Zero carbon: what does it mean to homeowners and housebuilders?

NHBC Foundation
Housing research & development in partnership with BRE Trust

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NHBC Foundation
Buildmark House
Chiltern Avenue
Amersham
Bucks HP6 5AP
Tel: 01494 735394
Fax: 01494 735365
Email: info@nhbcfoundation.org
Web: www.nhbcfoundation.org

This report has been written by Ian Davis and Vicki Harvey of Enterprise Planning & Research Ltd, Marketing and Research Consultants, www.epr-uk.com

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FOREWORD

The NHBC Foundation was established two years ago to provide practical and relevant research to help the new homes industry respond to the many challenges it faces, with a particular focus on supporting the objectives of the sustainability agenda.

The target of achieving zero carbon homes and the requirement of the higher levels of the Code for Sustainable Homes by 2016 are more ambitious than anywhere else in the world. And as housing currently accounts for around 30% of the UK's total energy use and 27% of all carbon emissions, it is clear that creating efficient, zero carbon homes will depend on new technology and innovations, many of which are still unproven on a mass-market scale.

One of the key aims of the NHBC Foundation is to provide the necessary data and intelligence to develop long-term solutions to the challenges ahead. The Foundation has published a range of reports to help the industry in this area including *A review of microgeneration and renewable energy technologies*, *Climate change and innovation in house building* and *Conserving energy and water, and minimising waste*. However, success in achieving the 2016 zero carbon objectives relies not only on effective and proven technology being used correctly, but also on willing and informed homeowners.

In order to achieve Level 6 of the Code for Sustainable Homes, the next generation of housing will differ significantly from that of today. And while previous evolutionary changes in housing, such as double glazing, central heating and extra sanitary facilities, have had positive effects on lifestyle for the consumer, the proposals for improving the environmental performance of new homes may not necessarily be perceived in the same way. Some people will undoubtedly choose a home because of its sustainable features, but for others the perceived inconvenience of giving up the luxury of a deep bath or power shower or having to grapple with sophisticated new technology may prove challenging.

The purpose of this unique research is to provide valuable insight into the psychology of homeowners and their attitudes towards environmentally friendly housing in order to identify issues and potential barriers to achieving the 2016 objectives. It also provides an accurate reflection of the views of housebuilders, who face the challenging task of delivering new housing that meets these ambitious targets.

We look forward to a continued and wider debate between industry, all levels of government and key stakeholders to ensure that we create a housing stock that is sustainable and, importantly, 'liveable' for the next generation.

Rt Hon. Nick Raynsford, MP

Chairman, NHBC Foundation

EXECUTIVE BRIEFING

Introduction

A detailed survey of the views of homeowners and housebuilders on zero carbon homes has been commissioned by the NHBC Foundation. This report presents the findings of this survey.

Communities and Local Government (CLG) published *Building a Greener Future: policy statement* in July 2007. This policy statement confirms the government's intention for all new homes to be zero carbon by 2016, with a progressive tightening of the energy efficiency building regulations – by 25% in 2010 and by 44% in 2013 – up to the zero carbon target in 2016.

The definition for a 'zero carbon home' is still to be set for the purposes of the 2016 ambition, but it is broadly understood to be one with 'zero net emissions of carbon dioxide (CO_2) from all energy use in the home'. This encompasses those energy uses that are currently part of building regulations (space heating, hot water, ventilation and some lighting) as well as all other energy uses such as cooking, TVs, computers and all other appliances. It means that, over a year, there should be no net CO_2 emissions resulting from the operation of the home.

The changes to building regulations will be complemented by the Code for Sustainable Homes, which is a new national standard for sustainable design and construction of new homes. The Code measures the sustainability of a new home against nine categories of sustainable design and construction, rating the 'whole home' as a complete package. The Code uses a 1 to 6 star rating system to communicate the overall sustainability performance. It sets minimum standards for energy and water use at each level and, within England, replaces the EcoHomes scheme. CLG has confirmed recently that mandatory rating against the Code will be implemented for new homes from 1 May 2008.

