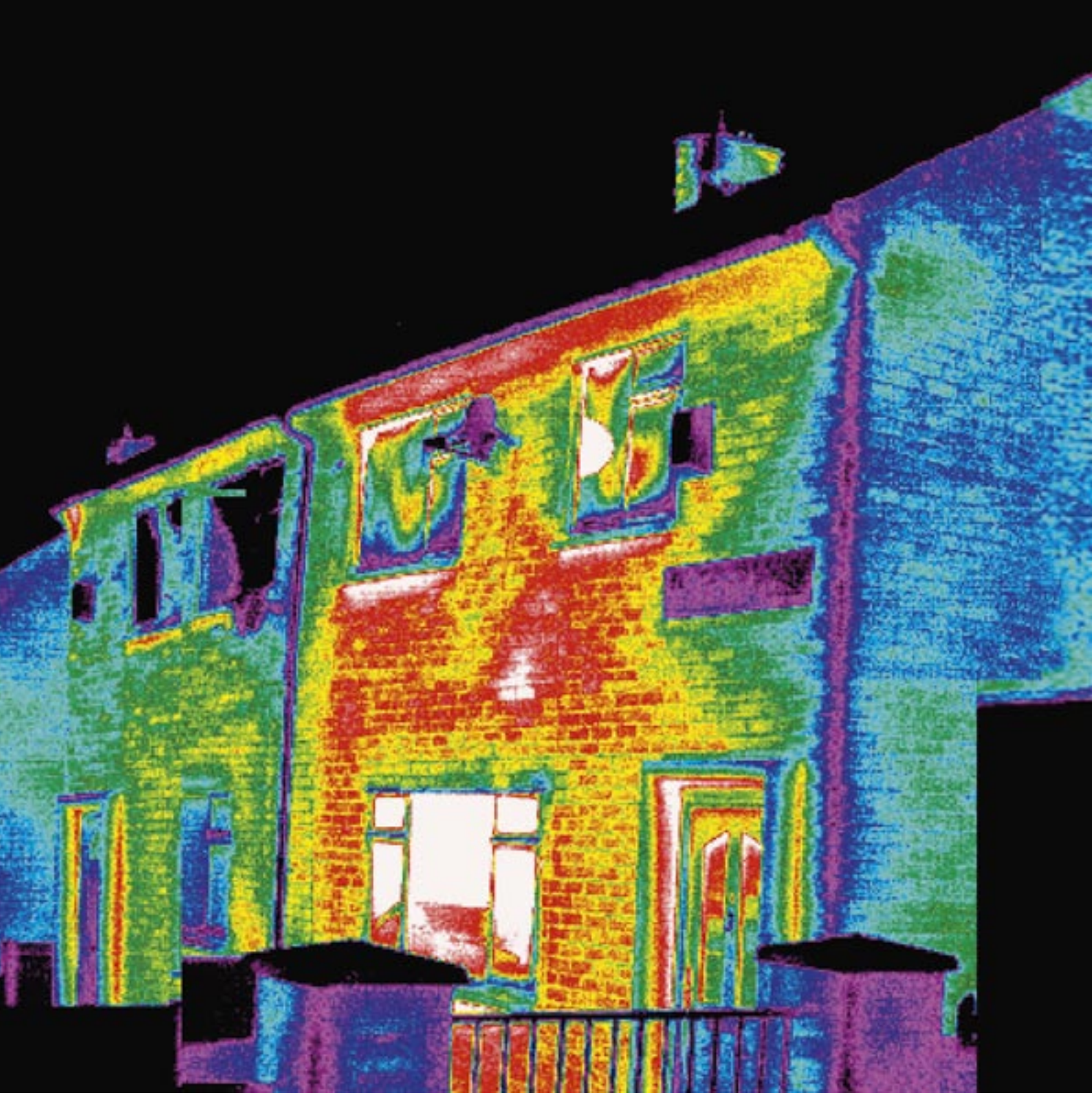

National Audit Office

Programmes to reduce household energy consumption

REPORT BY THE COMPTROLLER AND AUDITOR GENERAL | HC 1164 Session 2007-2008 | 11 November 2008

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National Audit Office

Programmes to reduce household energy consumption

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Tim Burr
Comptroller and Auditor General
National Audit Office

26 June 2008

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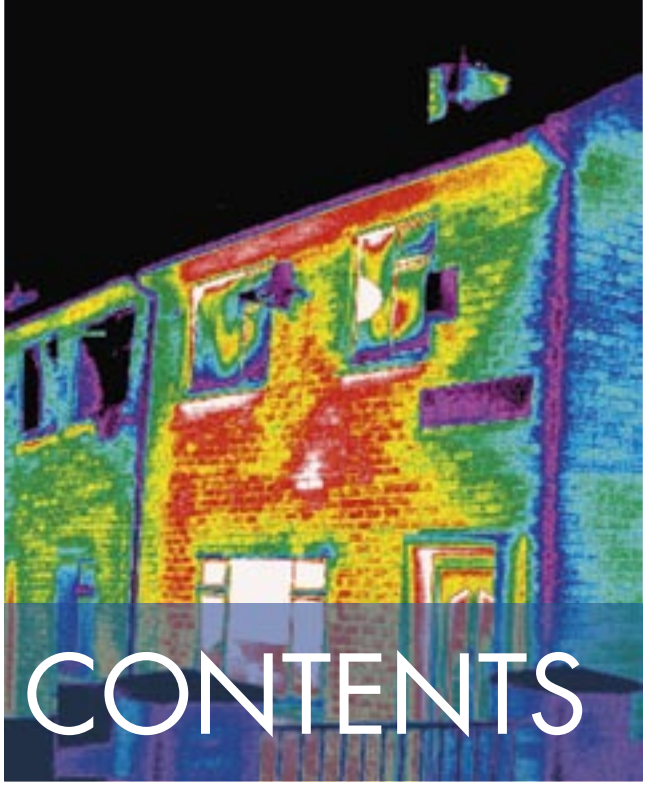
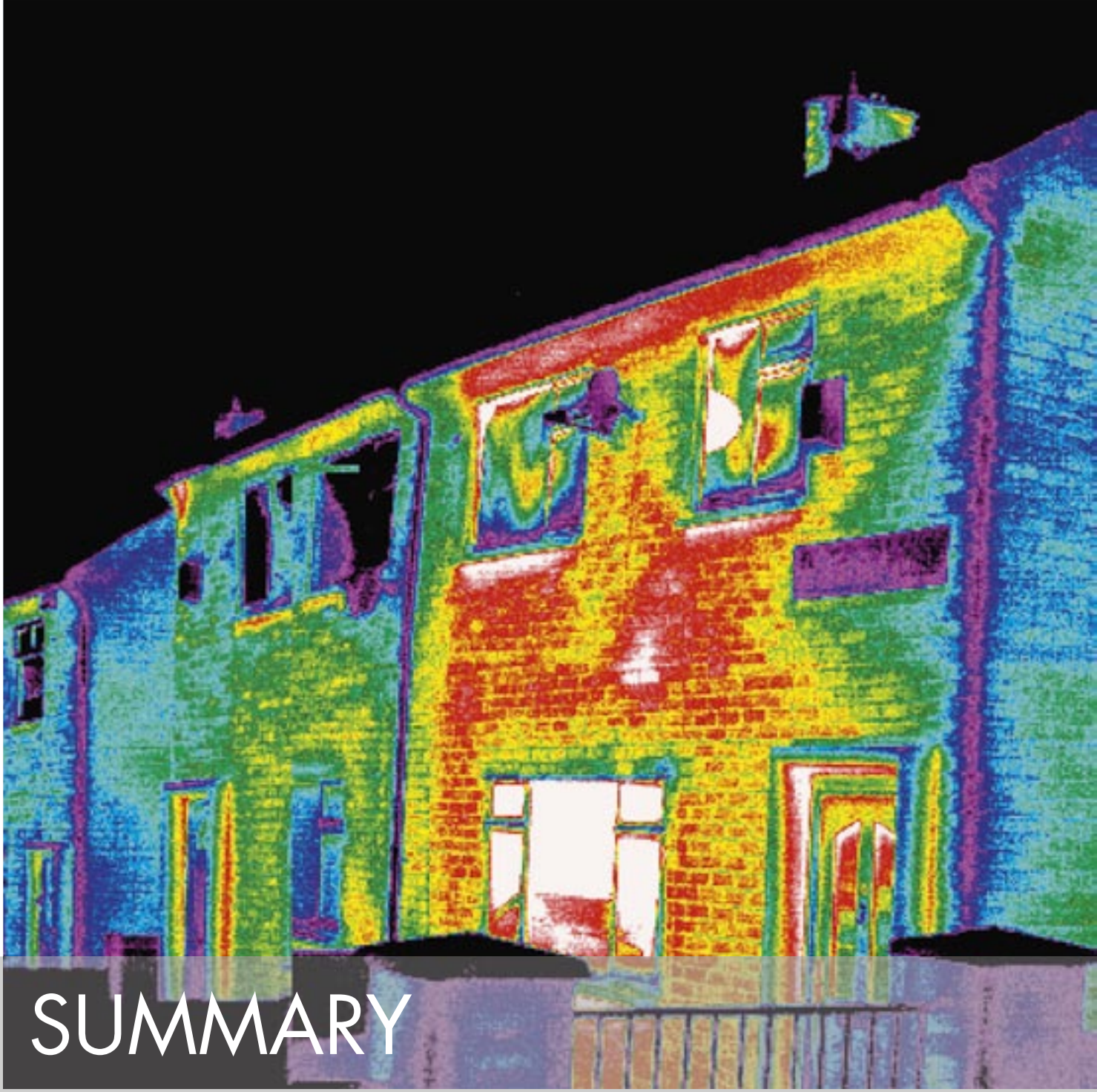


CONTENTS



SUMMARY

1 Household energy consumption is an important area of public policy. UK households spend £20 billion on energy each year, mostly on electricity and gas, and account for just under 30 per cent of all energy consumed in the UK. Programmes to improve energy efficiency and reduce energy consumption cost some £2.6 billion a year: a mixture of direct expenditure and compliance costs borne by business and households. However, the value of the possible energy savings is thought to outweigh these costs many times over –at current prices the typical household could save at least £280, or roughly 30 per cent of their energy bills, if they adopted the cost-effective measures already available to them. In addition to its financial importance, household energy consumption is responsible for 27 per cent of all carbon emissions, and is central to efforts to mitigate climate change. And in times of rising energy prices and concerns over energy security, reducing household energy consumption can help reduce fuel poverty and reduce reliance on imported energy.

Key targets

There are two measures against which government has set targets: energy consumption and energy efficiency. Improving energy efficiency contributes to the ultimate goal of reducing energy consumption.

On energy consumption:

- government has set a UK-wide target to cut total energy consumption across all sectors by 9 per cent by 2010 compared with average 2001-2005 levels; and
- government is expecting that the contribution from households towards that target will be to reduce their energy consumption by just over 11 per cent by 2010, and a further 2 per cent by 2016, compared with 2001-2005 levels.

On energy efficiency:

- government has set a target for households in England to be 20 per cent more energy efficient in 2010 than they were in 2000; and
- government has also set a target to save 4.2 million tonnes carbon (MtC) per year by 2010 through energy efficiency measures in the UK residential sector (3.5 MtC in England) from a 1990 baseline.[1] This carbon-based target reflects a similar outcome in terms of the required improvement.

2 This report examines the programmes government has put in place to reduce energy consumption in England, including UK-wide programmes, but excluding programmes specific to Scotland, Wales or Northern Ireland. It sets out government's targets and expectations, progress to date and the significant issues influencing the cost-effectiveness of the four major programmes in this field. In doing so, it draws upon departments' own estimates of energy savings, which are produced in accordance with cross-departmental guidance and processes.

Main findings

3 Programmes to influence household energy consumption have been in place since the early to mid 1990s. The main programmes have been those to promote and install energy efficiency measures in households, particularly in vulnerable households to reduce fuel poverty, setting energy efficiency standards for new homes via Building Regulations, and requirements for new household appliances to be more energy efficient. There have also been information campaigns to influence householder behaviour. These programmes are delivered by a range of government bodies, principally Defra, CLG and BERR. Defra is responsible for overall coordination and delivery.

4 These programmes have contributed to improvements in household energy efficiency (it now takes less energy to heat our homes to the same temperature) but, until very recently, overall household energy consumption has risen. Household energy efficiency improved steadily between 1990 and 2004 – by approximately 1.4 per cent a year (19 per cent since 1990), with greater improvements in social than in private housing, reflecting past concentration of efforts on vulnerable groups. However, improvements in energy efficiency have until recently not been enough to offset other trends – such as the growth in the number of households, more comfortable homes (e.g. more of the house heated to the same temperature), and the growth in energy-using appliances – which have meant that household energy consumption rose 19 per cent between 1990 and 2004.

5 Prior to 2004 there were no targets specifically for household energy consumption or efficiency. Targets and expectations have built up over time as a result of EU requirements and UK policy reviews. As a result, the main energy targets to which UK households contribute differ in the nature and timings of the baselines, their target dates and their geographical and sectoral coverage. No specific energy-related targets have been set beyond 2016. Therefore, the contribution that household energy consumption is expected to play in meeting the range of energy policy objectives in the longer term (including reducing fuel poverty, reliance on imported energy and climate change, where UK-wide targets have been set to 2050) is unclear. Departments expect that in the future, targets for household energy consumption will be driven by carbon budgets set by the Government in response to the recommendations of the proposed Climate Change Committee.

6 Despite the gradual rise in household energy consumption since 1990, government now anticipates a significant reduction in household energy consumption. Indeed, energy consumption has fallen in 2005, 2006 and 2007 (gas consumption decreased 12 per cent over the period; electricity consumption decreased only marginally and remained slightly higher in 2007 than in 2004). These are promising signs, and if this trend continues, suggest that households' share of the key targets for consumption, set for 2010 and 2016, can be met. Departments have made considerable efforts in recent years to pull together a more systematic approach to household energy consumption – especially in the Energy Efficiency Action Plans of 2004 and 2007. Achievement depends on successful delivery of various programmes; but is also dependent on non-policy factors influencing energy consumption such as energy prices.

7 It is difficult to assess progress against the 2010 energy efficiency targets; the latest available data are for 2004. Although Defra has an agreed method to measure performance against the target, it has not done so since 2005.

8 Departments' plans to reduce future household energy consumption rely mainly on an expansion or continuation of existing programmes, or new programmes: more stringent **Building Regulations** which require new homes and some renovated homes to be more energy efficient; **obligations on energy suppliers**, which require them to promote household energy efficiency measures to consumers; and **programmes to improve the efficiency and labelling of household appliances** to require or encourage the purchase of more energy efficient models. In addition the government provides **information to influence behaviour**, including proposals for Better Billing and Metering so that households are more energy-aware. But there are some major challenges:

- There is a growing recognition that non-compliance may undermine the effectiveness of Building Regulations, especially as they become increasingly stringent. But as yet there is little concrete information on the extent of non-compliance or how best to tackle it. There are also concerns, but little information, over the capacity of the construction supply chain to deliver more stringent energy standards
- Obligations on suppliers to promote energy saving measures have been successful, particularly in targeting vulnerable homes. But there are concerns about the capacity of the energy efficiency industry (e.g. insulation manufacturers and installers) to meet the required installation rates of key measures (such as loft and cavity wall insulation); and about the level of consumer demand required to drive expected future energy savings, particularly in private households.
- Even by 2050 two thirds of the housing stock will have been built before 2005, so there is a need to focus on existing housing as well as new homes. Future obligations on energy suppliers will require them to install more measures in private households, but it is uncertain whether sufficient consumer demand can be generated. Also, 43 per cent of homes in England have at least one feature associated with 'hard to treat' housing stock – so cannot be fitted with all standard energy efficiency measures.
- Programmes to move consumer choice to more energy efficient appliances through design and labelling schemes have had some effect although the UK lags behind others in Europe. Estimates of their future effectiveness depend on as yet unknown technologies, and on the European Union's preparedness to adopt them (the UK government is not able to set mandatory standards for products; international agreement is required). There are particular risks and uncertainties regarding the growing consumer electronics sector. Also, UK and EU standards are not as wide-ranging or as stringent as some in other parts of the world.
- Alongside technological efforts, programmes will need to address householder behaviour. Householder behaviour is not only important for the take-up and impact of the other programmes listed above but also because behaviours such as leaving lights on and using unnecessary heat have a big impact on overall energy consumption. But there remains a significant gap between householder awareness and behaviour. There is limited information about the outcomes of information programmes (in terms of a discernible shift in consumer attitudes and behaviours) and thus about their cost-effectiveness, or how they could be better designed in the future. In particular, there is considerable uncertainty over the likely impact of better ways of metering.

Recommendations

9 After years of increasing household energy consumption, the relevant departments (Defra, BERR, CLG) now anticipate a significant reduction in energy consumption and continued improvements in energy efficiency. But to achieve future targets, and for these programmes to be cost-effective, there is much that still needs to be done:

- **There are no explicit targets for household energy consumption beyond 2016 and none for energy efficiency beyond 2010.** Instead, departmental expectations are embedded in the analysis supporting the Energy White Paper and Climate Change Programme. Defra should consider whether household energy consumption is important enough in its own right to warrant more explicit targets, and clarify expectations of household energy beyond 2016.

- **There are some lags and deficiencies in the data needed to monitor progress towards targets.** The latest available household energy consumption data are a provisional figure for 2007. The target for energy efficiency was set in 2004 but Defra has not updated the data used to measure performance against it since that year. Defra will need to improve the data on which progress is monitored, so that programmes can be responsive and kept on track.

- **The evidence base about programme effectiveness needs further work.** Defra, BERR and CLG have developed better models and projections, but there is as yet a lack of genuine ex-post evaluations of effectiveness based on real practice in homes. This should include a deeper understanding of the impact of installation techniques on the effectiveness of insulation; the capacity of industry supply chains to meet required insulation installation rates and to meet stricter Building Regulations; and the performance of measures once installed, perhaps through learning from exemplar housing developments.

- **Until recently, there had been little work carried out to establish whether non-compliance with Building Regulations may be a significant factor inhibiting effectiveness.** Until now, projected impacts for this programme have assumed full compliance. A project, part funded by CLG, is now underway to look at average levels of compliance with energy efficiency standards in the Regulations. This work needs to be concluded and continued and convincing proposals made to address the issues. The results of this project must be used to inform future amendments to the Regulations and support more realistic estimates of impact. This will be especially important since future Regulations are expected to be more stringent and non-compliance correspondingly more likely.

- **Older and private homes may need to assume greater importance if energy targets are to be met.** Existing homes dominate the housing stock. Although departments believe that the current policy mix will deliver the required energy savings, there are nonetheless significant risks and uncertainties. It will be important that departments monitor the progress of current programmes in addressing the poor energy performance in many older and privately-owned homes and consider whether further intervention is required when deciding on the design of the Supplier Obligation post-2011.

- **Better information on the use of energy efficient appliances could help bring about more effective policy.** Data on the use of such appliances varies by type of product; Defra should consider what scope there is to improve the evidence base, for example by setting up long term monitoring of appliance use in a representative sample of homes. There is also limited information from which to compare and learn lessons from UK performance with European counterparts; Defra should renew its efforts to work with other Member States as far as possible to put together a more systematic picture of performance across the EU.

- **Whilst householders are aware of energy efficiency and climate change, there are many barriers to action, both real and perceived.** How householders use energy in their homes can undermine attempts to improve energy performance in UK homes; overcoming the barriers to action is crucial to delivering energy savings in the existing and new housing stock. Whilst Defra now has a good understanding of these barriers, it is less clear whether the policy mix is addressing all of them sufficiently. There is also a need to assemble more evidence about the outcomes of information programmes, incorporating the results of ongoing evaluations, and about how householders are likely to respond to Better Billing and Metering initiatives. The evidence base for the cost-effectiveness of smart metering compared with other ways of providing information to households is thin, and needs development before departments can be in a position to recommend expansion.

