to reverse the present manufacturing trend to ever-bigger fridges, washing machines, etc.
- Across Europe, implement immediately the 1W initiative for stand-by consumption, agreed at Gleneagles in 2005, with a timetable to reduce it further. In many instances, 0.1W is adequate.
- With electrical retailers, introduce a green retailer code, so that they stock and promote the most energy efficient appliances and consumer electronics.
- With electrical retailers, all electrical equipment to have power rating clearly identified on the front at the point-of-sale – an absolute number.

### Lighting

- With the lighting industry, phase out incandescent bulbs with more speed and more certainty than the present voluntary agreement. Agree to accelerate development of high-efficacy light emitting diodes (LEDs) through procurement and research.
- Work with the light bulb manufacturers to ensure that the packaging on compact fluorescent lamps replaces the 1:5 ratio with more accurate advice based on a 1:4 or even 1:3 ratio, to stop confusing the public.
- Remove the anti-dumping duty (66 per cent) on compact fluorescent lamps, as this puts up their price, at the point of entry, in comparison with inefficient incandescent bulbs. The US Energy Star voluntary light standards could be used as a reference, as these require both good efficacy and colour rendering.
- In the 2010 building regulations and onwards, increase the number of dedicated low-energy fixed light fittings required indoors.

### New build

- Confirm the importance of the Merton rule, for housing, in planning guidance, until the Building Regulations replace it.
- The policies on new build housing must remain strong, for instance the Code for Sustainable Homes, and integrating zero-carbon homes into the Building Regulations. By 2050 these will represent nearly a quarter of the housing stock. They must not be weakened.

### Renewable heat obligation

- Introduce a renewable heat law, so that a minimum amount of energy for space and water heating has to come from renewable resources, in each house. Green gas, solar thermal, combined heat and power, biomass would all qualify. Set targets for its introduction and identify how it will be monitored and statistics collated.

### Research and development

- Encourage research funding of new technologies, such as fuel cells and photovoltaics.This could be undertaken by the UK Energy Research Centre and the Energy Technology Institute, with funds from the research councils and industry. Innovative forms of service delivery, such as energy service companies and green concierges, to help households obtain the advice and practical support needed to become low-carbon are required.

## Government and utilities (no cost to Government, costs and savings to consumers)

### Renewable energy

- The Government and Ofgem to identify the contribution from the residential sector to the European 20 per cent renewable energy commitment for 2020 and to introduce the appropriate policies and monitor annual progress.
- Ofgem to introduce feed-in tariffs for household micro-generation, to encourage increased ownership and ensure that owners obtain a profit from providing electricity capacity, as the utilities would.
- Require Ofgem to introduce a green gas tariff and accredit both this and green electricity. Annual sales from these two tariffs to be reported to Government against pre-determined targets.
- The Government to strengthen the regulations on electricity disclosure, to prevent the present double counting of green electricity and Ofgem to enforce.

### Energy efficiency

- Introduce the Supplier Obligation in 2011, with firm caps on carbon emissions to the household sector, based on actual sales. The Government may have to convince suppliers by committing to introduce personal carbon allowances at the same time.
- The utilities to reintroduce the fridge-savers scheme, whereby energy-inefficient, but working, old refrigerators in low-income homes are replaced with a new, efficient model, for the price of a second-hand appliance.

### Monitors, tariffs and payment methods

- Get electricity and gas monitors into every home within two years, so all households can work out their own carbon emissions, in the house. Ofgem to monitor rates of distribution.
- Introduce monthly, informative bills, based on actual readings (if necessary self-reading) as soon as possible, to trigger 5-10 per cent saving through behavioural change. Ofgem to confirm compliance;Ofgem to ensure utilities introduce rising block tariffs, to discourage high consumption.
- Require Ofgem to eliminate the £150 price penalty paid by pre-payment meter users.

## Government (small costs)

### Energy Performance Certificates

- Start a big publicity campaign on the importance of Energy Performance Certificates and the introduction of energy efficiency minimum standards. Monitor its success to ensure that the public understand.
- Develop a mandatory reporting system and searchable public website and database to provide information on the efficiency of properties for sale, as measured by Energy Performance Certificates, and in the neighbourhood, so householders can track activity.
- Develop an online self-assessment calculator to enable people to gauge the banding of their property and judge what improvements they might wish to make before putting it on the market.