Housing accounts for around 30% of the UK's total energy use and 27% of its CO_2 emissions. Plans to reduce these levels depend to a large extent on technology, much of which will have to be provided in large quantities on a commercial scale. It is important that consumers continue to be protected during this evolution in home building against both financial and health-related risks that may occur as a result of adopting these new technologies and construction methods. Given the government's housing supply targets, it is also imperative that builders are able to construct homes in the required numbers and that homebuyers continue to have confidence in new homes.

Despite the heightened political profile of the sustainability agenda, flowing from the release of the Stern report, the debate has yet to engage consumers in any significant way when it comes to the impact of the inevitable changes on the development, design and construction of new housing in the UK.

The findings of this research are particularly important since success in achieving the government's 2016 objectives depends on willing and informed homeowners who will want to take advantage of and benefit from the opportunities offered by the housing of the future.

Zero carbon: what it means to homeowners and housebuilders reveals the current awareness, understanding and attitudes of homeowners towards issues relating to climate change, the Code for Sustainable Homes, airtightness, water conservation and microgeneration. It assesses where consumer priorities lie when purchasing a home and their views on energy saving mechanisms.

The research also establishes the awareness, views and attitudes of housebuilders in relation to the zero carbon agenda, how this is being driven by the Code for Sustainable Homes, emerging technologies and strategies for carbon reduction.

Research methodology

The research is structured into two sections – homeowners and housebuilders.

The survey of homeowners' knowledge and opinions involved both qualitative and quantitative activities:

- more than 500 interviews and nine focus groups with owners of both new and older housing stock across the UK. The groups comprised a full spectrum of owner occupiers, including first-time buyers, flat owners, families and retirees
- a focus group with residents of existing low energy developments in Milton Keynes built in the 1980s and 1990s.

The survey of housebuilders also involved both qualitative and quantitative activities:

- a focus group with leading UK housebuilders
- in-depth personal interviews with seven of the country's top ten housebuilders
- a structured telephone survey of more than 100 UK housebuilders.

Key findings: homeowner research

The research shows that, while many homeowners are aware at some level of the need to reduce carbon emissions, most have not taken any significant or meaningful steps to reducing their own carbon footprint. Many references were given to more recycling and switching lights off when not in use, however, homeowners do not tend to adopt a consistent approach. For example, when asked how savings from energy costs would be spent, the most popular choice was an overseas holiday. This is an example of what is known as the 'carbon rebound effect'.

The findings of the research show a significant lack of awareness and understanding of the 2016 targets and a widespread reluctance to accept the potential lifestyle changes associated with low and zero carbon homes.

On the basis of present information, homeowners expressed particular concerns around issues such as airtightness, restrictions on water use and the potential for increased service and maintenance responsibilities. There is also a marked preference for the appearance of conventional new homes as opposed to the low carbon homes currently being built.

The research suggests that the most effective means of engaging homeowners in the drive to reduce energy use would be to focus on the cost savings that would result.

There is currently considerable resistance to homeowners meeting the increased construction costs of the higher levels of the code, principally because of a lack of demonstrable payback on investment.

Climate change

- Few were aware that 27% of UK carbon emissions comes from housing stock.
- Nine out of ten homeowners surveyed agree that climate change is happening, but only 45% agree that this is mainly caused by CO_2 emissions.
- More than 30% said they were aware of a government initiative to reduce CO_2 emissions from housing – the most widely mentioned was the new Energy Performance Certificates. Just under half were aware of the term 'zero carbon home'.

Homeowner priorities and psychology

- Homeowners are currently making *minor* lifestyle changes to reduce their carbon footprint, such as recycling and switching off electrical items when not in use in the home.
- However, the research suggests that, in reality, good intentions may be eroded by a belief that climate change may not be as bad as people say it is or that it may not be related to carbon emissions and human activity.

- Even where homeowners believe the climate change argument, many are reluctant to make adjustments because they feel the effect of any changes will be insignificant.
- The consequence of these doubts is that few homeowners are prepared voluntarily to make the radical lifestyle changes required to substantially reduce their carbon footprint.
- Energy efficiency is not at all a major factor in the choice of home, and a higher proportion of respondents would prefer to invest in a higher specification kitchen or bathroom than in further energy efficiency measures.
- When asked how they would spend any savings from the lower energy bills in an energy efficient house, the most common single answer given by homeowners was an overseas holiday involving air travel. This is an example of what is known as the 'carbon rebound' phenomenon.