- **Earlier work on cost-effectiveness gives some assurance but could be updated and improved to inform future decisions on the best mix of programmes.** Work carried out at the time of the 2006 Climate Change Programme Review was based on carbon reductions rather than energy saving, and explored a limited number of options for varying the mix of programmes. Things have moved on, and departments should use forthcoming reviews of household energy policy to look again at the most effective mix of policies to reduce household energy consumption.

Value for money conclusion

10 Reducing household energy consumption should provide value for money for consumer and taxpayer alike. If government programmes are designed and carried out well, many householders across England will benefit from warm homes and lower energy bills, whilst wider objectives relating to climate change and energy security are made more achievable. There are some signs that these programmes have begun to reverse the long term trend of rising energy consumption and analysis shows that they have been cost-effective. However, for all types of intervention, departments must collect more evidence to be sure that their programmes are working as well as they could be.

11 To achieve their longer-term targets, programmes must focus increasingly on homes that are harder to treat, technologies that are newer and more expensive, and householders who are less keen to act. These challenges make the risks to cost-effective delivery of energy savings in the future all the greater. Departments have done good work to identify these risks, but as yet there is not convincing evidence that these risks can be overcome.

PART ONE

Introduction

Household energy is an important area of public policy

1.1 Household energy consumption is an important area of public policy, for several reasons:

- The UK's 26 million households spend around £20 billion each year on energy, but at current prices the typical household could save at least £280, or roughly 30 per cent of their energy bills, if they adopted the cost-effective measures already available to them.[2]
- There are a number of government programmes which aim to influence household energy consumption, which together cost taxpayers and households around £2.6 billion a year in public expenditure or compliance costs.
- Household energy consumption affects four major government policy objectives:
  - Household energy consumption is responsible for 27 per cent of UK carbon emissions[3] and is a significant component of climate change policy;
  - Household energy consumption influences overall energy demand and the need for energy imports – with consequences for energy security and reliability, which are the subject of increasing concern;
  - Household energy demand pushes up energy prices for both households and businesses, with potential adverse impacts on UK competitiveness; and
  - More energy efficient homes can reduce household energy bills, which in turn can reduce fuel poverty, allowing vulnerable households to heat their homes adequately.

There are both UK and EU objectives and targets for household energy

1.2 Energy targets have been set in terms of both consumption and efficiency:

- Consumption is an absolute measure of energy consumed in households.
- Efficiency is a relative measure of the amount of energy consumed to meet a certain level of 'energy service demand' – which reflects how warm householders want to heat their homes, how many hours householders want to watch TV and so on. For example, a better insulated house is more energy efficient, so will require less energy to heat to a certain temperature.

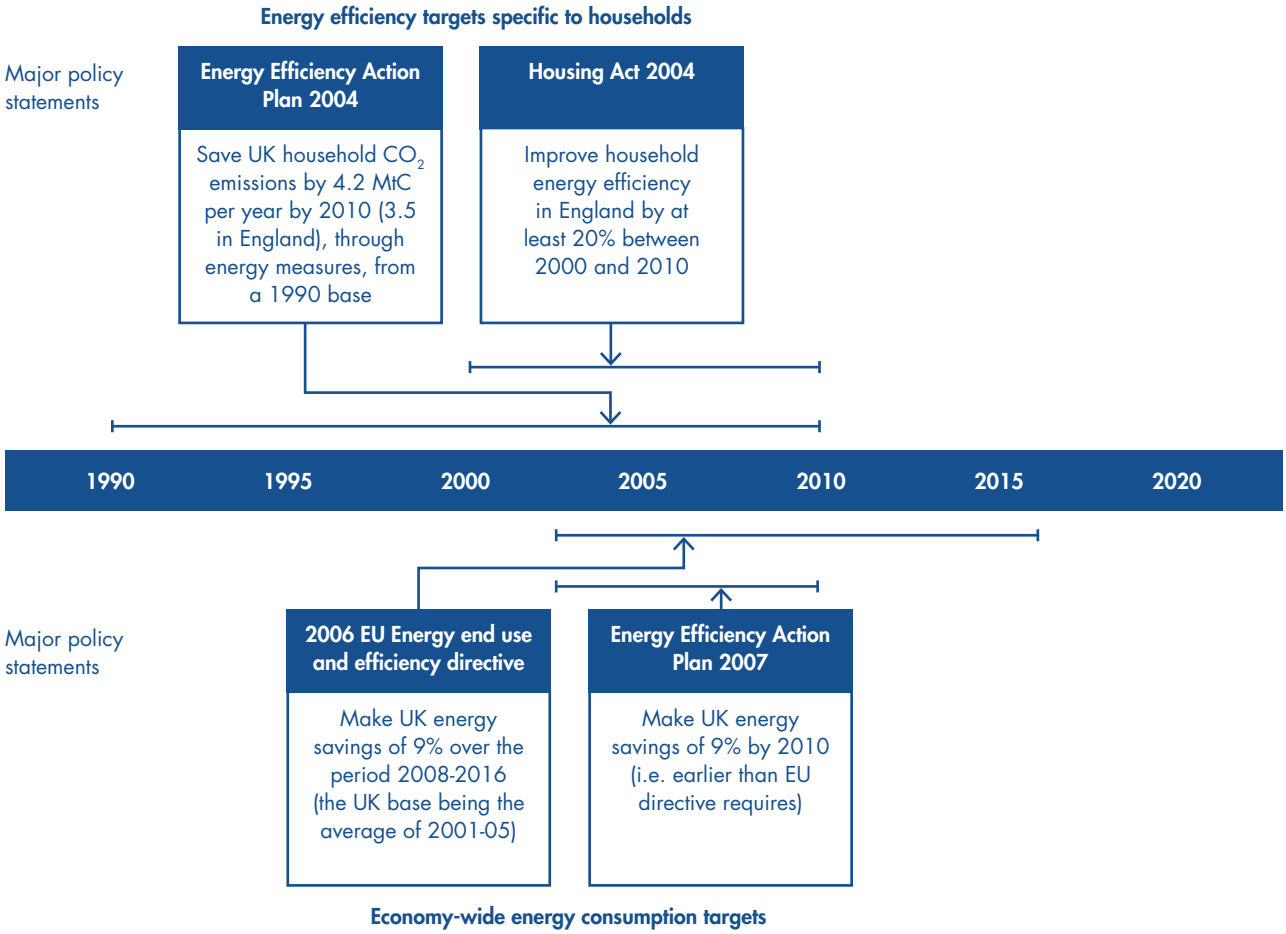
Figure 1 overleaf summarises the four energy targets to which households contribute, and the policy statements from which they arose. The Department of Communities and Local Government (CLG) is responsible for overseeing delivery against the Housing Act 2004 target, and the Department for Environment, Food and Rural Affairs (Defra) is responsible for the other targets. In practice, Defra calculates the information to monitor progress against all four targets.

1.3 Government has set two energy efficiency targets specifically for the household sector:

- To take reasonable steps to improve residential energy efficiency in England by at least 20 per cent by 2010, from a year 2000 baseline; and
- To save 4.2 million tonnes carbon (MtC) per year by 2010 through energy efficiency measures in the UK residential sector (3.5 MtC in England) from a 1990 baseline.[4] This carbon-based target reflects a similar outcome in terms of the required improvement to the energy performance standards of housing and so will not be discussed separately in this report.[5]

1.4 Government also expects the household sector to contribute towards economy-wide energy consumption targets. A 2016 target was set by the EU; the UK government has chosen to try to achieve this early, by setting the same target to be achieved by 2010. Although no targets have been set for households specifically, the sector's expected contribution to UK-wide energy savings in 2010 and 2016 imply the following levels of ambition: to save annual energy consumption in UK households of just over 11 per cent by 2010 compared with 2001-2005 levels[6]; and a further 2 per cent by 2016.[7]

1 There are four principal targets relating to household energy



Source: National Audit Office

NOTES

The arrows indicate when the target was introduced.

Two further targets and objectives have been specifically excluded from this review:

1 1995 Home Energy Conservation Act (HECA) requirement for local authorities with housing responsibilities to produce and report against improvement plans to achieve a 30 per cent improvement in energy efficiency by 2006-2011. This is a local authority requirement, outside the scope of our review; Defra is currently looking to repeal it.

2 The process (rather than outcome) intention, announced by government in the Budget 2007, that by 2020, 'all householders will have been offered help to introduce energy efficiency measures, with the aim that, where practically possible, all homes will have achieved their cost-effective energy efficiency potential'.

1.5 In addition to the energy targets, there is a host of other expectations for household energy, which are implied or built into the carbon and energy projections which underpin UK climate change policy. The first targets for UK carbon emissions were set in 1997; it was not until 2004 that a target was set for household energy.

1.6 Whilst UK carbon targets have been set for both 2020 and 2050, there are no specific energy targets set beyond 2016. Discussions have begun within government to determine whether setting longer term energy targets would be desirable. Current expectations for energy saving in the household sector by 2020 are demanding – when compared to the 2001-05 average consumption, they imply household energy savings of 36 per cent.[8]

1.7 In its Energy Efficiency Action Plan 2007, the Government committed to reporting annually on progress of delivery of the polices and measures set out in the plan as part of the report to Parliament already required under the Climate Change and Sustainable Energy Act 2006. Further Action Plans must be submitted to the European Commission in 2011 and 2014 which will include an analysis and evaluation of measures set out in preceding Action Plans and progress towards meeting the 2016 energy saving target.

A number of programmes influence household energy consumption

1.8 Government has a range of programmes to influence household energy consumption; most have been in place in some form since the early to mid 1990s. The programmes which are currently in place are set out in more detail in **Figure 3 on page 13**. They are delivered by a range of government bodies, principally Defra, CLG and the Department for Business, Enterprise and Regulatory Reform (BERR). Defra is responsible for overall coordination and delivery. The programmes fall into four main groups, involving a mix of subsidies, direct expenditures, regulation and fiscal measures:

- **Programmes which require higher energy efficiency standards for dwellings**, via regulation. CLG sets energy efficiency standards for the housebuilding industry and for social housing landlords. Industry faces the direct costs of compliance, but may pass these on to consumers, depending on wider market conditions.
- **Programmes to encourage the installation of energy efficiency measures in homes**, via obligations on energy suppliers, subsidy and fiscal incentives. Defra and Ofgem set targets for energy suppliers to promote energy efficiency measures to householders. The costs are met by suppliers, who may recover some or all of their costs from customers through retail tariffs. Defra offers grants to homeowners to improve the energy efficiency of their homes, paid for out of direct public expenditure. The Treasury forgoes some VAT to encourage homeowners to install energy saving measures.
- **Programmes to improve the efficiency and labelling of household appliances.** Defra promotes voluntary agreements with appliance manufacturers and retailers (a sector where mandatory regulation can only be set by the EU). Defra also overseas the implementation of mandatory EU standards in the UK. Industry faces the direct costs of compliance, but may pass these on to consumers, depending on wider market conditions.
- **Programmes to provide information to influence householder behaviour.** Defra and BERR run a series of programmes which involve direct public expenditure. And EU legislation now requires Energy Performance Certificates to be issued when buildings are constructed, sold or rented out.

1.9 Together these policies cost the taxpayer, industry and the public over £2.6 billion a year. Subsidy, information provision and fiscal incentives come at a direct cost to the Exchequer – about £358 million in 2008-09. Obligations, regulations and voluntary agreements tend to require expenditure by industry, which they may pass on to consumers – about £2.2 billion in 2008-09, based on information supplied by departments.

This report reviews what is known about the cost-effectiveness of programmes to influence household energy consumption

1.10 This report examines the programmes government has put in place to reduce energy consumption and improve energy efficiency in homes in England, including UK-wide programmes that impact on England, and follows previous National Audit Office and Committee of Public Accounts interest in this area.[9] The report focuses on the effectiveness of programmes to tackle household energy consumption and energy efficiency:

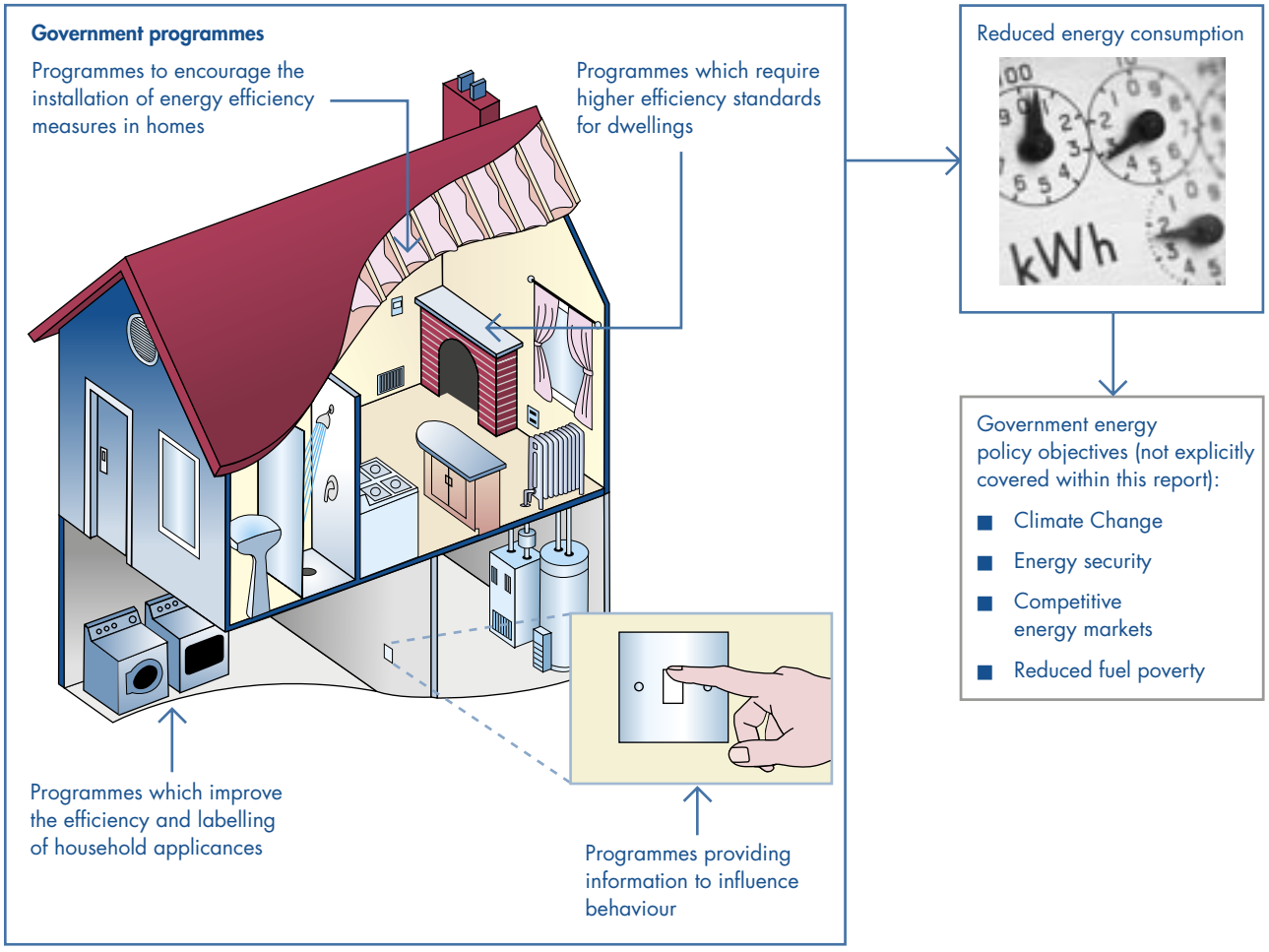
- Part 2 looks at progress to date and whether government is on track to meet its medium term targets.
- Parts 3 to 6 look at the four main programmes which together are expected to account for almost all the energy savings needed to meet the 2016 target, as well as around 80 per cent of the estimated £2.6 billion annual cost:
  - Building Regulations and similar standards for construction (Part 3);
  - Obligations on energy suppliers (Part 4);
  - Programmes to influence or dictate the selection, design and labelling of appliances (Part 5); and
  - Information to influence household behaviour (Part 6).

The report looks at the effectiveness of these programmes at reducing household energy consumption; it does not focus questions associated with wider energy policy government objectives **(see Figure 2)** or the method of energy supply.

1.11 Our report is based on a critical review of policy documents and evaluations; a wider literature review; interviews with policy officials; input from the house-building and energy supply industries; and consultation with independent energy policy experts. We employed AEA Technology to assist us with our critical review of policy documents. Our methodology is detailed in Appendix 1. Energy characteristics of housing in England are detailed in Appendix 2.

2 This report looks at the effectiveness of programmes to reduce household energy consumption

Scope of this report



Source: National Audit Office

3 Current household energy consumption programmes and estimated annual costs to the UK

Programmes arranged by type (UK-wide unless otherwise stated)	Type of programme	Estimated annual cost to the UK in 2008-09 (£m)	Description of costs	Lead department
Raising the standards of energy efficiency for dwellings				
Building Regulations 2002 and 2005-06 (England and Wales)	Regulation	485	Annual additional compliance costs	CLG
Decent Homes (England) Standards for social landlords to meet, which include energy efficiency criteria.	Regulation	100	Expenditure by social landlords to comply with standards relating directly to fuel poverty	CLG
Installing energy efficiency measures in homes				
Warm Front (England) Grants to improve household energy efficiency for people in fuel poverty.	Subsidy	300	Defra funding for 2008-09	Defra
Obligations on energy suppliers (known as the Carbon Emissions Reduction Target for 2008-2011) An obligation on suppliers to install energy saving measures in households.	Obligation	1,400	Compliance costs borne by suppliers, householders and social landlords	Defra and Ofgem
Fiscal and other measures These include the Landlords Energy Saving Allowance, reduced VAT on energy saving materials materials and grants made through the Environmental Action Fund.	Fiscal incentive	Data Not Available		HM Treasury/ Defra
Programmes to improve the efficiency and labelling of household appliances				
Market Transformation Programme This supports policy on energy efficient products, including negotiating agreements with manufacturers and retailers.	Voluntary agreements	4	Annual expenditure, of which around 70 per cent may relate to households	Defra
Influencing household behaviour through information				
EU Energy Performance of Buildings Directive Requires Energy Performance Certificates to be issued when buildings are constructed, sold or rented out.	Regulation	226	Annual costs of the Energy Performance Certificate scheme (England & Wales)	CLG
Energy Saving Trust and the Green Homes Service The Trust runs a range of measures promoting energy saving in households, including the new Green Homes Service, announced in November 2007.	Information provision	50	Current expenditure relating to household energy efficiency (£18m), plus likely spend on Green Homes (£32m)	Defra
Climate Change Communications Initiatives Range of initiatives to encourage positive attitudes towards tackling climate change.	Information provision	6	Defra funding for 2006-07	Defra
Billing and Metering Ofgem are currently trialling new ways of billing and metering and recording consumer responses.	Information provision	2	BERR plan to provide £9.75 million for trials between 2006-07 and 2010-11	BERR
Total estimated cost to the UK, 2008-09		**Around £2.6bn**		

Source: Defra, CLG, Ofgem, BERR

NOTE

Estimates are gross costs – i.e. exclude the financial benefits to householders, which could potentially outweigh these costs many times over.