### Local authorities

- Require each local authority to establish and complete an address-specific database on the energy efficiency of the housing stock in their area, by combining data from Energy Performance Certificates, Energy Efficiency Commitment, building regulations, Warm Front, etc. To cover all tenures, all properties, all energy use. An open, standard format to be used. The database is required to identify poor quality houses and the fuel poor (eg bands F and G) so that they can be treated by 2016.
- Confirm local authority targets for carbon reductions and fuel poverty, introduce as quickly as possible and identify resources needed and enforcement procedure.
- Obtain annual reports on carbon emissions and levels of fuel poverty from each local authority (for instance to replace the Home Energy Conservation Act [HECA] reports) and validate against national statistics;
- Each local authority to employ more building control officers, to enforce the building regulations properly and reduce self-certification by construction industry. Introduce compulsory pressure testing of new homes and require compliance before they can be sold.

### Home Improvement Agencies

- Enter into discussions with Home Improvement Agencies about the role they can fulfil in ensuring their clients have affordable warmth, including providing them with information on suitable new properties.

### Standard assessment procedure

- Revamp the Standard Assessment Procedure (SAP) used for Energy Performance Certificates, etc, to include all home energy use (including cooking, lights and appliances) accurately and make the software open source, so the decision-making framework for advice on the Energy Performance Certificates is clear and link with kWh pa of likely use. Move away from a relative measure, eg kWh/$m^2$.

### Personal carbon allowances

- In preparation for the possible introduction of personal carbon allowances in 2011, undertake a substantial trial in 2008. Give the trial wide publicity, to raise awareness of personal carbon allowances.

## Government and major expenditure programmes

### Tax cuts

- Introduce stamp duty rebates for existing homes, when the improvements recommended on the Energy Performance Certificate are undertaken, within the first year. Monitor take-up.
- Extend the Landlord Energy Saving Allowance in time and cover more qualifying expenditures, introduce a taper and give it wide publicity.
- Extend the 5 per cent rate of VAT to all energy efficient equipment and all methods of installation.

### Investment, local authorities and social housing

- Confirm with local authorities their responsibilities in delivering the reduction in fuel poverty and growth of community combined heat and power, and fund appropriately.
- Each local authority to declare a Low-carbon Zone in the area of most concentrated fuel poverty and improve the properties with enveloping schemes to insulate the solid walls externally, install solar thermal and photovoltaics, or combined heat and power. A SAP 80 has to be achieved. As a result, each local authority has halved the numbers in fuel poverty in their area by 2012.
- Introduce a major programme to promote community combined heat and power fired by green gas or waste products (anaerobic digestion, gasification), to enhance security of supply (less gas for electricity or for direct heating) and reduce landfill. These schemes to be undertaken by the local authorities as a contribution towards their carbon reduction targets.
- Provide resources for local authorities to fulfil their statutory obligation under Housing, Health and Safety Rating System and tackle G- and F-rated properties that fail the thermal comfort criteria as these are a category 1 hazard for excess cold (below SAP 30). Deal with G properties first.
- Introduce a second Decent Homes standard of SAP 80 and require all social housing to be treated by 2027.

### Investment and private householders

- Subsidise home loans to reduce the carbon footprint of the home by a specified amount – quite a rigorous standard to justify the administrative costs. Monitor take-up.
- Introduce a significantly larger grants programme to promote the installation of low- and zero-carbon technologies.

## Proposals for 2013-2017

In this time period, fuel poverty has to be eradicated and the minimum standard for existing homes becomes an E-rated property.

- Accurate database of all properties exists, in each local authority. This has been achieved by surveying the properties for which there is no information. The local authority can introduce strategic policies to improve the stock, with a clear understanding of the problems in their area.
- More Low-carbon Zones are introduced, still with a focus on the fuel poor, but they are less concentrated, so less subsidy will be needed in total, but the remaining fuel poor are more dispersed through the community, so each will be more expensive both to reach and treat. They can, at least, be identified.
- As additional building regulation inspectors are in place, the building regulations can be extended to include existing homes. The completion of cost-effective energy efficiency measures are a requirement of getting permission to extend the home. The carbon footprint of the larger home should be less than before it was extended;
- No F-rated property can be resold after 2013 and no E-rated property after 2016.