Energy saving in the home

- While almost 90% of homeowners could suggest one or more energy saving measures, only 76% could name one they have actually put into practice in recent years.
- Most reduction measures taken voluntarily are small or incremental and are not sufficient to meet the government targets for reducing emissions by 60% by 2050.
- Most homeowners correctly identified that the main source of carbon emissions in the home is a boiler but relatively few in older homes have chosen to replace conventional boilers with more efficient condensing boilers due to the cost involved.
- Cost savings and a return on investment are the main drivers when considering energy efficiency in the home. Heating bills are likely to be the key driver of whether they will consider investing in measures such as replacement boilers and upgraded insulation. Environmental concern remains very much a secondary priority.

Microgeneration

- Knowledge of microgeneration is limited. Although most are aware of solar panels and wind turbines, there is little awareness of the actual types of technology that builders will need to incorporate to deliver the required energy generation for a zero carbon home.
- The experience consumers have with microgeneration technology is mostly limited to solar panels on roofs and rechargeable batteries. There is very little knowledge of products like photovoltaics and ground source heat pumps.
- There is concern among homeowners about the additional costs, the reliability of the technologies and environmental impacts such as noise pollution. However, those owning new homes would, in principle, be fairly interested in purchasing a home incorporating microgeneration.

Airtightness

- Very few have come across the term airtightness and most associate this with draughts from windows and doorways.
- There is a general perception that fresh air is required to maintain the health of both a home and its occupants.
- It is therefore not surprising that airtightness emerged as a source of great concern for homeowners, because of fears that increased airtightness may restrict access to fresh air and ventilation.

Water conservation

- Homeowners are in general almost entirely unaware of the implications associated with the water targets for higher levels of the Code.
- Current water consumption is on average 150 litres per person per day but most people vastly underestimate the amount of water they use.

- Almost half of the owners of new homes interviewed have power showers compared with less than 30% of those in older homes. Most respondents were not aware that a power shower can use as much water as a bath.
- Three-quarters of homeowners take some steps to save water, such as turning the taps off when brushing their teeth. Three-quarters of those in new homes also have a dual flush toilet installed, compared to around a third of those in older homes.
- Three-quarters of owners of new homes believe that all homes should be metered, although fewer owners of older properties support this. Those opposed to compulsory metering fear this would result in higher bills.
- Four out of five homeowners would support using either grey water or rainwater for toilet flushing or outdoor use, although there is far less willingness to use grey water for washing clothes.

Homeowner acceptance of energy efficient features in low or zero carbon homes

- Most homeowners (60%) prefer the appearance of traditionally styled homes, with fewer than 19% favouring the present examples of energy efficient ones.
- A lack of gas appliances and power showers would discourage the majority from purchasing a home built to the highest levels of the Code. 76% of homeowners would be put off by the increased airtightness that is a feature of these homes.

The Code for Sustainable Homes

- Four out of five homeowners believe that the plans for a 25% reduction in carbon emissions by 2010 and to be zero carbon at 2016 are *desirable*, However, fewer than half believe the 2010 date is *realistic* and this figure falls to less than one third for 2016.
- Homeowners feel that the predicted annual savings of £50 are a good return on investment for the additional cost required to achieve a Code Level 1 home (£700). Most feel that the additional cost for Code Level 3 (£6000) is not reasonable for an annual saving of £120. Only 6% believe that the additional cost of a zero carbon home (£35,000) is reasonable given the annual returns of £400, with ten times as many disagreeing strongly.
- Homeowners believe it would be sensible to set higher energy efficiency requirements for extensions on older properties but are opposed to applying these requirements across the entire built stock.
- The majority of homeowners would prefer a consistent national approach to the implementation of the Code for Sustainable Homes as opposed to a regional or local approach.