Estimates are the best available and are based on the latest departmental impact assessments, management accounts or other statements. Estimates are not directly comparable because the underlying data on which they are based vary according to the timescales and estimation techniques used. Estimates included in impact assessments rely on a range of underlying assumptions about business and consumer responses to government programmes. These assumptions are produced by government economists; the National Audit Office have not sought to verify them.

Programmes focused on energy supply, including micro-generation, are excluded.

PART TWO

Progress towards targets

Programmes since 1990 have had some impact on energy efficiency yet until recently consumption has been rising steadily

2.1 Programmes to influence household energy consumption and efficiency have been in place for many years. Some grants for installing loft insulation were available in the 1970s. The first Warm Front scheme started in 1991, whilst the first obligation on energy suppliers began in 1994. Likewise, energy-labelling schemes as well as energy standards for new appliances began in the mid 1990s. Government has also provided advice and information aimed at householders for many years, for example through the Energy Saving Trust since the early 1990s. And the current system of Building Regulations has been around since 1985, with each successive revision (in 1990, 1995, 2002 and 2006) raising the bar for the energy performance of new homes.

2.2 **Figure 4** shows the main trends since 1990, and the extent to which government is on track to meet its targets:

- Household energy consumption rose 19 per cent between 1990 and 2004, but has since fallen in 2005, 2006 and 2007 (gas consumption decreased 12 per cent over the three years; electricity consumption decreased only marginally and remained slightly higher in 2007 than in 2004). Overall energy consumption in 2007 was still eight per cent higher than 1990. Energy consumption data are collected by energy companies, and collated by BERR.
- Energy efficiency has improved by 19 per cent between 1990 and 2004 (approximately 1.5 per cent a year).[10] Energy efficiency is calculated by Defra, based on a survey of energy efficiency measures installed in UK homes and assumed efficiency delivered by these measures.

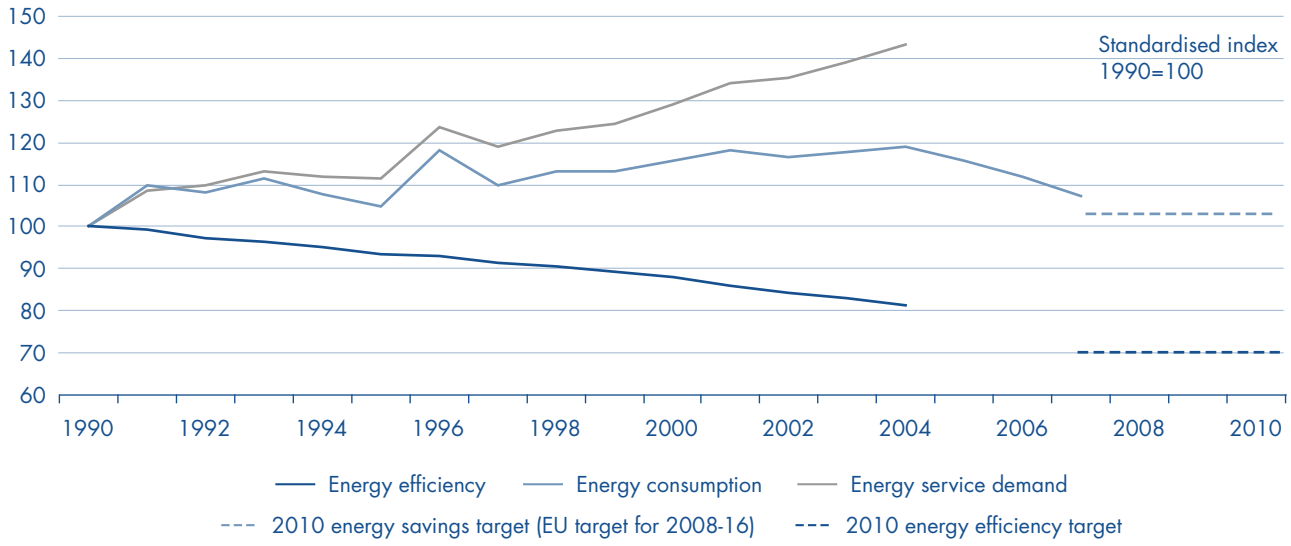
The 43 per cent increase in energy service demand (a measure of the demand for household services requiring energy) between 1990 and 2004 shown in Figure 4 is calculated from these two other data sets and is not measured directly.

2.3 Analysis carried out for departments established that the most important factors leading to improvements to energy efficiency between 1990 and 2003 were improvements in central heating boiler efficiency, the impact of new build, and improvements to insulation (mainly double glazing with growing savings attributed to cavity wall insulation and some contribution from top-up of loft insulation). Many of these improvements may have happened in the absence of government intervention; the majority of the energy efficiency improvements could not be attributed to specific government programmes. Some impacts were specifically attributed to the Home Energy Efficiency Scheme (now called Warm Front) and labelling schemes to inform purchases of cold and wet appliances. There were other government programmes in place over this period, such as promoting and labelling energy efficient boilers, but it is not possible to attribute specific changes to them. There existed a Supplier Obligation from 1994 onwards, but this was insignificant in scale until 2002. Building Regulations specifying standards for replacement boilers and windows only began in 2002 and so in 2003 it was also too early for their impact to be seen.

Programmes have had to compete against strong opposing trends

2.4 However, programmes to improve household energy consumption have had to counter an opposing trend towards more and smaller households, householders keeping more of their homes at warm temperatures, and the increasing availability of energy using appliances and equipment for home use. So whilst energy efficiency might have improved, total energy consumption continued to rise until 2004. There are four trends to note:

4 Until 2004, efficiency improvements struggled to offset rising demand



Source: BERR, Defra

NOTE

'Energy service demand' relates to the demand for household services that require energy – such as heating and lighting. It is calculated based on energy consumption and efficiency.

'Energy consumption' by households is measured directly by energy companies.

'Energy efficiency' determines the amount of energy needed to meet a certain level of 'service demand' such as heat or light; a more energy efficient house consumes less energy to heat it. Energy efficiency is estimated, and a downward trend indicates improvement. Latest available data are for 2004.

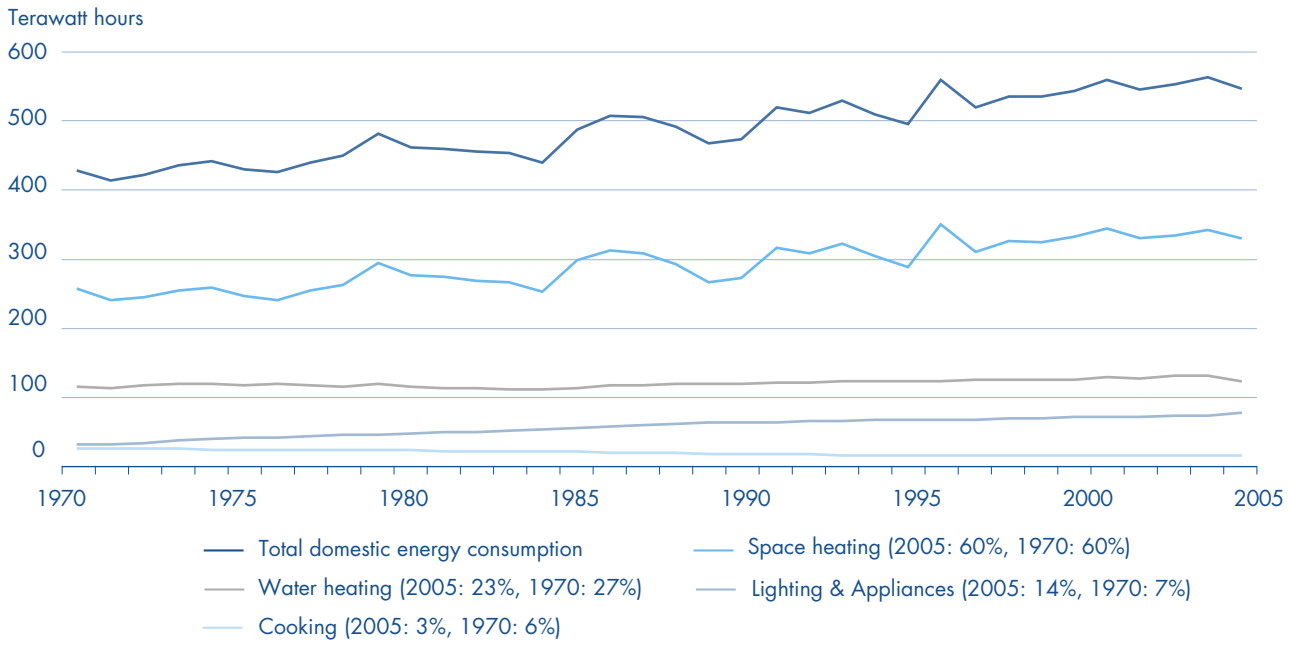
See the Glossary for detailed explanations of 'energy service demand', 'energy consumption' and 'energy efficiency'.

- Total UK household energy consumption increased by 19 per cent between 1990 and 2004; by 2007 it was still eight per cent higher than in 1990.[12]
- The number of households in the UK increased by 12 per cent to 2004, and energy consumption per household rose by six per cent over the same period. By 2007 the number of households had risen 15 per cent since 1990, but consumption per household had fallen by six per cent.
- The UK population increased 4 per cent in the same period, and energy consumption per person increased by 15 per cent by 2004; in 2007 it was only three per cent higher than 1990 levels.

Together these trends reflect the fact that the UK now has more, smaller, households than in 1990 – a trend which seems likely to continue. Smaller households result in more energy consumption per head – two or three people can live more efficiently than one person.

2.5 At the same time, there have been changes in the characteristics of energy consumption, reflecting in part the widespread availability and use of new technologies such as DVD players and home computers. **Figure 5 overleaf** shows the main underlying trends in household energy consumption (data are currently available to 2005). Space and hot water heating together account for over 80 per cent of energy consumed by households. And although the amount of energy used for heating water has remained steady since the 1970s, the amount of energy consumed for space heating has increased by nearly 30 per cent, varying year-to-year depending on the weather. The average temperature in UK homes rose from 13ºC in 1970 to 18ºC in 2004, reflecting the fact that more rooms within the home are being kept warm. It takes 50 per cent more energy to heat a house to 18ºC than 13ºC. Consumption for lighting and appliances has more than doubled in the same period.

5 Household energy consumption has grown over the last 30 years



Source: 2005 data – BERR/Building Research Establishment, Energy Efficiency Action Plan 2007

NOTES

See the Glossary for details of the relevant units of energy.

Around 70 per cent of energy consumed in households originates from gas fuel sources, with most of the rest from electricity, with minor amounts supplied by oil and solid fuel.

The UK lags behind other European nations

2.6 Trends in the UK do not compare favourably with some other European nations. **Figure 6** shows the Netherlands are leading the way, having reduced average energy consumption per dwelling by 16 per cent from 1990 to 2004; this compares with a two per cent rise in the UK. The Netherlands, and others, are doing considerably better than the UK at reducing the energy consumed for space heating. One reason for this is that the Netherlands began driving energy efficiency improvements in the early 1990s, a decade before the UK programme began in earnest. In terms of energy efficiency, the percentage improvement made by the UK is slightly below the average improvement made by nations across the 'EU-15' (the 15 member states of the EU following expansion in 1995 and before the further expansion in 2004).

Departments expect to achieve ambitious targets for 2010 and 2016

Energy consumption

2.7 Households' expected contribution to achievement of the government's economy-wide energy consumption targets mean that household energy consumption needs to fall by 11 per cent by 2010 compared with 2001-2005 levels[13]; with a further 2 per cent reduction by 2016. Figure 4 shows that the 2010 target is within reach, because consumption has begun to fall since 2004, after years of increase.

2.8 It is too early to know whether this recent fall is the start of a longer-term downward trend due to energy programmes, or the result of short term fluctuations, for example caused by high energy prices or the weather. Studies by the Building Research Establishment suggest the effect is greater than can be explained by weather alone, but too large to be explained by energy efficiency measures alone.[14] Recent price rises have been considerable and could account for some of the recent downturn in energy consumption: retail gas prices rose by 75 per cent and electricity prices by 54 per cent between

6 Other European nations have led the way in reducing household energy consumption

	Change in average energy consumption per dwelling 1990-2004 %	Change in average energy consumption per dwelling for space heating 1990-2004 %	Improvement in average household energy efficiency 1990-2004 %
Netherlands	–16	–27	18
Sweden	–12	–16	14
Ireland	–11	No data	23
France	–5	–9	13
Germany	–3	–6	9
UK	2	6	11
Belgium	4	No data	8
EU 15	–2	–6	13

Source: AEA, ODYSSEE annual reports

NOTE

Nations listed are selected northern European nations within the EU.

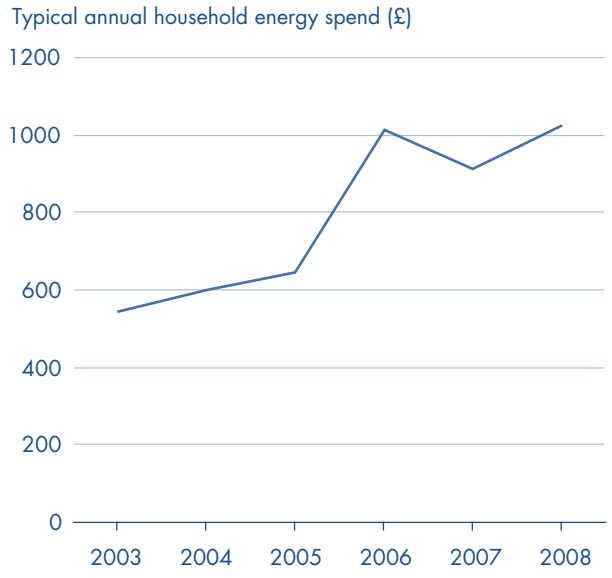
The ODYSEE energy efficiency indicator, developed by the European Commission and partners, is not comparable to the measure of household energy efficiency shown in Figure 4 as it is calculated on a different basis. Defra calculate energy efficiency independently of service demand based on known installations of efficiency measures. The ODYSEE indicator is based on changes in energy consumption divided by a measure of unit consumption, such as number of dwellings or number of appliances, adjusted for climatic influences. It includes some impact of increasing levels of service demand as well as technical energy efficiency improvements.

2003 and 2007.[15] A typical dual fuel bill for 2008 has been estimated at just over £1,000 – an 89 per cent increase from 2003 **(see Figure 7)**.[16]

2.9 Defra and other departments expect to meet (and just exceed) the pro-rata target for the household sector for 2010; and expect to meet – by more than double – the 2016 target. Indeed, they expect the household sector alone to more than achieve this economy-wide target. This confidence is based on analysis of trends and on estimates of the energy savings to be obtained from individual programmes. We examine these estimates in more detail, in Parts 3 to 6 of our report.

2.10 Achievement of future targets for energy consumption depends not only on the effectiveness of programmes, but also on factors affecting the underlying trend such as fuel prices, weather, number of households and population. For example, energy consumption could be much higher than expected because the UK experiences harsher winters, or because fuel prices are lower than expected, leading to increased energy consumption. Equally, the rising trend in numbers of households and population could be greater than expected and so offset energy efficiency savings made. Energy efficiency improvements are less subject to external factors, but need to be sufficient to offset them in order to reduce energy consumption overall. Departments' projections of energy consumption take these factors into account but cannot control them.

7 Typical household fuel bills have increased dramatically



Source: Energywatch

NOTE

Based on payments by standard credit and medium energy use in a dual fuel household.

Energy efficiency

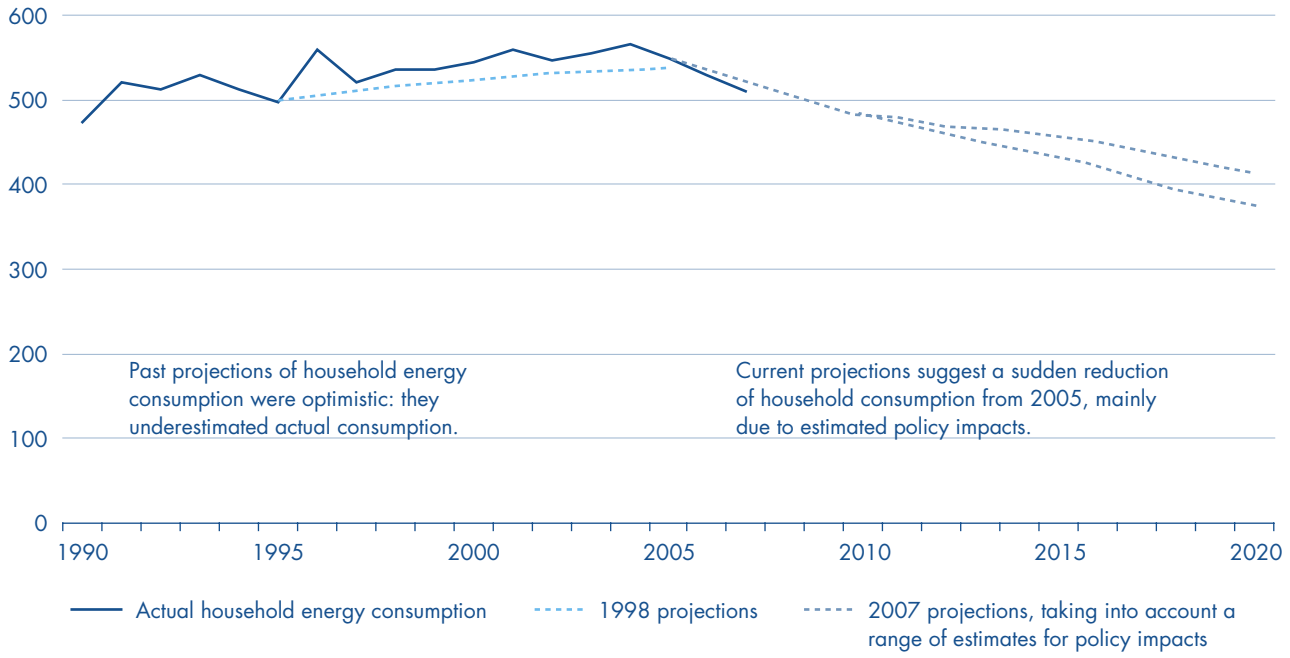
2.11 The Government's main target is to improve residential energy efficiency in England by at least 20 per cent by 2010, from a year 2000 baseline. Figure 4 suggests that the trend is one of steady improvement. If this trend continued at the same rate of 1.5 per cent per year, an improvement of just over 15 per cent would be achieved by 2010, just short of the target. Energy efficiency improvements of around 2.4 per cent per year are required from 2004 onwards to reach the target. Programmes such as obligations on suppliers and Building Regulations are expected to improve energy efficiency significantly from 2002 and so it is likely that household energy efficiency is on track to meet the 2010 target level. However, there is some uncertainty over this projection. Firstly, there was no settled measure of energy efficiency when the target was set, although Defra has since settled on a measure known as 'specific energy consumption' (see glossary). Second, the latest available data are for 2004: Defra and BERR are working to provide a more recent estimate of the energy efficiency of the household sector.[17] Finally, the target is for England, whereas the available data are for Great Britain.

Departmental projections have been optimistic in the past

2.12 BERR, working with Defra and CLG, produce projections of household energy demand using a model which takes into account assumptions about factors such as fuel prices, economic growth, population levels and number of households. The model is then adjusted to reflect estimated energy savings from individual programmes.

2.13 The latest published projections of household energy consumption were prepared to support the Energy White Paper 2007.[18] **Figure 8** shows the White Paper's central projections. The Figure also shows previous projections from the same model, and the latest outturn data (available up to 2007). Projections are published for a range of assumptions for fuel prices and policy impacts – for clarity we have shown only mid-range assumptions for fuel prices.