**Table 10.2**
**Tax cuts for people in Low-carbon Strategy, UK 2008+**

| | Per unit (£) | Number (pa) | Annual cost 2008+ | Years |
|---|---|---|---|---|
| Stamp duty rebates on existing homes | £3,500 | 400,000 | £1.4bn | 2008-50 |
| Landlord Energy Saving Allowance | £5,000 | 150,000 | £0.75bn* | 2008-15 |
| Lower VAT on energy efficient products and services | 17.5% down to 5% | £2bn | £0.25 | 2008-50 |
| Total | | | £2.4bn | |

*reducing annually until 2015

## Costs

The cost of achieving a stated carbon reduction depends crucially on the way policy is implemented. Some of the above proposals can be delivered for free, particularly if they are announced firmly in advance, for instance, minimum standards for the energy efficiency of appliances, based on directives from the European Commission. Others will require substantial investment, by Government, industry and individuals.

The zero-carbon new homes do not have to cost much more: a study by Arups for the Greater London Authority found that the additional cost is £5,000-£30,000 per unit (in TCPA and Lock, 2007, p15). These are incorporated into the purchase price and not included in this assessment.

The main costs are associated with the existing housing stock and the installation of low- and zero-carbon technologies. The principle adopted is that the majority of the policies are designed to stimulate investment in energy efficiency in existing houses, so energy demand is as low as possible, and then appropriately-sized low- and zero-carbon technologies can be installed. Energy efficiency is the most cost-effective energy option and, as the Government has identified, housing is the most appropriate areas for investment (HC 88-I 2007, para 46):

> "Policy evaluation work by DEFRA has shown household energy efficiency measures to be more than four times more cost-effective per tonne of carbon saved than the next best demand-side sector, which is business."

The options for demand reduction in the housing sector are better understood than either non-domestic buildings or transport, so the opportunities can be identified – as here – and acted on more promptly. Housing can deliver from tomorrow onwards.

An attempt has been made to implement two other principles: to have policies that are supportive of those without capital and not to reward those who spend the most. The effect of the former is for there to be a stronger emphasis on low-interest loans that cover the whole cost of the improvements, rather than on grants which only pay a proportion of the costs. Secondly, the maximum payment is fixed as an absolute sum of money, rather than a proportion of expenditure. It is a sensitive balance to unite equity and action, but that is the aspiration.

The following assessment is of the costs for Government. Expenditure by private individuals and industry are not included. There are two groups of policies: those that result in tax cuts for individuals (table 10.2) and those that require investment by Government (Table 10.3). The combined effect is equivalent to £500 per household, pa. These annual costs would apply from 2008 at least until 2016, to ensure that fuel poverty has been eradicated. But it takes over 12 years for these programmes under the Low-carbon Strategy to support energy efficiency investments in all 25.8 million existing homes. In many cases, if not all, at least one repeat round will be required either to improve the energy efficiency further or for replacements. It takes the whole 42-year period, to get low- and zero-carbon technologies into every home. That is the scale of the task and the ambition.

The summary details for the tax cuts in table 10.2 are:

**Stamp duty rebates on existing homes (chapter 5):** The householder is able to get a rebate of the full amount of expenditure, up to a maximum of £5,000. The average claim is assumed to be £3,500 and a third of all purchasers undertake work that will qualify for the rebate each year. The rebate comes into existence in January 2008, as the improvements are based on information in the Energy Performance Certificate. It continues indefinitely.