Key findings: housebuilder research

The research confirms that there is a firm commitment among UK housebuilders to tackle issues of climate change: however, there is concern at the considerable challenge of meeting both the government's ambitious sustainability targets and delivering a significantly higher volume of affordable and appealing homes.

The level of knowledge and understanding among the industry is variable: only 15% correctly identified that homes built to current building regulations do not even meet the requirements of Code Level 1, with 65% believing that the homes they are currently building already achieve Code Level 1 or above.

The research also shows that housebuilders vary widely in their approach to tackling the zero carbon objectives: however, there is a widespread reluctance to build speculatively to higher than mandated levels, due to a belief that customers simply will not pay the premium involved.

The research reveals that many housebuilders have serious concerns about whether microgeneration and renewable energy technologies can deliver the energy generation requirements of the Code. Housebuilders fear that homeowners may not accept the

required new technologies and could choose to retrofit carbon intensive appliances and systems, which would ultimately undermine the zero carbon objectives. There are further concerns that failure to maintain the new systems and technologies adequately may expose homeowners to health and safety risks.

The research indicates a demand for greater clarity on issues around onsite and offsite green generation. In addition, there is considerable concern at the lack of consistency of requirements among local and central government bodies and a lack of clear central leadership. It is feared that this may seriously inhibit the industry achieving the low and zero carbon objectives and the required increase in output.

Climate change

- A third of housebuilders did not know that 27% of UK carbon emissions come from housing.
- Most larger housebuilders are aware of these levels of carbon emissions and nearly all of them identify reducing these as a key business objective: some have already taken action.
- A key concern for builders is that the government remains focused on improving the efficiency of new homes, of which approximately 160,000 are built per annum, rather than on improving the efficiency of the existing stock of around 21 million homes.

The Code for Sustainable Homes

- All housebuilders are aware of the Code for Sustainable Homes but there is confusion about the dates when various levels of the Code should be adopted.
- There is also confusion about the way in which current building regulations relate to the Code. Only 15% are aware that homes built to current building regulations do not even meet the requirements of Code Level 1 and 65% believe that the homes they are currently building already achieve Code Level 1 or above.
- Estimates for the additional build costs involved were mainly in line with government figures, but slightly lower for Code Level 6 where fewer informed responses were provided. Housebuilders strongly believe that the additional costs will need to be financed by reductions in land values and this raises concern that landowners may not be willing to sell land at significantly lower prices. This could lead to shortages in land supply, fewer homes being built and heightened affordability problems.
- Builders would prefer the requirements of the Code for Sustainable Homes to be incorporated into building regulations, introduced across the whole market at the same time and enforced by building control rather than by planning departments.
- 25% of housebuilders have been asked by local authorities to build to higher levels of the Code ahead of the nationally agreed dates.
- The consequences of such early adoption of Code levels were identified as: higher build costs, additional build complexity, slower development, shortfalls in land supply and areas where it would not be profitable to build new homes.
- There is near-unanimous agreement that homeowners' interests would be better served if all local authorities worked to the same nationally agreed dates.

Microgeneration technology

- There is huge concern over the practicality of the various microgeneration technologies currently available and particular unease that homeowners could suffer as a result of the hasty introduction of technologies unproven on a commercial scale.
- Housebuilders are considering three approaches to microgeneration – for individual properties, at community level and for offsite schemes wired directly into a local distribution system. Property level schemes raise concerns whether the plot sizes required to meet current planning constraints are large enough to accommodate the necessary infrastructure and whether individuals will adequately maintain them. Larger builders are therefore also looking closely at community and offsite schemes,

although these will require managing companies and partnerships with energy providers. There is some concern that offsite schemes may not meet the requirements of the Code.

- Of the technologies, the most likely to be employed are: solar thermal (to heat water), photovoltaic (to generate electricity), ground source and air source heat pumps (for space and water heating).
- There is much less interest in wind turbines and combined heat and power, although some large builders see the potential in the latter.
- Concerns raised are in relation to the cost of technologies, space and design issues, visual impact, reliability of supply, and service and maintenance.