8 The Government's past household energy demand projections have been optimistic; future projections predict a sharp fall in consumption



Source: BERR Energy projections (EP68, UEP21, UEP26, Energy White Paper analysis)

NOTE

See the Glossary for details of the relevant units of energy and greenhouse gases.

The projections made in 1998 start from 1995, based on the latest available estimates of energy demand.

2.14 Figure 8 indicates the following:

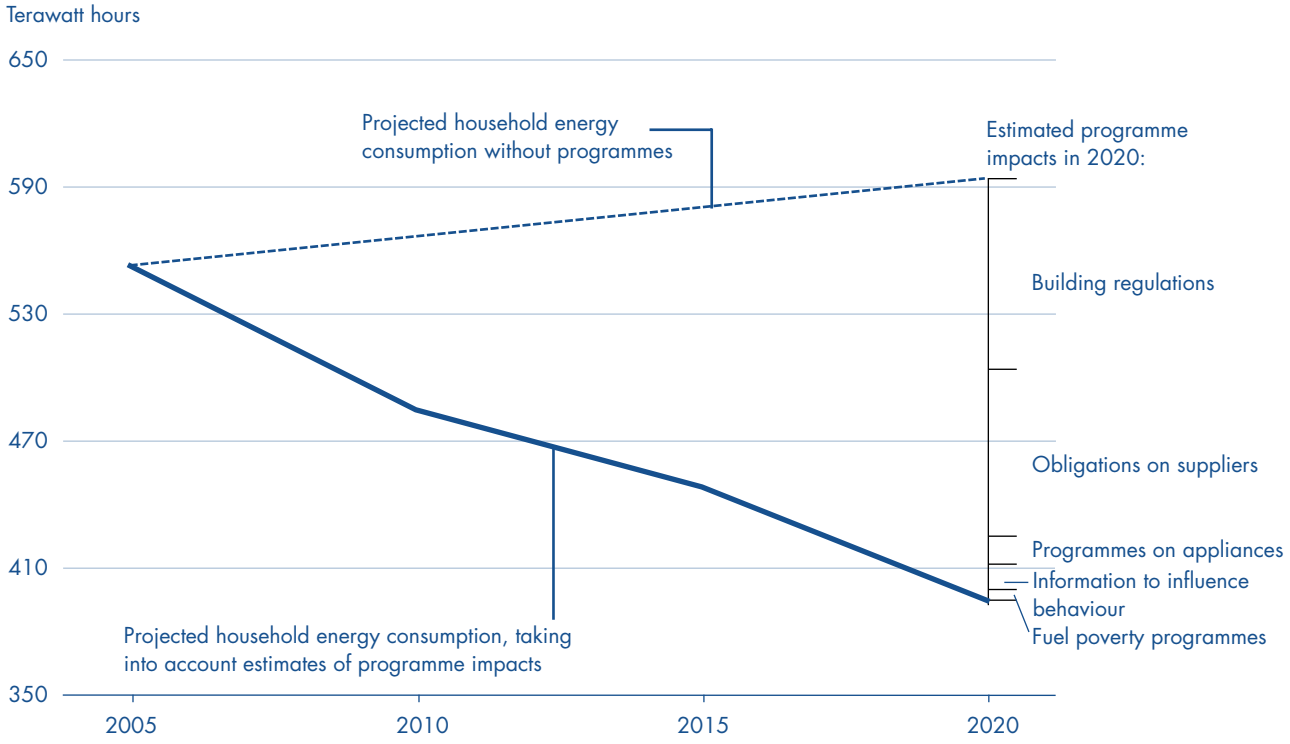
- The projections made in 1998 were optimistic – from 1995 to 2005 actual energy consumption was greater every year than was projected in 1998. The primary reason for this is that energy prices were lower than expected and so demand was greater.
- Departments now predict a major shift in energy consumption from 2005 onwards. Whilst there are other factors involved, notably fuel prices, most of the projected reduction is attributed by Departments to the expected impacts of household energy programmes, as shown in Figure 9. Indeed, without the impact of these programmes, energy consumption would be forecast to rise.

2.15 The likelihood of achieving the projected fall in energy consumption depends not only on the reliability of the estimated energy savings from programmes but also on the robustness of the energy demand model and the reliability of the assumptions made. These departmental projections were reviewed by the National Audit Office in November 2006. We found that projections are now more robust than those made previously, though there is considerable inherent uncertainty in making these projections[19].

Achievement depends on four main programmes

2.16 As shown in **Figure 9**, the projected energy savings from the four largest programmes are essential to achieving the projected reduction in energy demand by 2020, with the largest contributions expected from Building Regulations and the Supplier Obligation.

9 Government expectations of downward energy consumption rely on its programmes having impact



Source: National Audit Office, based on departmental estimates from the Energy Efficiency Action Plan 2007 and BERR Energy projections from the Energy White Paper 2007

NOTE

This figure is intended to be illustrative of the impacts of policy on the energy demand projections for 2020 but not of the impact of the policy before that date. These energy savings have been shown measured against BERR's latest central policy impact and central fuel prices projection.

2.17 The Energy Efficiency Action Plan 2007 set out the detail behind these projections. Nearly all of the estimated household energy savings in 2016 and 2020 will come from four main programmes or groups of programmes; all other programmes contribute a relatively small amount **(see Figure 10)**. The reliability of these estimates is explored in the rest of this report, taking each of the four main programmes in turn.

2.18 Achievement of the Government's targets relies on the successful delivery of these programmes. In the rest of our report we look at the effectiveness of the four largest programmes: for each policy we examine past performance, the reliability of projected impacts, the risks and uncertainties attached to them, and the extent to which departments have addressed those risks. We have not examined fuel poverty programmes as these

10 Government expectations of energy savings from programmes targeting household energy consumption and efficiency

	UK annual energy saving (TWh)[1]			Estimated annual cost to the UK (2008-09)
Programmes	2010	2016	2020	£m
1 Building Regulations	26.4	55.2	91.3	485
2 Obligations on energy suppliers	25.1	57.6	76.6	1,400
3 Programmes to improve the efficiency and labelling of household appliances	6.6	11.2	14.2	4
4 Information to influence household behaviour, including Energy Performance Certificates and Better Billing and Metering[2]	6.1	13.4	15.9	284
Fuel poverty schemes[3]	3.1	3.2	3.2	400
Other programmes	1.4	1.5	1.5	Data unavailable
Total	**68.7**	**142.1**	**202.7**	**Around £2.6bn**

Source: Departmental estimates quoted in the Energy Efficiency Action Plan 2007

NOTES

There are significant overlaps between programmes; these estimates represent an attempt to apportion energy savings between them. In reality, there are significant overlaps between obligations on suppliers, programmes on appliances and fuel poverty schemes.

1 Savings are compared against the 'without policies' baseline used by BERR in their household energy demand projections.

2 Influencing household behaviour is a feature or component of many programmes listed above. In addition there are programmes specifically targeted on behaviours, for example the work of the Energy Saving Trust, information campaigns such as Act On CO2, and new proposals for Better Billing and Metering. Expenditure and energy savings shown here are only for Better Billing and Metering and Energy Performance Certificates. Energy Saving Trust activities are considered necessary to achieve estimated savings of other programmes, including the Supplier Obligation and appliance programmes, so estimates of the Trust's impact is grouped with them.

3 Savings from fuel poverty programmes include those from Warm Front (the largest contributor), its predecessor (the new Home Energy Efficiency Scheme), the Decent Homes standard, the Local Authority Home Energy Conservation Act, and the Northern Ireland Energy Efficiency Levy.

have a primary social aim rather than to reduce energy consumption. Warm Front was the subject of an National Audit Office report and PAC hearing in 2003-04, and the National Audit Office is considering a further review in the near future.

Programmes targeting households offer some of the most cost-effective opportunities for reducing UK energy consumption

2.19 The Climate Change Programme Review of 2006 and the Energy Review of 2007 looked at programmes targeting households as well as those targeting industry, transport and other sectors relevant to the Government's climate change and energy objectives. Those reviews considered progress towards targets, options for improving performance, and a large body of evidence on the cost-effectiveness of different programmes. Those analyses were conducted in terms of carbon saved, but the results hold good for the relative cost-effectiveness of different energy-saving programmes. Analysis we carried out for the Environmental Audit Committee found that the methods used to estimate cost-effectiveness were broadly satisfactory.[20]

2.20 The results, set out in more detail in Appendix 3, suggest that household energy programmes, both as a group and individually, were among the more cost-effective measures available to reduce the UK's carbon emissions. Primarily, this is because in households, financial savings, per tonne of carbon saved, were deemed to be greater than in other sectors. The results also suggest that appliance and building standards are more cost-effective, whilst information campaigns to promote more energy efficient behaviour are less cost-effective. However, these conclusions should be treated with significant caution, for a number of reasons:

- Programmes interact – for example information campaigns reinforce incentives and other steps to encourage take-up of energy efficiency measures – and yet methods to attribute impact are relatively crude.
- One of the greatest determinants of cost-effectiveness is the scale of intervention: typically, as regulations are tightened, subsidies are increased etc., the relative cost-effectiveness of programmes decreases.
- Cost-effectiveness estimates also change over time as a policy is implemented and developed.
- In our earlier work for the Environmental Audit Committee we pointed out that the analyses done by government had mostly looked at existing programmes in terms of their current scale and scope, rather than explore a variety of policy mixes.

PART THREE

Building Regulations

3.1 Building Regulations specify standards of construction and design for new buildings and for certain categories of building work carried out to existing buildings. Since 2000, Part L of Schedule 1 of the England and Wales Regulations has included standards to improve energy efficiency. These were revised in 2002 and 2005-06. The standards to improve energy efficiency have been strengthened by 40 per cent for new homes built from 2006, compared to pre-April 2002.[21] The objective of these regulations is to enable householders to enjoy reduced energy costs and improved comfort; estimated energy savings are set out in **Figure 11**.

3.2 Figure 10 showed that by 2020, revisions to Building Regulations are expected to achieve half the energy savings of the UK household sector. Changes to UK Regulations are in part a response to commitments made in the 2003 Energy White Paper and to convey provisions of the EU Energy Performance of Buildings Directive that call for the adoption of a national methodology for setting energy performance standards.

Not enough is known about compliance with regulations, upon which estimated savings depend

3.3 There is as yet very limited information about actual versus projected impacts to enable a comparison of planned and actual cost-effectiveness. And the reliability of estimates of cost-effectiveness depends on empirical work to test the impact of new standards, the accuracy of assumptions about changes in the housing stock, and the degree to which new measures perform in line with expectations. But there is limited data on how well energy saving measures put into new homes work in practice and also whether the way in which builders install energy efficiency measures (even if they comply with Building Regulations) can limit actual energy savings. Estimates of the impact of Building Regulations are based on physical tests of different construction types in controlled conditions, and then modelling of the impacts of these methods and materials onto expected changes to housing stock. The latest estimated savings are about 28 per cent lower than earlier estimates, reflecting a greater understanding of what could be achieved in practice.[22]

11 The Government's anticipated energy savings are attributed to a number of different regulations

	UK annual energy saving (TWh)		
Measures	2010	2016	2020
Building Regulations England & Wales 2002	11.4	12.5	12.5
Building Regulations England & Wales 2005-06	13.2	33.8	49.4
Building Regulations Scotland 2007	1.8	4.7	6.8
Building a Greener Future	0	4.2	22.6
Building Regulations (total)	**26.4**	**55.2**	**91.3**

Source: Departmental estimates quoted in the Energy Efficiency Action Plan 2007

3.4 Projections to date have assumed full compliance by the construction industry with Building Regulations. However, there is a growing recognition of non-compliance as a potential problem. Poor compliance can result from poor understanding of the requirements, poor workmanship and local authorities' limited resources for enforcing compliance. The construction industry has already voiced concerns over the tightness of 2006 standards, the rapidity with which standards are being tightened, and the capacity of the industry supply chain to respond.

3.5 There is, however, limited information on the extent of non-compliance. A 2006 report prepared for the Energy Efficiency Partnership for Homes investigating the reasons for poor compliance with the 2002 Regulations found that local authority building control officers did not see the energy saving part of Building Regulations as a priority, and that compliance with this part of the Regulations was thought to be lower – but not quantified.[23]

3.6 CLG deferred a review of the 2002 Regulations because the next revision of Regulations was brought forward. CLG now considers that sufficient time has passed for housebuilders to factor in the 2006 standards as well, and a review is now underway. This project, jointly funded by CLG and the Energy Efficiency Partnership for Homes, aims to carry out an independent assessment of average levels of compliance with the energy efficiency standards. The results of this project, expected by the end of 2008, will help to inform the next amendment and support more realistic estimates of the impact of future changes. CLG expect that the results of this project could inform future amendments to the Regulations and support more realistic estimates of impact. CLG has also put in place direct measures to improve compliance, including a substantial training programme to promote the new Building Regulations, working with industry to develop a compliance performance indicator and technical guidance, and the establishment of new 'competent person' scheme allowing registered individuals or companies to self-certify compliance against certain elements. CLG now issue an annual report to Parliament on compliance. CLG is currently consulting on wide changes to the Building Control system (through which they hope to improve compliance levels, while also making it easier for industry to comply) and are considering how to continue monitoring compliance. Proposals include new enforcement powers, introducing a three year planned approach to the way Regulations are updated, and new and simplified guidance.[25]

The costs associated with future Building Regulations are uncertain

3.7 Under Building a Greener Future proposals announced for consultation in December 2006 and confirmed in July 2007, CLG envisages that future Building Regulations, planned for 2010, 2013 and 2016, will implement progressively stricter standards on the energy performance of new homes, attaining the goal of 'zero carbon' homes by 2016. **Box 1** outlines what is currently known about the meaning of zero carbon, based on information from CLG. The new building standards will require homes to be carefully designed to minimise energy requirements for heating, lighting and other uses – through both energy efficient construction and the installation of energy efficient appliances. The new standards will affect insulation, ventilation, air tightness, heating and lighting, and can be linked to performance standards in the *Code for Sustainable Homes*. The building industry is already planning developments based on the 2016 target.

3.8 These higher standards are expected to achieve annual energy savings of 22.6 TWh by 2020, and will achieve ever increasing savings as new built homes gradually supplement the old stock. They are estimated to raise the cost of building a new home by 3.3 per cent and 5.4 per cent on average over 2006 costs in 2010 and 2013 respectively, and by anywhere up to 19 per cent by 2016 – though actual cost increases will vary widely according to house type, the technology used and the final set of rules used to underpin the definition of zero carbon.[26] It is too early to say what the impact on house prices will be, although some economic analysis that has been conducted suggests that there would be a very limited impact on house prices.[27] Savings in fuel bills paid by householders in the new homes are estimated at anywhere between £114 and £360 per year, taking 'zero carbon' as it is currently defined. What is clear is that there will come a point before 2016 where the Regulations cannot push the cheaper measures such as insulation much further. To drive further savings, regulations will have to promote more expensive energy efficiency technologies, or similarly expensive micro-generation options (though the cost of these will fall if the market for them grows).

BOX 1

Zero Carbon Homes

The rules for what constitutes a 'zero carbon' home are yet to be defined precisely, but in principle this means that the annual net carbon emissions from all energy consumption will be zero – i.e. that carbon emissions from energy taken from the grid have to be less than or equal to the amount put back by renewable technologies (on-site or directly connected to the site).

More evidence is needed to assess the risks of 'Building a Greener Future'

3.9 The main risks to achieving the anticipated energy savings of existing Building Regulations (non-compliance and also a lack of understanding of the performance of measures once installed) also apply to future Building Regulations anticipated under the 'Building a Greener Future' programme. There have been recent calls for more evidence, stronger government leadership, and better enforcement of regulations to increase the chance of detection and penalties for non-compliance. For example, the Callcutt Review of house-building recognised the potentially significant risks associated with non-compliance, and recommended a focused delivery timetable to ensure that industry could deliver the 2016 zero carbon homes target, including a requirement for the definition of 'zero carbon' to be finalised by the end of 2008.

3.10 In a move to further stimulate the market, CLG recently announced a requirement for all new homes from 1 May 2008 to be rated against the Code for Sustainable Homes.[28] CLG is also now working with DIUS and the relevant skills councils to ensure that the construction industry will have the skills in place to comply with future Building Regulations and meet the demand for zero-carbon homes. There are also a number of exemplar housing developments being constructed from which on-the-ground lessons can be learned – the Callcutt Review recommended that the scale of these developments should be expanded and co-ordinated under a national programme.[29] English Partnerships, through its 'Carbon Challenge' initiative, aims to create a number of housing developments meeting the highest level of the Code for Sustainable Homes. Elsewhere, the National Trust has partnered with house builders to build an exemplar housing scheme at Stamford Brook in Cheshire **(see Box 2)**.

3.11 CLG has established a 2016 taskforce and is launching a private sector-led delivery unit to guide, monitor and coordinate the zero-carbon programme, and to ensure risks are addressed. The risks to delivery will become clearer as the future Building Regulations are developed, but the issue of compliance is likely to become more problematic as Regulations become ever more stringent. However, until a review of compliance with the most recent Building Regulations is completed, the significant projected impacts to 2010 and especially 2020 must remain uncertain.

BOX 2

The exemplar housing development at Stamford Brook resulted in many lessons learned and a number of recommendations

Stamford Brook is a partnership between the National Trust, Redrow Homes and Bryant Homes. Some of the lessons learned fed into the 2006 Building Regulations. The project was supported by BERR and CLG. A recent report[1] highlighted the key lessons and gaps in the data, and made recommendations including:

- **Regulators and industry should work closely together to ensure that tighter standards are achieved on the ground.** This will require greater emphasis on post-construction thermal performance measurement and significant changes in the way the industry produces housing. Currently, developers' control on the energy performance of the homes they build is weak and they face few consequences if energy efficiency performance is unsatisfactory.
- **There are supply chain risks** to providing the volume of energy efficient products required, and the skilled labour to assess performance and install the products. An integrated approach is needed to link supply chains, training and demand.
- **More on-the-ground data are needed, including behavioural influences, in the form of a 10-year programme of national research**. Research should include design and construction studies, 'energy-in-use' studies and a 'significant extension of post-completion performance testing', as well as more data to better understand space heating consumption (e.g. influence of user behaviour, weather, construction defects) to improve modelling, and smart technology and occupant information.

NOTE

1 Wingfield, J., Bell, M., Miles-Shenton, D., Lowe, R.J., and South, T. *The Stamford Brook field trial: final report. Partners in Innovation Project: CI 39/3/663*, CLG, 2008. Lovell, J., *Volume: Delivering Sustainable Housing*, 2008.

PART FOUR

Obligations on energy suppliers

4.1 Since 1994 Defra has, via a series of programmes, required energy supply companies[30] to achieve energy savings targets by promoting approved energy saving measures in households. Such measures include insulation, low energy light-bulbs and high-efficiency appliances or boilers. The programmes have changed in name, and also changed over time in terms of the types of measures available, the extent to which the scheme is targeted on some household types, and the targets and other terms of the obligation placed on the suppliers. In 2002 the obligation was significantly increased, and has continued to expand through successive versions since then **(see Figure 12)**. Defra is consulting on the form of the obligation beyond 2011; there are calls for the energy supply industry in the future to reduce energy consumption by providing energy services (e.g. energy saving products) to consumers, rather than selling units of energy.

4.2 Defra allows suppliers to choose what mix of measures they promote, within certain guidelines. However, Defra does publish an 'illustrative mix' of measures, indicating what the mix of measures promoted by suppliers might be, from which the Department can estimate what the costs of the scheme might be. The costs are met by suppliers, who may recover some or all of their costs from customers through retail tariffs. Suppliers can promote measures by a number of means (typically providing installation or enabling the householder to self-install), but have to satisfy Ofgem that the measures will be installed and used, and will result in energy efficiencies that would not have occurred in the absence of the programme.