**Table 10.3**
**Government investment, Low-carbon Strategy, UK 2008+**

| | Per unit (£) | Number (pa) | Annual cost 2008-16 | Years |
|---|---|---|---|---|
| Fuel poverty through Low-carbon Zones | £7,500 | 440,000 | £3.3bn | 2008-16 |
| A second Decent Homes | £5,000 | 185,000 | £0.93bn | 2008-27 |
| Low interest loans | £450 pa x 10 years | 900,000 per cohort | £3.65bn* | 2008-50 |
| Low- and zero-carbon technologies | £2,000 | 400,000 pa | (£0.8bn) | 2017-50 |
| Home Improvement Agencies | £100,000 | 250 agencies | £0.025bn | 2008-50 |
| Local authority | £6m each | 436 | £2.6bn | 2008-50 |
| Annual total (2008-16) | | | £10.5bn | |
| Annual total (2017-27) | | | £8bn | |
| Annual total (2028-50) | | | £7.5bn | |

*annual payment after nine years

**Landlord Energy Saving Allowance (chapter 5):** The present scheme is expanded with a maximum expenditure per property of £20,000, but an average of £15,000. As many buy-to-let landlords do not pay income tax on rent (the mortgage is too high), only about half of landlords will qualify for tax relief, but their allowance is £5,000 on average. The allowance tapers off from 2008-15, to encourage prompt action and 10 per cent of the qualifying 1.5 million apply each year; 40 per cent of all landlords will take up the allowance before 2015.

**Lower VAT on energy efficient products and services (chapter 5):** It is assumed that about £2 billion pa is spent by householders and the construction industry on measures such as double glazing, on which 17.5 per cent is charged at present.

The remaining measures require investment by Government. Some of these could and may be undertaken by lenders (such as low-interest green mortgages) or the utilities (for instance on low- and zero-carbon technologies through the Supplier Obligation). However, the aim is to limit the costs that are transferred to non-participants, especially through energy costs to the fuel poor, so the assumption is that the Government funds all these schemes directly.

Summary details of investment programmes (Table 10.3):

**Fuel poverty (chapters 7 & 9):** The programme is delivered mainly through Low-carbon Zones. The 4 million homes of the fuel poor are starting from a very low level of energy efficiency (around SAP 30) and have to be brought up to a high standard (SAP 80) to account for the effect of recent fuel price increases. This has to be achieved by 2016, to comply with the Warm Homes and Energy Conservation Act 2000. The investment is both in insulation and low- and zero-carbon technologies and the recipients are in all tenure groups, but predominantly owner occupiers.

**A second Decent Homes (chapter 5):** Most social housing has already been improved (or will be by 2010), in theory, to a level of SAP 65, so that it costs less to upgrade these properties to SAP 80. The improvements include low- and zero-carbon technologies, to provide training for the construction industry. Of the 4.6 million properties, only about 20 per cent are in fuel poverty and already covered by an investment programme. The remaining 3.7 million homes are treated over a 20 year period.

**Low interest loans (chapter 5):** This is the major programme, because it encompasses the most households and requires no prior capital. At any stage, a householder can apply for a loan with a low rate of interest, as the Government provides a 3 per cent subsidy. The maximum loan is for £20,000, though the average is £15,000. This results in a £450 subsidy pa

for 10 years, that is £4,500 per household in total. A substantial improvement in the energy efficiency of the house has to be achieved. The loan is taken out by 5 per cent of owner occupiers each year, that is 900,000 households pa. By 2016, after nine years, this has built up to an annual expenditure of £3.65 billion.

**Low- and zero-carbon technologies (chapter 6):** The aim is to promote 25 million installations into existing homes by 2050, at an annual rate of 600,000, through one programme or another. The rate has to be maintained, even if an individual programme slips. For the first nine years, it is assumed that these technologies are being installed through the Low-carbon Zones and a second Decent Homes scheme at a rate of 625,000 pa. After 2016, the LZC programme supplements the second Decent Homes scheme with an annual installation rate of 400,000, until 2027. From 2028-50 it is the only source of assistance with the capital cost of low- and zero-carbon technologies and supports 600,000 pa. The average grant is for £2,000.

**Home Improvement Agencies (chapter 7):** A nominal annual supplement of £100,000 is provided for the 250 existing agencies, on the assumption that their main role is to help their clients access the other grants.

**Local authorities (chapter 9):** The local authorities have a major co-ordinating role, which includes developing a heat network, organising the Low-carbon Zones and dealing with unhealthy homes. The figure of 436 local authorities with housing responsibilities is assumed to be for the whole UK.

The total costs of these two types of payments (tax cuts and investment) for each of the years 2008-16 is £12.9 billion. Whilst the scale of these costs is large, the Government has so far failed to reflect the urgency of tacking climate change in its expenditure plans. As the chief scientist has declared, climate change is a greater threat than terrorism.