Thermal efficiency and airtightness

- Housebuilders appear relatively optimistic about their ability to build to the required standards of airtightness. However, they are concerned about air quality, the welfare of homeowners and the service and maintenance required by mechanical ventilation systems.

Water conservation

- Most housebuilders are aware that the Code for Sustainable Homes covers water use, but most underestimated the average daily water use in UK households of 150 litres per person. There are again concerns whether homeowners will accept the lifestyle changes required to meet the water use targets.
- Builders tend to favour property level schemes for rainwater harvesting and grey water recycling. As with microgeneration, this gives rise to concerns about the added service and maintenance responsibilities homeowners will face and the availability of space to locate the hardware.
- In addition, however, builders also expressed concern that grey water and rainwater systems could pose serious risks to human health.

Confidence in ability to build homes to Code Level 6 specifications

- There is little confidence that microgeneration technology will deliver the required levels of energy by 2016.
- Builders are cautiously optimistic about their ability to build a home with the required levels of water conservation and airtightness. However, this confidence is undermined by doubts as to whether homeowners will accept some of the lifestyle constraints these measures will impose.
- Housebuilders do not believe that Code Level 6 homes can be built profitably by 2016, which could have serious consequences for the government's objective of increasing the number of houses built each year by more than 50% per annum.

Perceptions of consumer acceptance

- Housebuilders think only one feature of a Level 6 Code Home may be attractive to homeowners – high levels of thermal insulation.
- They believe that homeowners will find the following aspects unacceptable: grey water recycling, lower water use, community and property level microgeneration. The real 'deal-breakers' are perceived to be the lack of gas appliances and power showers, and the additional service and maintenance responsibilities for microgeneration, water conservation and ventilation systems.
- 42% of builders expect homebuyers to have to pay more for a zero carbon home.

Alternative strategies to reduce CO_2 emissions

- Many builders believe that re-directing some, if not all, of the incremental costs between Code Level 4 and Level 6 elsewhere would produce far greater carbon savings and thus contribute more effectively to negating the effects of climate change.

- Four out of five of the UK's housebuilders would rather build to Level 4 and invest the resulting savings in either upgrading the existing built stock or investing in renewable energy generation schemes at a national level.

Future considerations

The findings of this research highlight a number of areas of concern and potential barriers to achieving the 2016 goals. There is a clear need for government and industry dialogue to develop an education, research and communications programme to address the key issues if the zero carbon target is to be met successfully:

Education

The report clearly indicates the pressing need to increase awareness and understanding among both homeowners and builders of the design, technical specification and system management and maintenance issues relating to the higher levels of the Code for Sustainable Homes.

There needs to be an education programme to bring the whole industry up to a higher level of understanding and clarity as to the issues and steps necessary to achieve the goals.

In parallel there is a need to identify and demonstrate the benefits of zero carbon homes to homeowners in order to address the potential lifestyle barriers and psychological resistance which threaten greater acceptance of these homes.

Financial considerations

The report highlights the vital need for a clearer understanding of the relationship between costs, selling prices and the land supply chain to avoid the risk of reducing output.

A detailed, transparent analysis of the exact cost of building zero carbon homes and cost-saving benefits and pay-back periods is key to understanding how the additional build costs will be funded.

Technology and investment

The findings of the report reinforce the urgent need for further investment in research and development into new technologies and the support services required to maintain and repair them.

The fact that the potential environmental benefits of technology in low or zero carbon homes could be undermined by subsequent alterations by homeowners also needs to be addressed.

Central co-ordination

The research identifies the necessity for a clear framework and consistency of approach to achieve the zero carbon targets.

There is considerable concern that the current fragmented approach, with local targets for microgeneration and renewable energy technology, will hinder the achievement of the overall objectives and adversely affect local housing markets. The most effective way to address these concerns is through clear central leadership.

Health and safety considerations

Further analysis and research on health and safety issues associated with new technologies and elements of zero carbon housing must also be undertaken to address concerns among housebuilders and eliminate potential risks to homeowners.

What is a zero carbon home?