4.3 Suppliers have relied heavily on insulation measures to achieve the targets. In the first phase 56 per cent of target savings came from insulation measures, 24 per cent from energy efficient lighting, 11 per cent from energy efficient appliances and 9 per cent from more efficient heating systems. **Figure 13 overleaf** shows some examples of measures which can be promoted under the policy. It also shows the number of years it will take a measure to repay its cost by making energy savings. The target of annual energy savings of 76.6 TWh by 2020 can be achieved by focusing solely on measures which have short payback periods.

12 The growing impact expected from obligations on suppliers

	UK annual energy saving (TWh)		
Obligations on energy suppliers	2010	2016	2020
Energy Efficiency Commitment Phase 1 (2002-05)	3.1	3.1	3.1
Energy Efficiency Commitment Phase 2 (2005-08)	7.8	7.8	7.8
Carbon Emissions Reduction Target (2008-11)	14.2	15.5	15.5
Future Supplier Obligation (2011-20)	0.0	31.2	50.2
Obligations on energy suppliers (total)	**25.1**	**57.6**	**76.6**

Source: Departmental estimates quoted in the Energy Efficiency Action Plan 2007

Suppliers have exceeded their targets so far

4.4 In both phases of the Energy Efficiency Commitment (the Supplier Obligation which ran from 2002 to 2008) suppliers successfully met their targets before the end of the phase. The phase 1 target was to install or provide measures which would result in an energy saving over the lifetimes of those measures of 62 TWh (target figures estimate the total savings those measures will achieve over their lifetime, so are not comparable with the annual figures shown in Figure 13). By the end of phase 1, suppliers had installed or provided measures equivalent to 86.8 TWh, exceeding the target by 40 per cent.[31] The second phase, which concluded in March 2008, has also seen suppliers exceed their targets. Provisional results suggest measures were installed or provided equivalent to 185 TWh, exceeding the target of 130 TWh. Suppliers were encouraged to exceed their targets in these early phases because Defra gave an early indication that the target would increase in the future and that the suppliers would be permitted to carry forward all of their excess energy savings.

13 Examples of measures allowed under obligations on suppliers

Measure	Payback period (years)
Hot water tank and pipes insulation	0.2
Improved heating controls	0.4
Energy efficient lightbulbs	0.9
A++ rated (i.e. very efficient) fridges and freezers	3.2
Cavity Wall Insulation	4.2
Loft insulation up to 270mm[1]	16.7
Micro-generation, such as wind turbines or solar power	25+

Source: National Audit Office, adapted from Building Research Establishment (2007)

NOTE

1 Loft insulation varies in depth. Top ups to loft insulation to depths of 270mm are considerably less cost-effective than putting in loft insulation for the first time.

Estimates of impact have been optimistic, but are improving

4.5 Targets for the obligations placed on suppliers since 2002 are expressed in terms of lifetime TWh. However, supplier performance is assessed based on the number of measures they have promoted or installed – and estimates of the amount of energy those measures will save, in TWh. Thus it is crucial that these estimates are accurate if the true impact of the policy is to be known.

4.6 Estimates were made in 2004 but have since been found to be optimistic. In 2007 they were revised downwards by about one quarter (to the savings shown in Figure 12).[32] This re-evaluation resulted from research undertaken by Defra, which updated the evidence base (the 2004 estimates had been partly based on studies performed in the 1980s). New surveys of homes which had insulation installed under the scheme found that loft and cavity wall insulation were not as effective as the 1980s evidence suggested. For example, the impact of cavity wall insulation on energy consumption was found to be 30 per cent lower than earlier estimates.

4.7 The estimates made in 2007 rely on a range of assumptions, but can be considered more robust than the 2004 estimates for the following reasons:

- Defra commissioned an independent review of the performance of Phase 1 of the Energy Efficiency Commitment.[33]
- Further research has included independent studies by, among others, the Energy Saving Trust and Caledonian University. This research covered both the performance of specific measures installed under Supplier obligations and behavioural aspects (such as to what extent householders respond to better insulation by keeping their homes warmer rather than reducing their energy bills).
- Defra published its new assumptions for formal consultation.

4.8 However, there is still more research that could be undertaken to further improve Defra's understanding and assumptions (see Paragraph 4.14). Defra's estimates have tended to be revised downwards in the light of new evidence.

Supplier obligations have been more cost-effective than expected

4.9 Although few ex-post analyses have been completed, the evidence suggests that Supplier Obligations have saved more money for consumers than they have cost consumers, suppliers and government (in terms of installation or administration costs). For example, the independent Eion Lees Energy evaluation of the 2002-05 phase estimated that electricity was being saved at a cost to the average UK consumer of 1.3p per kWh (gas at 0.5p per kWh)[33]; this compares with an average 2006 consumer price of 10.1p per kWh (gas at 3.0p per kWh)[34].

4.10 According to the Eion Lees evaluation, energy suppliers have met their targets at 20 per cent lower cost than was initially expected by Defra; a key reason was found to be that suppliers have found innovative routes to householders. Examples include focusing on builders' merchants and heating installers instead of the householder for heating measures; direct sales of energy efficient lightbulbs to householders; major marketing and promotional offers via appliance retailers; and wide ranging insulation programmes with social housing providers.

There are significant risks to cost-effective achievement of targets, which need to be addressed

4.11 By 2020 the Supplier Obligation is expected to deliver a much greater level of energy savings than has been delivered so far (see Figure 13), which implies much greater rates of promotion of measures by suppliers. The required annual rate of energy savings set by Defra doubled in 2005, doubled again in 2008, and must be maintained at that rate until 2020. This will translate into considerable increases in activity by suppliers: for example, between 2002 and 2005 around 250,000 installations of loft insulation were made each year, but future plans envisage that an average of 1.2 million installations may be required each year from 2008 to 2011.

4.12 The projected savings take into account the fact that opportunities for some measures are drying up. For example, Defra estimates that there are around 8.5 million cavity walls that are currently unfilled, but that this number will have reduced to around 5.5 million by 2011. Even after taking this into account, cost-effective achievement of the estimated energy savings will depend on a number of risks being regularly reviewed, and mitigating action taken. These are outlined below.

Consumer demand for installations of measures

4.13 Capacity in the social housing sector is likely to be exhausted in the next few years. Outside of this sector, measures can only be installed by suppliers if agreed by the owner or occupant. This will become a more significant concern because from 2011 a greater proportion of installations will need to be made in the private rented or owner occupied sectors if targets are to be met. There are also concerns that for some measures household demand will not be high enough. Loft insulation is one example: Defra's estimates of energy savings assume that between 500,000 and one million installations will be made each year from 2011-2020; yet householders' perceptions of cost, the hassle of installation and the loss of storage space can prevent uptake.[35] Examples of householders views on installing insulation are illustrated in **Box 3** below. Energy suppliers already offer significant subsidies of up to 100 per cent to get householders to take up measures. They, and local authorities and installation companies, are also spending more on advertising the available measures. Recent reports and consultations commissioned by Defra have emphasised that further work is needed to raise consumer demand.[36] It has been estimated that awareness campaigns can stimulate consumer demand such that the Supplier Obligation and other policies could be up to 30 per cent more effective than they otherwise would be. There is a significant risk to cost-effectiveness if energy supply companies are left to spend money on advertising campaigns that are not backed up by clear and consistent messages from government. The Government's recent announcement of an 'Act on CO_2' helpline, run by the Energy Saving Trust, is in part a response which seeks to mitigate this risk.

BOX 3

Householder views on installing insulation

Focus groups and energy audits conducted by Brook Lyndhurst[1] have revealed the following:

- Householders see installing more insulation as an accessible goal, especially as a means of saving money.
- Many householders perceive the costs and time to install insulation to be higher than they really are.
- Householders are generally unaware of the type of boiler they use or that insulation can make it more effective.

NOTE

1 Brook Lyndhurst on behalf of Defra, Public Understanding of Sustainable Energy Consumption in the Home, November 2007.

Capacity of suppliers to meet their obligation

4.14 Projections for the savings to be delivered from insulation measures have been informed by market research on the industry supply chain.[38] Current analysis suggests that for some measures, the required installation rates are feasible, but that others are very challenging **(see Figure 14)**. It is important that Defra keeps abreast of supply chain issues if it is to ensure that its targets for suppliers are reasonable – for example, by regularly comparing its illustrative mix of measures with estimates of supply chain capacity.

Performance of measures once installed

4.15 Defra's research programme has expanded the evidence base about the performance of measures (as was recommended by a previous National Audit Office report)[39]. The Department should set out what scope for further research there is, and commission such research as soon as possible. For example, the research has yet to focus on how typical techniques used by installers might limit the effectiveness of insulation. Related to this is the issue of evidence on householder behaviour, which is discussed in Part 6. Measures to promote behaviour change, acting in concert with the actions by suppliers, may account for up to a fifth of estimated energy savings from the obligation by 2020[40], but the validity of this expectation will depend on an accurate understanding of how households react to having measures installed in their homes. Defra has indicated that research may be needed to achieve a better understanding of the quantity of products used in homes, and how they are used, which could include longer-term studies of electricity consumption.

Requirement to address the Priority Group

4.16 The 'Priority Group' refers to vulnerable households which are most likely to face fuel poverty – typically the elderly and those on benefits. Previous versions of the policy have required suppliers to undertake 50 per cent of their installations within this group. Although this has helped combat fuel poverty, suppliers have had to turn down demand from other householders in order to keep to the required proportions, thus limiting the total energy savings achieved by the policy. When Defra doubled the overall supplier obligation targets from 2008, Defra also reduced the target proportion to 40 per cent of installations. It is estimated that supplier costs for the Priority Group will rise from some £750 million to £1.5 billion across the period 2008-2011. A recent consultation suggested that many stakeholders want to see the separation of this social obligation from the environmental obligation.

14 Installation rates for key measures by 2020 may become very challenging

Measure	Feasibility of the rates of installation that may be required to meet Supplier Obligation targets
Cavity wall insulation	Rates appear feasible, but are close to supply chain capacity
Loft insulation	Rates appear very challenging, and exceed some estimates of supply chain capacity
Solid wall insulation	The feasibility of the rates is uncertain, as this is as yet an uncommon measure

Source: Building Research Establishment and Energy for Sustainable Development Limited

PART FIVE

Improving the efficiency and labelling of household appliances

5.1 Programmes to influence or dictate the selection, design and labelling of household appliances on offer to householders originate both in the European Union (a mix of mandatory and voluntary codes) and the UK (voluntary schemes only); they now cover a wide range of appliances **(see Figure 15)**.

15 EU programmes and UK voluntary programmes now cover a wide range of appliances

Appliance	EU mandatory energy labelling scheme	Other EU programmes on product design[1]	Voluntary UK labelling scheme
Lighting	✔	✔	✔
Fridges and freezers	✔	✔	✔
Ovens	✔		
Washing machines, tumble dryers, washer dryers, dishwashers	✔		✔
Integrated digital TVs			✔
DVD players			✔
Set-top boxes		✔	✔
External Power Supplies		✔	
TV standby		✔	
Home computing		✔	✔
Air conditioners	✔		

Source: Market Transformation Programme

NOTE

1 Other EU programmes include codes of conduct, voluntary agreements and the energy star scheme. A number of new mandatory design standards will be included in the forthcoming EU Energy Using Products directive.

5.2 As shown in Figure 15, the two key labelling schemes currently in operation in the UK are:

- The **EU mandatory energy labelling scheme** which introduced ratings between A-G (an A-rating being the most efficient) in 1995 for fridges and freezers, with ratings for other appliances introduced in the following years.
- The **UK's own voluntary Energy Saving Recommended label** established in 2000 and run by the Energy Saving Trust. This label aims to endorse the top 20 per cent (in energy efficient terms) of products in each of 29 product groups. The UK cannot set mandatory standards for appliances because they are traded within a single EU market.

5.3 UK policy is co-ordinated under the Defra-run Market Transformation Programme, which:

- collects and provides the Government with information, and develops policy briefings; and
- works with industry and other stakeholders to implement policy.

Defra is also responsible for the implementation of the EU Energy Using Products Directive, which is expected to have a significant positive effect on the efficiency of products placed on the EU market.

5.4 Programmes influencing the energy efficiency of appliances are complemented by Building Regulations, the Supplier Obligation and the work of the Energy Saving Trust, each of which promotes demand for efficient appliances. Quantifying the additional impacts of these design and labelling programmes over and above Building Regulations or Supplier Obligations is difficult because, for example, estimates of impact of other programmes include savings associated with more energy efficient appliances. The methodology for taking into account overlaps between these programmes is as yet a crude one; it is difficult to reconcile data from different models.

The efficiency of appliances has improved but there are now many more of them in the average home

5.5 The range of household appliances nowadays is very much wider than was available to households in 1990. Ownership has risen significantly. It is not surprising, therefore, that the consumption of energy for household appliances and lighting increased by 34 per cent from 1990 to 2005, and now accounts for 14 per cent of all household consumption. Though energy consumption for appliances such as washing machines, dishwashers, fridges and freezers has levelled off since 1990, **Figure 16** shows that growth has continued due to the rise of home computing and consumer electronics such as plasma TVs.

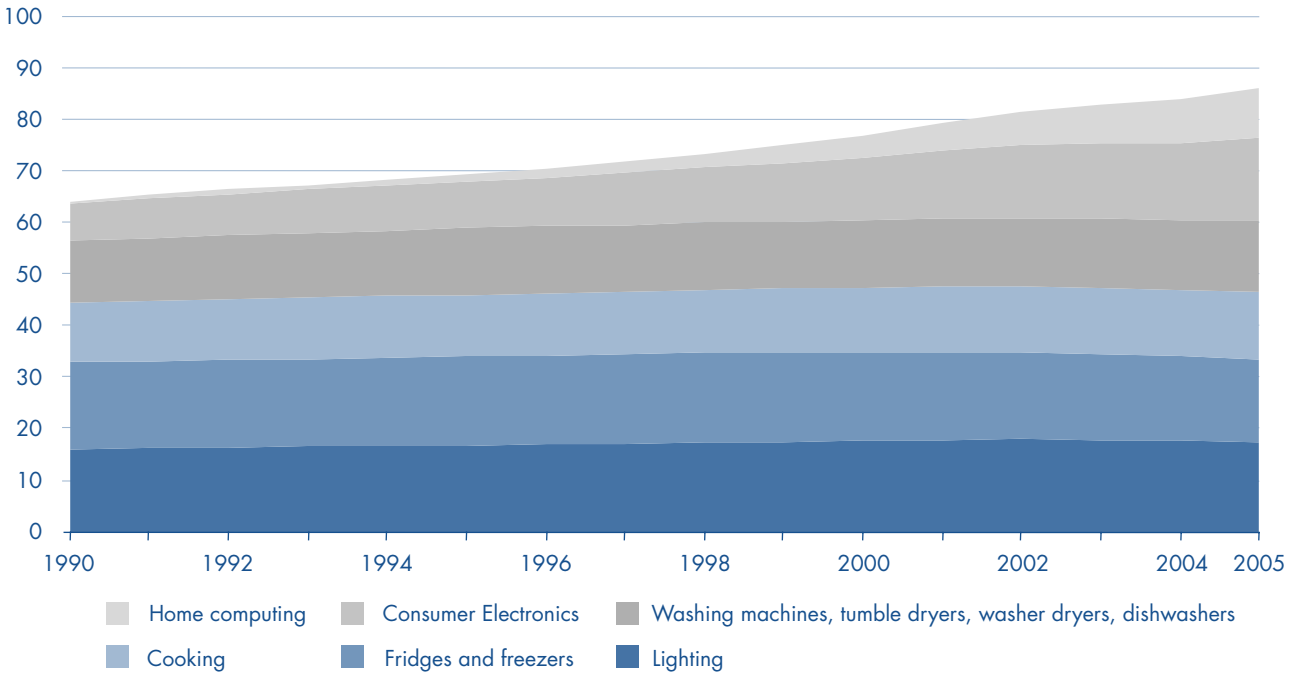
5.6 This rise in ownership has been partially offset by improvements in energy efficiency, limiting the overall increase in energy consumption. For example, the energy efficiency of fridge-freezers has increased 32 per cent between 1990 and 2005 whereas ownership has increased 46 per cent over the same period.[41]

Labelling schemes have been effective at improving the energy efficiency of appliances but there are issues for the future

5.7 The EU compulsory energy labelling scheme has contributed to market transformation in the UK. In 1999, only 2 per cent of all fridge and freezer sales were A-rated, whereas 65 per cent were A-rated or above in 2005-06.[42] Nearly all washing machines now sold are A-rated. There is limited information from which to compare this performance with other EU countries (though it is known that the UK is performing poorly with regards to sales of the most efficient fridges and freezers - **see Box 4**).

5.8 An EU-wide review of mandatory energy labelling in 2007 concluded that it led to significant market transformation towards A-rated appliances but that there were problems regarding visibility of labelling, consistent application of testing against the standards, and incorrect energy labelling.[43]

16 BERR's data shows that household electricity consumption by most appliances is stable, but consumption by home computing and consumer electronics is rising



Source: BERR

5.9 The Energy Saving Recommended scheme has also had an impact on the consumer appliances market. An Energy Saving Trust evaluation of the scheme in 2006 found that 54 per cent of the UK public recognised the label and that 10 per cent of those who had purchased an appliance recently had done so as a result of the label.[44]

5.10 It should be noted that there are no mandatory programmes in the fastest growing areas – consumer electronics and home computing. Current programmes depend on voluntary agreements negotiated at an EU or UK level. Defra is currently consulting on future programmes to improve the energy efficiency for consumer electronics. Voluntary initiatives (both UK and international) and increased labelling under the Energy Saving Recommended scheme are likely to be vital in the short term. The EU Energy Using Products Directive will impose mandatory measures in the areas of consumer electronics and home computing; these are likely to take effect from 2010.

5.11 The EU currently falls well short of most of the G8+5 countries, including Brazil and China, when it comes to the number of products covered by EU-wide standards[45], which is one reason why individual Member States including the UK have established further voluntary schemes. For some products, the strength of EU standards does not yet match standards elsewhere, as illustrated in **Box 5**.[46] This is recognised within the EU; the European Commission is currently reviewing mandatory standards and labels with a view to setting a much more ambitious regime.

Significant savings are forecast but there are significant risks, not all of which can be managed

5.12 Despite the current upward trend in energy consumed by household appliances, departments expect that programmes on appliances will deliver annual energy savings of 6.6 TWh by 2010 and 14.2 TWh by 2020 (about ten per cent and seven per cent respectively of total expected energy savings from UK households). These figures derive from modelling undertaken by the Market Transformation Programme. These models make assumptions for each product type regarding expected energy efficiency and lifespan over time, number of households, ownership profiles, usage patterns, and likely policy impact. Policy development is at an early stage, and this savings figure is heavily reliant on assumptions about the products market in the next decade and the international and voluntary UK agreements which can be made.

BOX 4

The UK is performing poorly compared to the EU on sales of the most efficient fridges and freezers

More stringent energy ratings for fridges and freezers (A+/A++) were introduced in 2004. Each A+ model consumes 23 per cent less energy than a comparable A-rated model, with the A++ rating saving 46 per cent. The introduction of these ratings has had little impact in the UK – only 3.8 per cent of total refrigerated appliance sales in the UK in 2006 were rated at A+ or A++ compared to an EU average of 13.8 per cent[1].

One of the reasons suggested for the poor take up of these products in the UK is their low representation in the market place – they represent only 6.7 per cent of available models compared to 20 per cent in France. Other potential factors include the price difference between models and the rising popularity of frost-free freezers which consume more energy than standard models.