At today's prices, the average householder has moved from an annual expenditure of £725 for all energy costs in 2006, to £250 in 2050 – a 66 per cent reduction. Across the 25.8 million households that exist now, this represents a total saving of over £12.3 billion recurring annually.

Everything to do with the housing sector involves large numbers, for instance:

- The housing stock is worth over £4 trillion (£4 million million), but is not being replaced – it is being fossilised. It should be protected and prepared for this, the climate change century.
- Householders spend £18.8 billion each year on their energy costs, but obtain poor value for this money, often through a lack of capital or ignorance.
- £5.4 billion pa is already spent on double glazing, central heating and insulation for households, both new and existing (Mintel 2007).
- Householders spend about £23 billion pa on home improvements, but only a proportion of this relates to reducing carbon emissions (DTI 2007b), though when the builders are in the house, the costs of carbon reductions would be low.
- The residential sector is worth £50 billion pa to the construction industry; half of this is for new construction and the remainder is for repair, maintenance and improvement (DTI 2007b). Again, the link with carbon emissions is difficult to isolate.

The present expenditure on energy-in-housing policies already includes about £630 million pa on the fuel poor and a level of £1 billion pa for fuel poverty has been proposed (FPAG 2007). Under the proposed Carbon Emission Reduction Target, the utilities will be spending about £1 billion pa. These sums are insufficient to eradicate the growing problem of fuel poverty and to ensure that residential carbon emissions begin to fall consistently and substantially. However, they do indicate that other sources of funds, for instance from the utilities, are available, though with the latter, there are resultant increases in costs for consumers. To protect the poor, most of the investment has to come from Government.

The findings of the Stern Review (Treasury 2006) were that early action is still the least costly route to a low carbon future. Any delay increases the costs and the risks:

> "Mitigation – taking strong action to reduce emissions – must be viewed as an investment, a cost incurred now and in the coming few decades to avoid the risks of very severe consequences in the future."

The Stern Review found that the net effect of all policies to cut carbon dioxide emissions would lead to a 1 per cent reduction in world GDP and this approach would be justified now to reduce the risk of future costs equivalent to 5-20 per cent of world GDP. He confirmed the need for leadership from the developed countries. The Stern analysis easily justifies the spending figures in this report. For example:

- The spending figure of £10.5 billion is part of a cost effective package to deliver 80 per cent carbon emission cuts by 2050.

- An 80 per cent cut by 2050 by the UK is compatible with preventing globally dangerous climate change.
- Stern reports that preventing such climate change would be five to 20 times better for the global economy than not taking action.
- Damage from not tackling climate change is estimated at 5 to 20 per cent of world GDP by 2050. Assuming just 5 per cent damage, the cost to the UK economy is over £100 billion a year by 2050.

## Wider benefits

There are several tangible benefits from these investments:

- The value of the housing stock is maintained.
- They result in income for the Treasury, through VAT (even at 5 per cent) on the higher levels of expenditure on energy efficiency and low- and zero-carbon technologies.
- There is more taxation from the salaries of those newly employed.
- Less benefits are paid to the unemployed.
- There are less NHS costs as a result of the reduction in fuel poverty.
- The reduced energy consumption contributes to the UK's future balance of payments and security of supply, by reducing the need for expensive imported fuels, such as gas. As the UK becomes ever more dependent on imports, this is a significant benefit, both financially and in energy security terms.
- The resultant carbon reductions mean that the UK will be more able to meet its international commitments and so does not incur carbon penalties. If programmes are really successful, then there may even be surplus carbon to sell.
- But, overall, the commitment should be made to reduce the risk of climate change – the UK should be showing the leadership expected of us.

These benefits will only occur as a result of the right policies – it is not just about spending sufficient money. The policies brought together in this Low-carbon Strategy and outlined earlier in the report demonstrate powerfully the scale of the challenge that has to be met.