To encourage take up of these models, the Market Transformation Programme recommended the promotion of these models in the current phase of the Supplier Obligations and the provision of more information on which retailers sell Energy Savings Recommended products. Both have now been implemented but it is too early to say whether there has been a significant change in the market as a result.

NOTE

1 Market Transformation Programme, *Briefing Note BNC14: GB market for A+ and A++ refrigeration products*, Dec 2007.

BOX 5

International comparison – Japanese product standards

Since 1998 the Japanese Government has operated the 'Top Runner' system, which sets minimum efficiency standards for 18 energy intensive product classes including refrigerators, TVs and computers. The standards are recognised as being some of the most stringent in the world; for example, 2004 refrigerator standards require electricity use to be no more than 0.38kWh/litre of space, compared to 2.25kWh/litre as required by Japan's 1995 standards.[1] It is expected that they will contribute 16-25 per cent of Japan's total energy savings target by 2010.[2]

NOTES

1 Based on table contained in UN foundation report which summarises the number of products covered by testing standards. UN foundation, *Realizing the potential of energy efficiency: targets, policies, and measures for G8 countries*, 2007.

2 Joaquim Norquist for AID-EE, *Evaluation of Japan's Top Runner Programme*, 2006.

5.13 The main ways in which government plans to achieve these ambitious targets are

- At an international level:
  - working in the EU to adopt minimum performance requirements for 20 priority products through the framework directive on Eco-Design of Energy Using Products by the end of 2008, and expanding the range of EU mandatory labels and voluntary labels;
  - lobbying within the EU for lower VAT on energy efficient products; and
  - promoting co-operation between countries on standards and labelling, for example through the UK-led International Task Force on sustainable products.
- At a domestic level, Defra is limited to making voluntary agreements with UK retailers, manufacturers and service providers. Action is currently focused on:
  - working with manufacturers and retailers of light bulbs to phase out inefficient light bulbs for household use by 2011;
  - developing agreements with retailers so that the consumer electronics they sell are more energy efficient; and
  - providing incentives for efficient products, such as lamps and refrigerators, through Supplier Obligations.

5.14 Defra has tried to ensure that its estimates of savings are realistic by:

- consulting with stakeholders and making the key assumptions used in the modelling available for public scrutiny, including the development of a web-based model to allow stakeholders to test improvements in product groups[47]; and
- undertaking research to underpin their modelling and develop an evidence base relating to products. This includes work with partners such as the Energy Saving Trust. But as yet, more could be done to understand the impact on consumer behaviour.[48]

5.15 Estimates of potential energy savings from programmes targeted at the design and labelling of appliances are inherently uncertain as it is difficult to predict which technologies will emerge in the future to replace the current stock. Estimates are based on knowledge of the demand for, and efficiency of, existing appliances; there is inevitably limited data available for appliances that have only just been developed, or are still being developed. One recent example is the uptake of digital set top boxes **(Box 6)**.

5.16 There are many other risks to the future success of programmes targeted at the design and labelling of appliances. They include the following:

- **Consumer behaviour.** The effectiveness of these programmes depends on householders choosing to purchase energy-efficient appliances and how the appliances are actually operated in the home. Part 6 explores householder behaviour in more detail. **Box 7** outlines a recent study of householder views on energy efficiency appliances.
- **Reliance on international agreements.** Standards can only be enforced through EU and international agreements. This leads to a number of risks such as:
  - a lack of cooperation at EU and international levels in sustaining and implementing existing policy or developing future policy;
  - uncertainties in the timing and level of EU programmes, leading to delays in the delivery of the expected savings. For example, there are a number of uncertainties surrounding the timing and delivery of standards under the framework directive on Eco-Design of Energy Using Products.
- **Underperformance of voluntary programmes.** Voluntary agreements can be less reliable than regulatory mechanisms, as they rely more upon the willingness of business, often in the absence of strong market incentives.

- **Challenges posed by a rapidly changing market.** Regulatory mechanisms may not be able to respond quickly enough to a rapidly changing market. For example, there is a variety of labelling schemes, some of which are not keeping pace with technological change enough to provide adequate product differentiation for consumers (here, voluntary programmes may be preferable). For example, nearly all washing machines sold in the UK are A-rated under the EU energy label scheme, suggesting that the label standards need to be revised.
- **Difficulty of evaluating product standards.** For each product area there are difficulties in agreeing internationally consistent and robust testing standards and methodologies. This makes it difficult to ensure that the desired energy standards are met in practice.
- **Poor compliance**, both with regulatory policies and voluntary initiatives, could significantly undermine savings. Recent IEA research has estimated non-compliance could be costing 25-30 per cent of the energy savings expected from buildings and products policy.[49]

5.17 Through the Market Transformation Programme, Defra is currently consulting on how to mitigate these risks. There are some aspects that the UK government can influence but not control, such as the level of international cooperation or the level at which EU regulations for minimum performance standards are set. Further policy responses may be required in future to achieve the desired energy savings. Potential options include further development of voluntary initiatives, expansion of voluntary labelling schemes or fiscal incentives for energy saving appliances.

BOX 6

The uptake of digital set top boxes[1]

The increasing popularity of digital television and the planned digital switchover by 2012 have led to rising demand for set top boxes. Early modelling in 2000 by the Market Transformation Programme attempted to account for this and estimated annual energy consumption by set-top boxes of 8.6TWh 2010. In 2005 this was revised upwards to 12.1TWh. Due to faster than previously expected availability of TVs and video recorders with integrated digital tuners, the current published (2007) estimate for 2010 is now only 4.7TWh, and new estimates may revise this down further. An EU voluntary Code of Conduct with manufacturers has contributed to these lower estimates. The wide fluctuations in estimates reflect the difficulties in predicting changing technology.

NOTE

1 The source for this box were officials at the Market Transformation Programme.

BOX 7

Householder views on energy efficient appliances

Focus groups and energy audits conducted by Brook Lyndhurst[1] have revealed the following:

- Householders assume that newer products are more energy efficient; many are surprised to learn that plasma screen TVs use high amounts of energy, for example.
- Many householders aspire to own more or higher energy-consuming appliances, such as plasma screen TVs.
- In general, energy is not a factor considered by householders when making purchasing decisions. Upfront costs have the greatest impact on decisions; running costs are not often considered.

NOTE

1 Brook Lyndhurst on behalf of Defra, *Public Understanding of Sustainable Energy Consumption in the Home*, November 2007.

PART SIX

Information to influence householder behaviour

6.1 The programmes discussed so far all focus on improving household energy efficiency by affecting the physical character of the building or the appliances in it. But there is another set of programmes which aim to influence householder behaviours – both in how they use energy in their home and also to encourage the installation of energy saving measures.

6.2 In theory, there is significant scope for household energy savings from behavioural change. For example, the Energy Saving Trust has estimated that about 10 per cent of household electricity consumption is wasted by leaving appliances on standby.[50] And behaviour change is vital if government programmes are to achieve their full impact – for example:

- Dwellings built to conform with new Building Regulations will not save as much energy as expected, if, for example, householders keep a lot of windows open in cold weather.
- Obligations on suppliers will rely increasingly on private householders choosing to have energy saving measures installed.
- Programmes on appliances rely on householders considering energy efficiency labels when making purchasing decisions. Energy efficiencies will only be maximised if householders make sensible decisions as to where to place and how to use their appliances: for example, not placing a fridge next to an oven.

6.3 The main programmes currently in place aiming to influence household behaviour are:

- the Climate Change Communications Initiative and the work of the Energy Saving Trust, which have been in place for some time; and
- Energy Performance Certificates, which have been introduced in 2008; and
- Better Billing and Metering, which is in development.

6.4 Defra does not apportion energy savings figures to the Energy Saving Trust and the Climate Change Communications Initiative as they are hard to split out from the impact of other programmes such as obligations on suppliers and programmes on household appliances. Energy Performance Certificates are estimated to achieve annual savings of 10.1 TWh by 2020. Better billing and metering is estimated to achieve annual savings of 5.8 TWh by 2020. This Part reviews how the existing programmes are addressing a gap between householder awareness and action. It then explores the barriers faced in understanding and influencing householder behaviour and the challenges to delivering future savings from Better Billing and Metering.

Despite some long-running programmes, there remains a gap between householder awareness and action

6.5 Householders' awareness of energy consumption and its related issues (in particular, climate change) have certainly risen in recent years. 73 per cent of the UK population worry about climate change[51] and over half the UK population recognises a real link between the energy they use at home and climate change.[52]

6.6 However, there remains a persistent gap between this awareness and real action. Recent surveys reveal that, for example, 71 per cent of people leave appliances on standby, 63 per cent forget to turn lights off in rooms and 28 per cent of people leave the heating on when their house is unoccupied.[53] Yet 61 per cent of Britons have stated they 'do enough already' to save energy.[54] We now look at the two programmes which have been seeking to close this gap over recent years.

Communication Initiatives

6.7 To encourage householders to change their behaviour, government has run a series of communication initiatives. These include the 'Are you doing your bit?' campaign which ran from 1998 to 2002, the Climate Change Communications Initiative which ran from 2005 to 2007, and the 'Act on CO_2' campaign which launched in 2007.

6.8 Defra launched the Climate Change Communications Initiative to promote understanding and awareness of climate change and to inspire public action to tackle it. The launch responded to calls from the Carbon Trust, Energy Saving Trust and others for a national communications strategy to link together existing work; the format of the strategy was based on research which recommended local and regional initiatives, supported by coordinated national communications.[55] The 'Act on CO_2' campaign is now taking this work further, seeking to not just show people how to act, but to inspire them to want to act.

6.9 These initiatives have included the following elements:

- Climate Challenge Fund – grants for local and regional communications projects.
- Free resources and information tools to encourage individuals to act – including a website, attitude surveys, a short film and the 'Act on CO_2 Calculator', which allows users to calculate their carbon footprint, and provides a personal action plan; and
- The climate change 'youth champions' initiative – which encourages young people to act as figureheads for the initiative.

6.10 The final outcomes of the campaign (i.e. the shift in attitudes and behaviours) are difficult to measure; outputs to date (summarised in **Box 8**, based on information supplied by Defra) are based on levels of activity, focusing on the amount spent or number of people reached.

6.11 Defra has put in place evaluation plans for the initiatives: the Act on CO_2 campaign is monitored through regular attitude surveys, the results of an evaluation of the Act on CO_2 calculator is due shortly, and an evaluation of the projects funded by the Climate Change Fund is underway. When the results of these evaluations become available, they should be taken into account in designing future information campaigns.

BOX 8

Outputs of communications initiatives (based on information supplied by Defra):

Awareness raising:

- **Climate Challenge Fund Grants:** £8.5 million spent by June 2007 in grant funding to support 83 communications projects to organisations such as the Scouts and the Women's Institute.
- **Climate challenge website:** The website received an average of 120,000 page views per month; the film and brochure from the website had been downloaded 40,000 times.
- **Climate Change Champions Initiative:** Regional print coverage of the champions activity during 2006 was expected to be seen by 18 per cent of adults.

Behavioural actions:

- **Act on CO_2 calculator** – The calculator has had over 750,000 unique visitors who generated over 250,000 carbon footprints; over 200,000 action plans have been generated as a result;
- **Act on CO_2 campaign:** Of those that have seen the TV advertising campaign, around 50 per cent said they either had or intended to take action as a result.

Energy Saving Trust

6.12 The Energy Saving Trust was set up in 1992 to encourage 'energy efficiency and the integration of renewable energy sources into the economic fabric of our society'. Its key activities focus on awareness raising and the provision of information and advice on energy saving measures and sustainable transport to householders. This is delivered through marketing and PR campaigns, telephone and web-based advice, community programmes and events, and involves joint working with local authorities and others. A pilot Green Homes Service, offering a one-stop shop for energy advice and assistance, to be run by the Trust, was announced recently.

6.13 It is difficult to assess the Trust's effectiveness for the following reasons:

- It often works with other bodies and government programmes, and contributes to the impact of other programmes such as the Supplier Obligations. It is therefore difficult to split out the impact of the Trust from other programmes. The Trust is working with Defra to try to find better ways of acknowledging its impact.

- Many of its impacts rely on householders taking action following advice or assistance by the Trust. The Trust surveys its customers to gauge its impact. However, getting a true picture of householder behaviour is difficult, not least because people generally claim to be greener than they really are[56] – something the Trust endeavour to adjust for.

Energy Performance Certificates

6.14 Energy Performance Certificates are a requirement of the EU Energy Performance of Buildings Directive. They provide an energy performance rating for dwellings and recommendations on how to improve that rating. Householders will receive a certificate when they rent or purchase a property. It is not mandatory for householders to respond to the certificate's recommendations. However, CLG expects that over time this information will increase householders' awareness of their energy consumption and encourage them to have positive impacts on behaviour. The scheme is in its infancy and has not yet been evaluated.

To close this gap, programmes must address the barriers to behaviour change

6.15 Barriers to behavioural change present a challenge to the effectiveness of all the major household energy programmes in place and planned. Some key barriers, and departments' methods of addressing them, are outlined below.

Affordability

6.16 Poorer households will struggle to afford some energy saving measures without support. In general, householders tend to focus on the potentially higher up-front costs of energy efficient products, rather than longer term savings.[57] Grant schemes such as Warm Front are a response to this barrier.

Lack of information

6.17 50 per cent of householders cite a lack of understanding of their energy consumption – and the corresponding costs and potential savings – as a reason for not taking action.[58] In response, trials of Better Billing and Metering to provide more information are underway.

6.18 Defra's information campaigns and the Energy Saving Trust offer information on what financial savings could be made. It has been suggested that government action could go further, for example by extending UK and EU labelling schemes to include estimates of average running costs of appliances, so that the financial advantages of energy efficient products are clear to consumers at the point of purchase[59] – though it would be very difficult to provide a meaningful estimate, given that households can use the same appliance to different extents.

Lack of trust in sources of information

6.19 Britons have a noticeably lower level of trust in information about energy related issues than other Europeans.[60] They may distrust energy suppliers or others promoting energy saving measures. People tend to react better to information from friends and family and other trusted sources or in social settings than to information from government sources.[61] There is some evidence that local government sources are trusted more than national government sources.[62]

6.20 In response, the Energy Saving Trust has begun to identify key influencers in communities. The Energy Saving Trust has expressed an aspiration to use more existing social networks within its community programme. National and local messages must be consistent and if possible supported by organisations seen to be independent of government. **Box 9** highlights recent evidence of householders' views on information provision in relation to energy consumption.

Split incentives

6.21 The main example of this is the 'landlord-tenant split', whereby landlords do not invest in energy efficiency because the tenants, not the landlords, pay the energy bills. Equally, tenants may not economise on energy if

BOX 9

Householder views on information about energy consumption

Focus groups and energy audits conducted by Brook Lyndhurst[1] have revealed the following:

- Householders are often unable to determine which products use the most energy in their homes (and are surprised to find out, for example, the high amount of electricity required to light a home by traditional light bulbs).
- Householders want to know more information about cost-specific savings possible from energy saving measures.
- Householders cite the tone of communications as highly negative: they perceive that they often hear about impending environmental disaster but rarely hear success stories.
- Most householders respond favourably to the idea of having a smart meter in their home.

NOTE

1 Brook Lyndhurst on behalf of Defra, *Public Understanding of Sustainable Energy Consumption in the Home*, November 2007.

the landlord pays the bill. In response, HM Treasury has introduced the Landlords Energy Saving Allowance which provides tax relief to landlords when they invest in energy efficiency measures. However, a recent Parliamentary enquiry has found that take-up has been low to date, and it is not clear how well known the scheme is, particularly to smaller landlords.[63] Private rented households account for 12 per cent of dwellings.[64]

Psychological and sociological barriers

6.22 These include the 'hassle-factor' associated with even limited building improvements, and perhaps most importantly, a feeling of 'I will only if they will': surveys suggest that people are reluctant to act unless they see their neighbours, businesses and government acting first. Even in light of the knowledge of why to act and how to act, people may not act themselves until the government takes a strong lead.[65]

6.23 In response, Defra's 'Act on CO_2' campaign has emphasised actions that the government has taken; the campaign has emphasised a pact between citizens and government to take action. But it is important that campaigns which focus on small everyday actions (e.g. boiling kettles, turning off lights) in relation to large-scale problems such as climate change, should make a convincing argument that the everyday actions can make a difference, given the scale of the problem.[66] Another option is to limit directly householders' choice of action: for example, under Defra's plan to phase out the sale of incandescent lightbulbs, householders will only be able to buy energy efficient bulbs.

Further research is required to ensure behaviour change is addressed cost-effectively

6.24 Defra has recently published a framework to encourage pro-environmental behaviours[67], which picks up on many of the barriers outlined above, such as the relative trust in different information sources, and the need for a consistent message. However, the framework does not provide details on how the information programmes should change as a result. The Energy Saving Trust already segments the population by various criteria to help them target the specific groups of people with offers and advice. But the evidence base must be built up further.

6.25 Despite Defra's understanding of the barriers, there is relatively little hard data yet available on how many people have already changed, or may change, their behaviour, by how much, for how long, or the most effective ways to encourage it. For example, cost-effectiveness analysis has not been widely applied to evaluate the impact of behavioural measures such as information campaigns. Given the potential impact of behavioural change on household energy consumption, further data are needed to ensure the right programmes are in place to target the barriers preventing behavioural change, and to assess whether the information campaigns tackling environmental concerns will be successful in changing behaviour to the extent required to meet future energy savings goals.

6.26 One related issue which warrants further consideration in respect of all programmes is that of 'rebound effects', so-called because an effect of the policy is opposite to the one intended. **Box 10** describes rebound effects in more detail.

Better billing and metering needs a stronger evidence base

6.27 'Better billing and metering' is a programme across Great Britain which aims to provide householders with better information on household energy consumption, in the expectation that this will drive changes in behaviour

BOX 10

'Rebound effects'

Particularly important are so-called 'direct rebound effects' or 'comfort taking' where, for example, householders may respond to better insulation by keeping their homes warmer rather than by using less energy. Policy appraisals, such as those for the Energy Efficiency Commitment, are now taking into account evidence from studies of individual homes to estimate how great this effect is.

However, there may be further, indirect, rebound effects, which are not picked up in studies of real homes. For example, it could be the case that householders who save money on energy bills through greater efficiency spend the money on more travel instead – which may result in greater energy and carbon use for the country; elsewhere consumers could replace their existing television with a more efficient but larger model – which uses more energy. Defra has commissioned economy-wide studies based on econometric modelling to try to quantify such effects. One estimate suggests that seven per cent of theoretical energy savings would be lost through greater energy consumption elsewhere, but others studies suggest higher effects[1].

Appraisals and evaluations of programmes, and the policy mix, do not yet take into account any indirect rebound effect. Thus the total savings expected from the mix is likely to be overstated, and overall cost-effectiveness will be less than stated. On the other hand, studies also suggest small positive impacts on UK economic activity, suggesting that in some areas overall cost-effectiveness will be more than stated[2]. The impact on cost-effectiveness is therefore unknown, and should be a focus of further research.

NOTES

1 Studies for Defra by Cambridge and Strathclyde/Stirling Universities on the macroeconomic rebound effect and the UK economy.

2 Studies for Defra by Cambridge and Strathclyde/Stirling Universities on the macroeconomic rebound effect and the UK economy.

and conserve energy. The policy was first announced in 2006 and was developed further in the 2007 Energy White Paper. It is, in part, a response to the requirements of the EU Energy Services Directive, which requires the promotion of Better Billing and Metering. It comprises:

- **Better billing** to provide better historical information on electricity and gas consumption, in an easily understood format.
- **Smart metering** which would permit direct communication between the supplier and customer, avoiding the need for manual or estimated meter readings. Smart meters might also measure electricity generated within the home and supplied to the national grid, which could encourage micro-generation.
- **Real-time displays** to provide ongoing information about electricity consumption and cost. Typically, these involve a device which clips onto the cables to the meter, and a handheld reader which can be used around the home. Real time displays can be used with existing meters or with smart meters.

6.28 The 2007 Energy White Paper included proposals for a requirement for better billing and for all new meters to be installed with a real-time display from 2008, and an offer of free real-time displays for other households until 2010. These proposals were the subject of a consultation paper in August 2007. In addition, the consultation also sought evidence on the provision of smart metering, in the light of the Government's vision that all homes would have smart meters within ten years. In the period following the consultation, BERR conducted an economic Impact Assessment of smart metering. In November 2007, the Prime Minister announced that over the next decade every household will be offered a smart meter.[68]

6.29 In its response to consultation, published in April 2008, the government announced its decision to go ahead with better billing from January 2009 and, rather than opt for a mandatory approach to display devices, to seek voluntary arrangements with gas and electricity suppliers on a limited "free" offer. With respect to a roll out of smart meters to small businesses and domestic customers, fully quantifying expected benefits and estimating future costs on a project of this scale carries a degree of uncertainty; and the impact assessment work completed to date has identified a number of areas for further work. Work on both the qualitative and quantitative evidence base will be undertaken over the coming months. Before taking decisions the Government also wants to take into account any initial results from the Energy Demand Research Project (see Paragraph 6.33 below). Decisions will therefore be made after the second report from the trials, which is due in November 2008. The Government has introduced clauses in the Energy Bill to provide it with the necessary powers to roll out smart meters (which would be accompanied by a linked display) if a positive decision to proceed is taken.

6.30 The cost-effectiveness of more informative billing is relatively uncontroversial: energy providers already have the ability to provide more information to householders.

6.31 The cost-effectiveness of smart meters and real-time displays compared with other ways of providing information to householders is more controversial. BERR's April 2008 Impact Assessment found that the costs associated with smart meters may be higher than the potential benefits. The cost of smart meters or technologies, including installation, could range from £41 to £164 each depending on whether used for gas or electricity and the level of technology in the meter; real-time displays would be around £15 each. Total one-off costs of introducing smart meters across all households, including the cost of the meter, installation and communications technology, would be £7.5-£16.1 billion; in addition there would be ongoing costs of between £0.2 and £0.3 billion a year.[69]

6.32 There is a great deal of uncertainty about the likely financial and energy savings smart meters and real-time displays would generate, as it depends on how householders choose to act on the information. Ofgem have assumed likely savings to be around 1 per cent of an annual bill. A report for Energywatch calculated the total benefits to householders to be higher, at 3.5 to 7 per cent. BERR estimate the saving to be 2.8 per cent for electricity and 2 per cent for gas.[70]

6.33 A limited evidence base lies behind this uncertainty. Much of the evidence comes from studies conducted in other countries, which vary in their applicability to Great Britain. Problems with applying findings of these studies to Great Britain include differences in climate, small trial sizes and self-selecting response groups. Government estimates have therefore so far used conservative assumptions, and acknowledged a wide range of uncertainty. The greatest uncertainty is how, and for how long, householder behaviour might change – and what government and industry can do to ensure these measures have greatest impact.

6.34 Until the evidence base improves, estimated savings must be considered very uncertain. The refining of the Government's impact assessment over the coming months will improve the understanding of both costs and benefits, whilst, to improve the reliability of its estimates, BERR is also funding an Energy Demand Research Project involving several thousand households' receiving smart meters or real-time displays. The project will run until 2010 and will publish an interim report in November 2008. The Government intends to make its decision about smart meters after the refining of its impact assessment and publication of this interim report.

APPENDIX ONE

Scope and methodology

This report examines the programmes government has put in place to reduce energy consumption in England, including UK-wide programmes, but excluding programmes specific to Scotland, Wales or Northern Ireland. The scope of the report includes the demand for energy and energy efficiency, but excludes programmes and measures which primarily target the supply-side, including micro-generation. Supply-side measures and micro-generation have only been looked at where they are part of a policy which primarily targets demand or efficiency.

The study set out to answer the following questions:

- What targets has government set and what progress against them has been made?
- What is known about the effectiveness of the four main programmes which together are expected to account for almost all the energy savings needed to meet the 2016 target, as well as around 80 per cent of the estimated £2.6 billion annual cost?
- What are the likely risks to cost-effective delivery of energy savings by these programmes as they develop?

Much of government policy on household energy consumption is now framed within the broader objective of reducing greenhouse gas emissions to combat climate change. This study therefore used analysis performed for the UK Climate Change Programme, where relevant.

The fieldwork was assisted by our consultants, AEA Energy & Environment. AEA supports the Government and its agencies on a number of key energy programmes, and so were well qualified to assist us. AEA have tested conflicts of interests procedures in place. These procedures are externally accredited and are audited annually. The National Audit Office team performed a thorough review of information and analysis performed by AEA to provide additional assurance over its accuracy and impartiality. A particular conflict of interest could have arisen because AEA run the Market Transformation Programme for Defra in support of programmes on appliances. To mitigate this conflict of interest in this area, we confirmed information received from our consultants by direct recourse to Defra and the Market Transformation Programme.

Review of policy literature

Our consultants reviewed a variety of literature including parliamentary, departmental, academic and consultancy reports, many of which are identified in the footnotes to the report. The literature provided details of government projections and targets; analysis performed to support those projections and targets; independent evaluations of government programmes. It also included the findings of a number of recent surveys and other pieces of research which explore the views of householders.

Interviews with departments

Our consultants, and in some cases the National Audit Office, conducted semi-structured interviews with policy officials and analysts in:

- Defra (Climate Change and Energy: Household Markets division);
- CLG (Building Regulations programme);
- BERR (Metering and Billing);
- HM Treasury (Household Measures);
- Ofgem; and
- the Office for Climate Change.

The interviews enabled us to gather further information and clarification to support the literature review, and to gather the views of departmental representatives on the challenges associated with reducing household energy consumption, as well as identifying the factors for success.

Stakeholders' views

During the scoping and fieldwork stages of our study we consulted stakeholders from:

- Association for the Conservation of Energy;
- Brook Lyndhurst;
- Building Research Establishment;
- Centre for Sustainable Energy;
- Construction Industry Council;
- Energy Retail Association;
- Environmental Change Institute;
- Green Alliance;
- Home Builders Federation; and
- Sustainable Development Commission.

Expert panel

At key points during and after our fieldwork we liaised with an expert panel drawn from the following institutions to test the reasonableness of our emerging conclusions:

- Centre for Environmental Strategy, Surrey University
- Environmental Change Institute, Oxford University
- Science and Technology Policy Research Unit, University of Sussex

International comparisons

To set UK programmes in perspective and explore the scope for benchmarking, we conducted a series of desk-based international comparisons. Information came primarily from the ODYSSEE programme, a pan-European collaboration to produce a database of energy consumption, energy efficiency and carbon dioxide emissions in the countries of the European Union plus Norway. Further information came from the United Nations and Japan.

Previous National Audit Office studies

Our work builds in particular on two previous studies produced by the National Audit Office for the Environmental Audit Committee in 2006 and 2007 respectively. These looked at, in relation to the 2006 Climate Change Programme Review, i) the use of cost-effectiveness analysis, and ii) the robustness of emissions projections. This earlier work informed our review of cost-effectiveness and our comments on the energy demand projections included in this report, and gave us broad assurance as to the analytical methods used. However, as highlighted in that work, we recognise that all such estimates are subject to a level of uncertainty or margin of error.

APPENDIX TWO

Energy characteristics of housing in England

The energy efficiency of homes is influenced by the following factors:

- **Type** – on average larger detached dwellings are less energy efficient than small terraced houses, which are in turn less efficient than a typical purpose built flat. It follows that by location, dwellings in urban areas (typically flats and terraced houses) are on average more efficient than those in rural areas (typically detached dwellings).
- **Age.** Due to the influence of Building Regulations and modern materials, newer properties tend to be more energy efficient than older properties, even if older homes have had measures such as new boilers and insulation installed.[71] The turnover of housing stock is slow – even if current government house-building plans are realised, two thirds of the housing stock in 2050 will still be houses built before 2005.[72]
- **Ownership.** Social housing is generally more energy efficient than private sector housing, as it tends to include more modern and smaller properties such as purpose built flats[73] (even though private dwellings tend to contain more energy saving features such as loft insulation).[74]
  - Within the social sector (20 per cent of dwellings), dwellings owned by registered social landlords tend to contain more energy saving features than local authority housing.
  - Within the private sector (80 per cent of dwellings), private rented housing tends to contain fewer energy saving features than owner occupied housing. Private rented households account for 12 per cent of dwellings.[75]

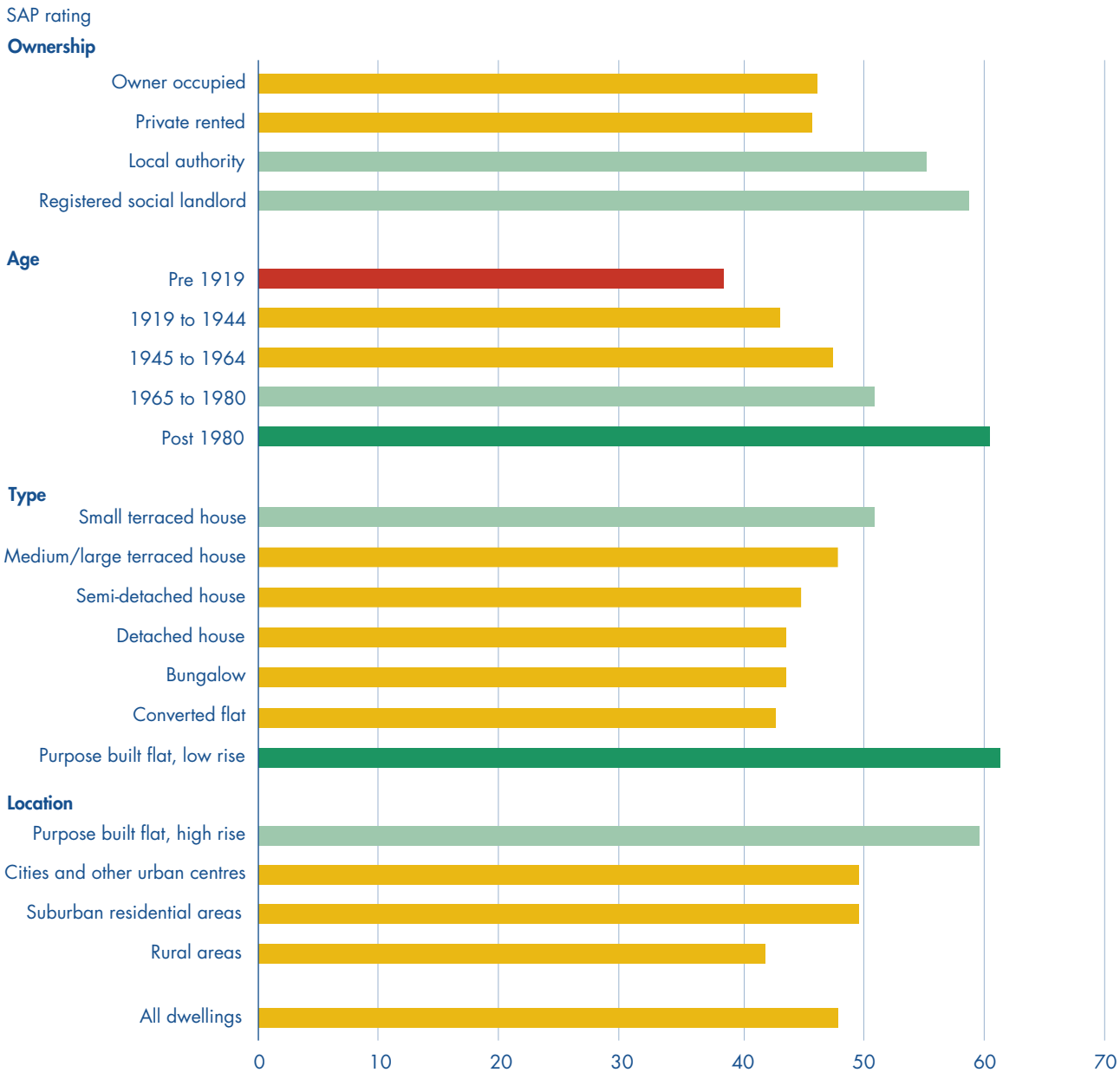
The energy efficiency of households is most commonly measured in terms of a SAP ('Standard Assessment Procedure') rating. Average SAP ratings, based on a recent review by the Department for Communities and Local Government[76], are shown in **Figure 17 overleaf**.

The prevalence of particular housing types in different regions of England helps to account for some broad regional trends in average SAP ratings:

- The average SAP rating of houses in London and the North East tends to be higher than average, mainly due to the large number of private terraced houses and flats, and the higher proportion of social sector homes.
- The West Midlands has significantly lower ratings due to a high proportion of poor social and private sector housing.
- Lower ratings in the South West are due to a large proportion of rural housing.

Housing types by region are shown in **Figure 18 on page 43**.

17 Household energy efficiency varies by ownership, age, type and location



Source: English Housing Condition Survey 2005

NOTE

Data are from 2005. SAP ratings were assessed on a scale from zero (homes which are energy inefficient and difficult to heat) to 100 (very efficient homes).

Hard to treat homes

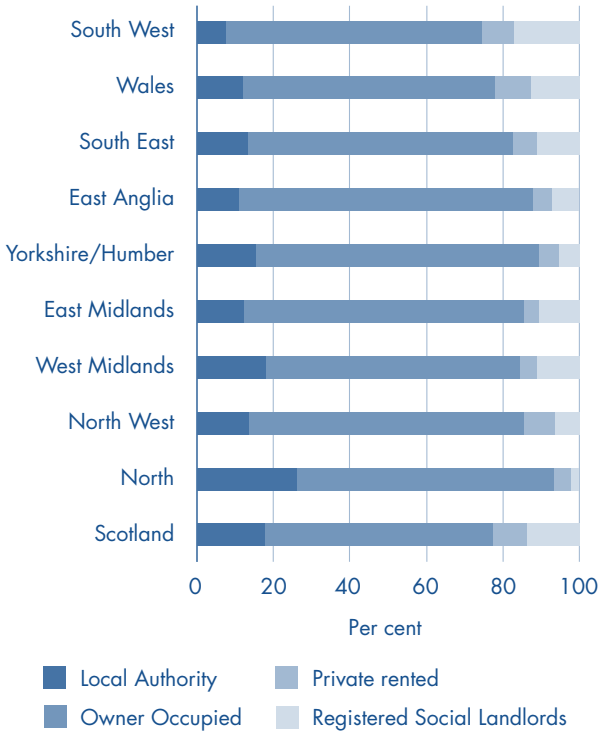
Hard to treat homes represent a particular challenge in the context of improving household energy efficiency as for a number of practical or technical reasons they are prevented from having all the standard cost-effective energy efficiency measures installed (such as loft insulation, cavity wall insulation or the installation of a gas central heating system). Approximately 9.2 million or 43 per cent of homes in England have at least one of the features generally found in hard to treat homes: solid walls, off the mains gas network, no loft space or are in high-rise blocks.[77]

Homes with solid walls and those off the main gas network make up the majority of hard to treat homes – 72 per cent have solid walls and 30 per cent are off the main gas network. Over 800,000 homes have both characteristics.[78]

Analysis by the Building Research Establishment[79] shows that there is potential for the majority of hard to treat homes to have one or more cost-effective energy efficiency measures installed. However, there are 1.7 million homes or 8 per cent of homes in England that have a combination of features, such as solid walls and no loft, that can only have more expensive measures installed to improve their energy efficiency, such as solid wall insulation.

Nearly 84 per cent of the hard to treat homes in England are in the private sector, and the majority of these are owner-occupied. The private rented sector has the highest proportion of hard to treat homes by ownership type at 65 per cent, although it only makes up 16 per cent of all hard to treat homes. On a regional basis, London has the highest percentage of hard to treat homes, mainly due to the large number of homes with solid walls.[80]

18 Housing types vary by region



Source: Building Research Establishment Domestic Energy Factfile 2006

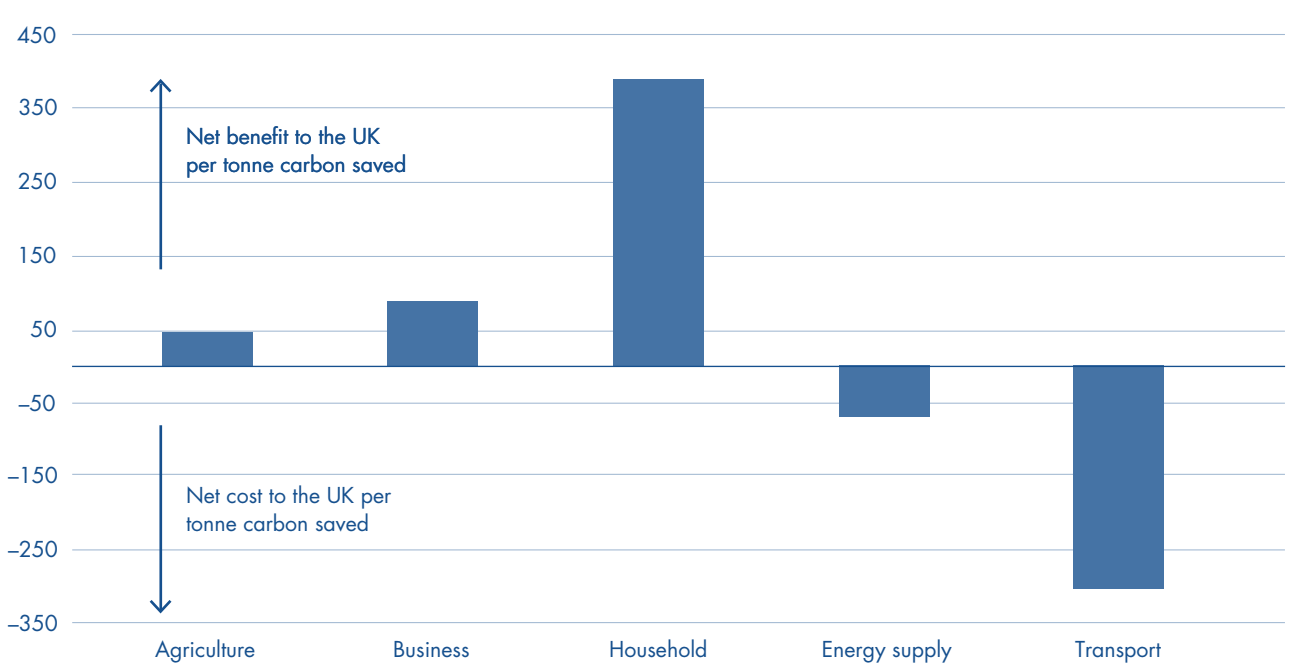
APPENDIX THREE

Cost-effectiveness

Government analysis suggests that there is a greater cost-effective potential to reduce energy consumption and greenhouse emissions by households than by transport, industry or other sectors of the economy. Analysis undertaken for the 2006 Climate Change Programme Review, and more recently for the 2007 Energy White Paper, suggests policies in the household sector offer a significant overall benefit to the UK **(see Figure 19)**, and should therefore be at the forefront of efforts to save energy and emissions. Analysis is performed with reference to carbon, rather than energy (in terms of the overall cost or benefit to the UK per tonne of carbon saved).