## An 80 per cent house

As final confirmation of the benefits of this Low-carbon Strategy, the following gives an insight into what it will be like living in an 80 per cent house:

- The house will look much like it does today, but with the addition of solid wall insulation (inside or out), double or triple glazing and shutters to protect against the summer sun. There is at least one solar technology on the roof and may be a wind turbine, if the house is in an exposed or rural area.
- The indoor environment will be more comfortable as a result of the insulation, achieving a temperature of 21°C when occupied. Even when there is no-one at home, or at night, the house is never cold.
- The family scourge of ill-health from asthma has been reduced, now that there is no mould and condensation in the house.
- In the summer, the house is kept cool by closing the shutters during the day and leaving the upstairs windows open at night.
- There is more space: the reduced need for heating has resulted in fewer radiators on the walls. The woodstove in the sitting room is lit occasionally in winter on cold days and special occasions, to give a cosy atmosphere. Otherwise, it is not needed.
- The household's lifestyle fits around the way in which heat and electricity are generated: they are more likely to have a shower in the evening than the morning, to use the solar-heated water. The washing machine comes on, as a result of a sunlight-sensitive timer, to use the electricity from the photovoltaic panels on the roof.
- The careful use of electricity is second nature. Lights and appliances are turned off when not needed, to earn the most from the feed-in tariffs on electricity exports. These actions also help conserve the personal carbon allowance for the occasional holiday abroad.
- Information on the monitor in the kitchen warns when the price of electricity is high, in case something else can be switched off, and shows how much electricity is being exported. This helps identify that everything is working properly – recently the inverter on the photovoltaic panel broke and was replaced promptly by the Energy Service Company, without the loss of too much electricity;
- The householder has become a consumer watchdog, checking that each new piece of equipment is delivering the expected savings. A recent purchase was returned when the stand-by consumption proved to be more than 0.1W.
- The lighting throughout the house is from light emitting diodes (LED), but they are beginning to experiment with oleds – organic LEDs – where the light comes from material or wallpaper, not specific 'fittings'. This has some exciting effects that all members of the family enjoy.

## Summary

All of the above components come together to form a powerful strategy for converting UK housing to low-carbon. By 2050, the emissions are 17 per cent of the 1990 level as a result of both strong levels of investment in reducing demand and in supplying that demand from low- and zero-carbon technologies. This reduction is achieved despite a 23 per cent increase in household numbers and higher standards of living within the home: each person has more space, is warmer, uses slightly more hot water and has access to more appliances and household equipment. Life is very comfortable in the 80 per cent home.

Substantial levels of investment are required by Government to achieve this and to ensure that low-carbon living is enjoyed by all income groups. Fuel poverty has been eradicated and the average household has fuel costs that are a third of today's level. This is without factoring in income from selling electricity through the feed-in tariff: the residential sector is producing 10 per cent more electricity than it needs. The Government has been careful to ensure that the extra costs of investment by the utilities and from the renewable obligation have not resulted in disproportionate price increases for the poorest households.

It is the level of investment by Government and new direction that this heralds that is the single most important message for the public: fighting climate change is essential and action is required now. The necessary changes are going to cost money, but the Government is committed to the task and this proves it.

Local authorities have major responsibilities, both for eliminating fuel poverty and for controlling household carbon emissions. This has resulted in many innovative policies, the widespread adoption of combined heat and power and clear support for renewable technologies. Many homes that used to be hard to heat and cold are now low-carbon, but still occupied by low-income families.

This Low-carbon Strategy provides an exemplar for other sectors on how to achieve a low-carbon future. For Members of Parliament, it provides a sound basis for discussions on the Climate Change Bill and the commitments that the UK can give to mitigating future climate change.

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# HOME TRUTHS:

## A LOW-CARBON STRATEGY TO REDUCE UK HOUSING EMISSIONS BY 80% BY 2050

The Low-carbon Strategy from the Environmental Change Institute at Oxford University identifies the policies needed to deliver an 80 per cent cut in carbon emissions from UK homes by 2050. These cuts are achievable but will require a quantum leap in commitment from Government and a radical new approach.

The policies have been designed not only to dramatically reduce carbon emissions, but also to be delivered equitably. The poorest households will be prioritised for assistance and fuel poverty will be wiped out.

The scientific consensus is that for the UK to play its part in helping the world avoid a rise of more than 2°C, we must reduce our carbon emissions by 80 per cent by 2050. The household sector represents 27 per cent of our total emissions and achieving deep cuts here is an imperative.

The low-carbon revolution starts at home.

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