This analysis[81] suggested that programmes to reduce emissions from households are as a whole the more cost-effective because they directly result in financial savings on fuel bills. Programmes to reduce emissions from business also result in financial savings, but were considered less cost-effective overall. Previous work by the National Audit Office, based on departmental analysis underlying the 2006 Climate Change Programme Review, suggests this could be due to the relatively high upfront costs associated with identifying and acting on efficiencies in industrial processes.[82] The agricultural programmes covered by the analysis were schemes to create and manage woodlands to act as carbon sinks,

19 The household sector offers more cost-effective opportunities to reduce greenhouse gas emissions



Source: Synthesis of Climate Change Policy Evaluations 2006 (Defra)

NOTE

Net benefits or costs are derived by converting future cash or resource flows into today's terms by discounting them at a percentage rate which aims to reflect the fact that £1 today is worth more than £1 tomorrow, even after taking inflation out of the equation. For the 2006 Review, analysts used a discount rate of 3.5 per cent for impacts occurring within the next 30 years, and lower rates thereafter, in line with Treasury guidelines.

which are less cost-effective again: these programmes bring benefits to local communities but overall benefits were analysed to be less than those associated with energy efficiency programmes. Within the energy supply industry, the analysis only covered the Renewables Obligation and found it resulted in a net cost to the UK due to the expense associated with renewable technologies (primarily wind turbines). Programmes to improve the fuel efficiency of transport (primarily voluntary agreements with manufacturers) came out as the least cost-effective. This is because the analysis suggested that people would respond to more fuel efficient cars by driving more: this would bring significant costs associated with greater congestion and street level air quality.

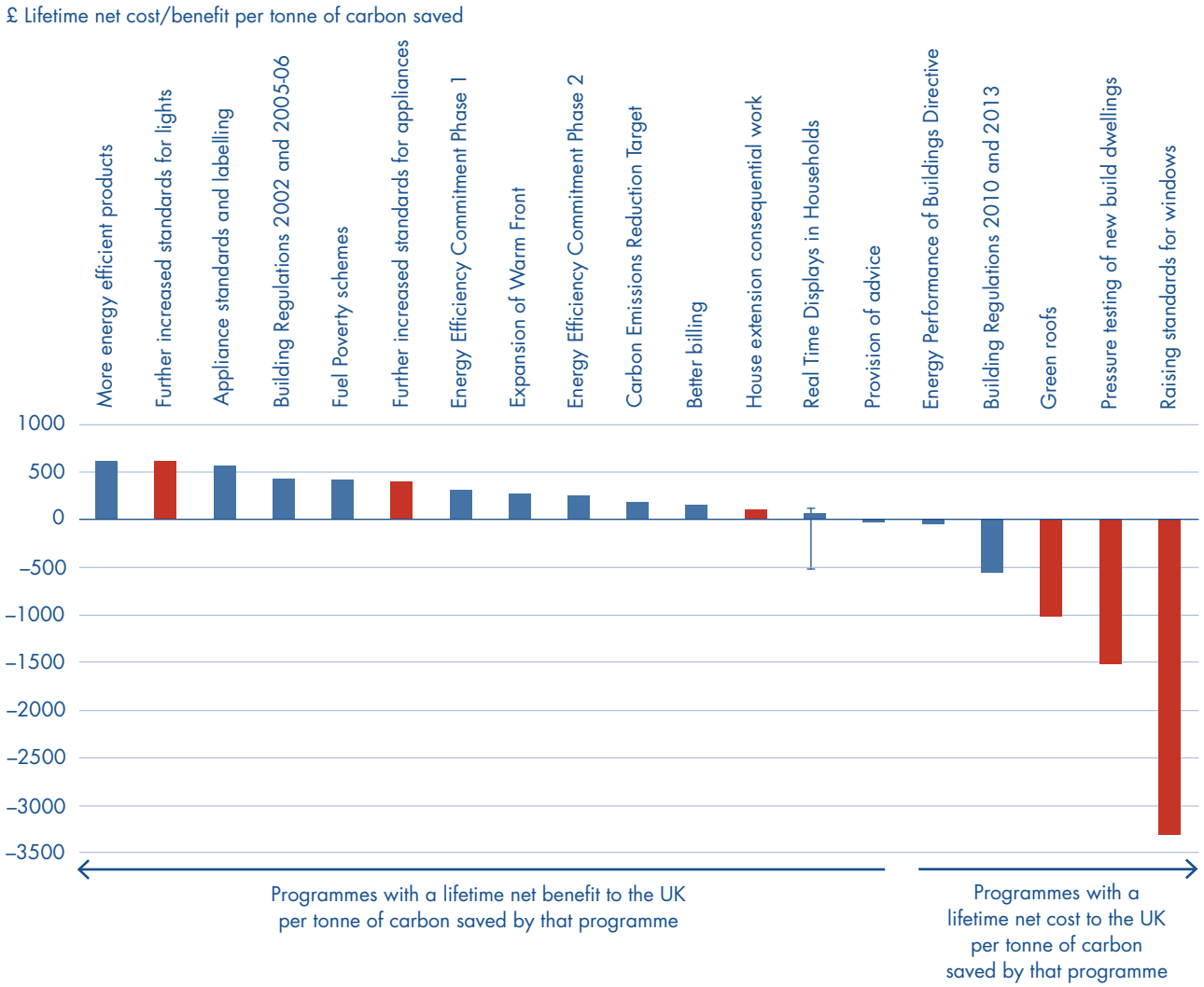
Defra and CLG take into account a number of factors when choosing programmes to influence household energy consumption and efficiency, including:

- cost-effectiveness of policy and specific policy design;
- ability of programmes to target and overcome specific barriers and market failures such as behavioural change;
- EU and other international requirements;
- estimated impacts of new programmes on the existing policy mix (for example, whether the policy would make additional energy savings) and on wider energy and other policy objectives – such as reducing fuel poverty, driving innovation and stimulating new markets; and
- political acceptability.

Cost-effectiveness analysis for programmes impacting on household energy consumption and efficiency has tended to be measured in successive policy reviews in units of carbon saved, and appears to have had a significant influence on the choice of individual programmes pursued to tackle energy consumption in the household sector. As shown in **Figure 20 overleaf**, for those programmes that have been subject to a cost-effectiveness appraisal, and on the basis of data reported as part of the Climate Change Programme Review (2006) or later analyses, programmes selected were generally more cost-effective than those rejected. The use of cost-effectiveness analysis conducted for the CCPR 2006 was reviewed by the National Audit Office and found to be broadly satisfactory.[83] The analysis performed for the 2007 Energy White Paper followed the same guidance and a consistent process.

Exceptions to this general trend highlight that other considerations affect policy choice. Some programmes have been pursued despite not being as cost-effective as others (such as zero carbon homes), and some programmes have not been pursued despite being more cost-effective (such as increased product standards). As found by a previous National Audit Office study[84]: 'Working papers show that the cost-effectiveness analysis did have an influence on the final policy programme. However, the principal driver of policy choice in the 2006 Review was the early recognition that the UK would fall well short of its 2010 [carbon dioxide] household target … Cost-effectiveness data was just part of policy-makers' consideration of the right policy mix to achieve the national target'.

20 Recent programme choices generally reflect estimates of cost-effectiveness



Source: Departmental estimates quoted in the Climate Change Programme Review Synthesis of policy appraisals (2006), Energy White Paper 2007 Synthesis report, and individual impact appraisals

NOTES

Current or intended programmes are marked in blue. Rejected programmes are marked in red. Error bars reflect ranges of estimates.

Net costs or benefits reflect analysis performed in 2005-06, or later where published later for specific programmes. The names of some policy areas have since changed. In a few cases, more recent appraisals have been conducted – but these have not changed the policy mix chosen. These indicators exclude the social cost of carbon.

The cost-effectiveness estimates shown here exclude the social cost of carbon.

Some programmes are not captured due to a lack of published information or the costs and benefits being included within other programmes. These include the post-2011 Supplier Obligation, Decent Homes, Energy Saving Trust and the Climate Change Communications Initiative.

GLOSSARY

The numerous government programmes in this area are outlined and described in Figure 3 on page 13. Other terms referred to in the report include:

Energy consumption	Is the amount of energy consumed in households. This data are collected by energy companies, and is collated by BERR.
Energy efficiency	Determines the amount of energy required to meet a certain level of 'energy service demand' in homes. Energy efficiency is calculated based on the estimated number of energy efficiency measures installed in UK homes and the assumed efficiency delivered by them. For example, a better insulated house is more energy efficient, so will require less energy to heat to a certain temperature. (See also 'specific energy consumption'). Note that it is not always easy to estimate the impact of individual measures installed, as this will depend on the type of dwelling in which they are installed and the other appliances within that dwelling.
Energy service demand	Is a measure of the demand for the useful end product of energy usage (the service) – i.e. heat, light and appliance function. It reflects how warm householders want their home to be, how many hours they want to watch TV, and so on. Energy service demand is not measured directly but is calculated through the understanding that changes in consumption = changes in efficiency X changes in service demand). If the level of energy service demand was constant, energy consumption should fall as energy efficiency improves. It is measured as an index, compared to a base year (typically 1990).
Micro-generation	Is the production of heat or electricity on a small-scale from a low carbon source. Various technologies can be used for micro-generation, including pumps that transfer heat from the air or ground, fuel cells, solar panels and small scale hydro or wind power.
Million tonnes carbon (MtC)/Million tonnes carbon equivalent (MtCe)	Indicates the amount of carbon released into the atmosphere for a given level of energy consumption. A tonne of carbon is equivalent to 3.67 tonnes of the gas, carbon dioxide. Carbon equivalency is a quantity that describes, for a given mixture and amount of other greenhouse gases (including e.g. methane), the amount of CO_2 that would have the same global warming potential as that mixture of gases, when measured over a specified timescale (generally, 100 years).

Social cost of carbon	The social cost of carbon (SCC) measures the full global cost today of an incremental unit of carbon (or equivalent amount of other greenhouse gases) emitted now, summing the full global cost of the damage it imposes over the whole of its time in the atmosphere. It measures the scale of the externality which needs to be incorporated into decisions on policy and investment options in government. It signals what society should, in theory, be willing to pay now to avoid the future damage caused by incremental carbon emissions.
Specific energy consumption	The change in the energy required to produce a constant level of energy service in households. It is the measure of energy efficiency that was proposed by the Government in its paper for the Joint Working Group on Energy and the Environment.
Terawatt hour (TWh)	Is one thousand billion watt hours. One watt hour is the amount of (usually electrical or natural gas) energy expended by a one-watt load (e.g. a light bulb) drawing power for one hour. One watt hour is equivalent to 3,600 joules of energy.

ENDNOTES

1 Defra, *Energy Efficiency Action Plan*, 2004.

2 The 30 per cent savings can be achieved if households adopt all measures with a payback period of 3 years or less. Calculated by the National Audit Office, based on modelled estimates of energy and cost savings for a range of measures for existing homes, based on housing stock as at 2005. Estimates from Building Research Establishment, *Delivering cost-effective carbon saving measures to existing homes*, 2007.

3 Defra, *UK Energy Efficiency Action Plan* 2007.

4 Defra, *Energy Efficiency Action Plan*, 2004.

5 Defra, *Energy Efficiency Action Plan*, 2004

6 Based on the proportion of expected energy savings from measures in the household sector in 2010, applied to the target economy-wide energy savings required by 2010, as a percentage of the average household energy consumption during 2001-2005. Figures from Defra, *Energy Efficiency Action Plan*, 2007.

7 Based on the proportion of expected energy savings from measures in the household sector in 2016, applied to the target economy-wide energy savings required by 2016, as a percentage of the average household energy consumption during 2001-2005. Figures from Defra, *Energy Efficiency Action Plan*, 2007.

8 Defra, *Energy Efficiency Action Plan*, 2007.

9 National Audit Office, *Ofgem – Social Action Plan and Household Energy Efficiency* (HC 878, 2003-04) and *Warm Front: Helping to Combat Fuel Poverty* (HC 769, 2002-03).

10 Calculated from BERR energy consumption statistics including energy efficiency and service demand calculations by Defra. Latest available data for energy consumption is 2007, whereas it is 2004 for energy efficiency and service demand, hence the differing ranges for these calculations.

11 Joint Working Group on Energy and Environment, *Progress on development of indicators*, July 2005.

12 Calculated from Energy Consumption data from BERR and population figures as used by the Market Transformation Programme, Defra.

13 Based on the proportion of expected energy savings from measures in the household sector in 2010, applied to the target economy-wide energy savings required by 2010, as a percentage of the average household energy consumption during 2001-2005. (Figures from Energy Efficiency Action Plan 2007).

14 The household Energy Supplier Obligation from 2011: *A Call for Evidence* June 2007.

15 Source: BERR energy data – see http://www.berr.gov.uk/files/file45393.pdf, Table 2.1.1.

16 Based on payment by standard credit and medium energy use. Source: Energywatch press release 6 Mar 2008, 18 Jan 2008.

17 CLG, *The English House Condition Survey*, 2006, provides data on average energy efficiency as measured by 'Standard Assessment Procedure' (SAP) ratings and suggests that energy efficiency has continued to improve from 2004 – 2006; however there has been no updated measurement of energy efficiency in terms of 'specific energy consumption' since 2004.

18 *The Energy White Paper* (Urn 07/947), May 2007; Updated energy and carbon emissions projections.

19 National Audit Office, *Emissions projections in the 2006 climate change programme review*, November 2006.

20 National Audit Office, *Cost-effectiveness analysis in the 2006 Climate Change Programme Review*, January 2007.

21 HM Government, *Climate Change Programme Review*, 2006.

22 The precise reduction in energy terms cannot be calculated because 2004 figures were only published in carbon terms. In those terms estimated savings were revised down from 1.8 to 1.3 million tonnes carbon equivalent a year. Source: Energy Efficiency Action Plans: 2004 and 2007.

23 Future Energy Solutions (division of AEA Technology), *Compliance with Part L1 of the 2002 Building Regulations (An investigation into the reasons for poor compliance)*, 2006.

24 CLG, *Monitoring the Sustainability of Buildings*, February 2007 – sets out the actions taken to improve compliance with Building Regulations, but does not assess levels of compliance.

25 CLG, *Future for Building Control*, March 2008

26 CLG, *Building a Greener Future: policy statement*, July 2007.

27 CLG, *Building a Greener Future: policy statement*, July 2007. Findings were based on the fact that the price of newly constructed houses is determined largely by the market price of comparable existing housing stock.

28 CLG *Eco friendly ratings for all new homes*, February 2008.

29 The Callcutt Review team, *The Callcutt Review of Housebuilding Delivery*, 2007.

30 The Supplier Obligation applies to companies that supply electricity or gas to households under the terms of the Electricity Act 1989 or the Gas Act 1986. The largest household energy suppliers do not just supply electricity or gas, but also generate and distribute.

31 Ofgem, *A review of the Energy Efficiency Commitment 2002-2005*, August 2005.

32 The precise reduction in energy terms cannot be calculated because 2004 figures were only published in carbon terms. In those terms estimated savings were revised down from 1.1 to 0.8 million tonnes carbon equivalent a year.

33 Eoin Lees Energy, *Evaluation of the Energy Efficiency Commitment 2002-05*, February 2006.

34 BERR, *Digest of UK Energy Statistics* – Table 1.7, 2007.

35 Defra estimates.

36 Building Research Establishment, for Defra, *Delivering cost-effective carbon saving measures to existing homes*, September 2007.

37 Oxera on behalf of Defra, *Policies for energy efficiency in the UK household sector*, January 2006 (table 6.1).

38 Energy for Sustainable Development Limited, *UK Insulation Sector Supply Chain Review*, February 2007.

39 The last National Audit Office report on this subject (*Ofgem – Social Action Plan and Household Energy Efficiency*, HC 878 2003-2004) recommended that 'more research is needed into the extent to which theoretical energy savings credited to suppliers are achieved in practice.'

40 Defra working papers.

41 BERR energy consumption statistics.

42 Energy Saving Trust, *The rise of the machines*, 2006.

43 Viegand & Maagøe, commissioned by ANEC and Defra, *A review of the range of activity throughout Member States related to compliance with the EU Energy Label regulations in those countries*, 2007

44 Tom Lock, Jennifer Hindson, *Energy Saving Trust and European Energy Network (EnR) Working Group on Labelling and Eco-design, Energy Saving Recommended: Key Principles for a successful product labelling scheme*, 2006.

45 Based on table contained in UN foundation report which summarises the number of products covered by testing standards. UN foundation, *Realizing the potential of energy efficiency: targets, policies, and measures for G8 countries*, 2007.

46 For further details as to how standards compare internationally, see for example, Market Transformation Programme, *Comparison of UK and Best International Energy Standards as at March 2006*, 2006 and HM Treasury, *Energy Efficiency Innovation Review*, 2005.

47 The What-if Tool is an online calculator based on the Market Transformation Programme models. It allows users to analyse the impact of changes on the key assumptions upon the energy impacts of products. http://www.mtprog.com/Whatlf.aspx.

48 In separate studies, both the Energy Saving Trust and the Centre for Sustainable Energy have highlighted the need for further information on the impact of consumer behaviour on energy consumption of appliances. Energy Saving Trust, *The Rise of the Machines*, 2006 and Centre for Sustainable Energy, *Study of user benefits, views and perceptions of the Market Transformation Programme*, 2007 (unpublished).

49 Paul Waide, *Meeting Energy Efficiency Goals*, Paris, 28-29 February 2008.

50 Energy Saving trust, *Habits of a lifetime*, 2006.

51 Logica, *Turning concern into action: Energy efficiency and the European consumer*, September 2007.

52 Energy Saving Trust, *Green Barometer*, April 2007.

53 Energy Saving trust, *Habits of a lifetime*, 2006.

54 Logica, *Turning concern into action: Energy efficiency and the European consumer*, September 2007.

55 Futerra on behalf of Defra and others, *UK Communications Strategy on Climate Change*, February 2005.

56 Norwich Union study, August 2007 as quoted in The Telegraph, *'Green Guilt' causing neighbours to fib*, 24 Aug 07.

57 Brook Lyndhurst on behalf of Defra, *Public Understanding of Sustainable Energy Consumption in the Home*, November 2007.

58 Logica, *Turning concern into action: Energy efficiency and the European consumer*, September 2007.

59 Brook Lyndhurst on behalf of Defra, *Public Understanding of Sustainable Energy Consumption in the Home*, November 2007.

60 Logica, *Turning concern into action: Energy efficiency and the European consumer*, September 2007.

61 Brook Lyndhurst on behalf of Defra, *Public Understanding of Sustainable Energy Consumption in the Home*, November 2007.

62 LGA Climate Change Commission: *A climate of change: final report*, November 2007.

63 Communities and Local Government Select Committee, *Existing Housing and Climate Change*, April 2008.

64 CLG Household characteristics statistics, table 801.

65 Brook Lyndhurst, *Bad habits and hard choices: in search of sustainable lifestyles*, November 2004. This research looked at general awareness of environmental problems rather than energy consumption in households specifically.

66 The difference in scale between small individual actions and climate change is highlighted as a challenge for climate change communication within the following report: Institute for Public Policy Research, *Warm Words: How are we telling the climate change story and how can we tell it better?*, 2006.

67 Defra, *A framework for pro-environmental behaviours*, January 2008.

68 Prime Minister's Speech on Climate Change, 19 Nov 2007.

69 BERR (April 2008) Impact Assessment of Smart Metering roll out for domestic customers and for small businesses.

70 ibid.

71 CLG, *2006 Sustainability of existing housing*.

72 CLG, *Building a Greener Future: policy statement*, July 2007.

73 CLG, *Review of the sustainability of existing buildings: The Energy Efficiency of Dwellings – Initial Analysis Sustainability of existing housing*, 2006.

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75 CLG Household characteristics statistics, table 801.

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