Communities and Local Government (CLG) published *Building a Greener Future: policy statement* in July 2007. This statement confirms the government's intention for all new homes to be zero carbon by 2016 with a progressive tightening of the energy efficiency building regulations – by 25% in 2010 and 44% in 2013 – up to the zero carbon target in 2016.

The definition for a 'zero carbon home' is still to be set for the purposes of the 2016 ambition, but it is broadly understood to be one with 'zero net emissions of carbon dioxide (CO_2) from all energy use in the home'. This encompasses those energy uses that are currently part of building regulations (space heating, hot water, ventilation and some lighting) as well as all other energy uses such as cooking, TVs, computers and all other appliances. It means that over a year there are no net CO_2 emissions resulting from the operation of the home.

The changes to building regulations will be complemented by the Code for Sustainable Homes, which is a new national standard for sustainable design and construction of new homes. The Code measures the sustainability of a new home against nine categories of sustainable design and construction, rating the 'whole home' as a complete package. The Code uses a 1 to 6 star rating system to communicate the overall sustainability performance. It sets minimum standards for energy and water use at each level and, within England, replaces the EcoHomes scheme. CLG has confirmed recently that mandatory rating against the Code will be implemented for new homes from 1 May 2008.

Abbreviations	
BERR	Department for Business, Enterprise and Regulatory Reform
CABE	Commission for Architecture and the Built Environment
CHP	Combined heat and power
CLG	Communities and Local Government
DEFRA	Department for Environment, Food and Rural Affairs
EPC	Energy Performance Certificate
HIP	Home Inspection Pack
MMC	Modern Methods of Construction
NHBC	National House-Building Council
PV	Photovoltaic
SDC	Sustainable Development Commission
SUDS	Sustainable urban drainage systems

CONTENTS

PART ONE
HOMEOWNERS' ATTITUDES

1 Introduction

1.1 Context

This part of the report presents the results of the research undertaken with homeowners and:

- investigates their attitudes towards climate change and sustainability
- discusses the underlying psychology influencing homeowner behaviour
- establishes which measures they have taken to reduce the carbon footprint of their home and assesses how far they are prepared to invest in reducing the carbon footprint of their home both in lifestyle and monetary terms
- discusses the technologies involved.

The remainder of Section 1 provides:

- guidance on how to interpret these results
- a detailed explanation of how this part of the research was undertaken
- the sample structure for the homeowners represented in this research.

Section 2 summarises the key findings for the homeowner research, and Sections 3–12 provide the detailed responses of homeowners to each topic.

1.2 Interpretation of results

The findings in this report are reported in a number of ways, depending on the type of question. In some cases answers are given in % terms, for example questions which relate to awareness or behaviour. In other cases results have been given in the form of a mean score or average, for example in relation to ratings of importance or levels of interest in new ideas. Mean scores are a reliable way of measuring differences in perceptions, taking into account both positive and negative responses. Each rating scale runs from a lowest or least positive score of 1 to a maximum of 5. A rating of 3 is therefore to be interpreted

as neutral, ie neither important nor unimportant. A mean score of 4 or more is normally regarded as important and, in EPR's experience, it is unusual to see a mean score of higher than 4.5. Mean scores of less than 3 express factors of less importance.

The homeowner research is based on a total sample of 557, split between 251 owners of new homes and 306 with older properties. Differences in answers between new homeowners and those in older properties have been tested for statistical significance at the 95% confidence level, ie 95 times out of 100 the difference is statistically significant, and is not due to random error. This applies to both % and mean score results. Where significant differences exist, results are presented separately for each of the two groups. Where no significant difference exists, results are presented on the basis of all 557 homeowners. Levels of accuracy for the respective sample groups, together with a comparison to a sample size of 1000, are as follows:

250	± 3.7–6.2%
300	± 3.4–5.7%
550	± 2.5–4.2%
1000	± 1.9–3.1%

1.3 Method of work

The work was undertaken in two stages. The first stage involved qualitative research to investigate the issues and understand the attitudes of homeowners. The second stage involved a large-scale, quantitative study to establish the relative importance of the issues and attitudes identified in the qualitative work.

The qualitative stage comprised:

- eight consumer focus groups with homeowners across the UK, four each with respondents in new homes (built in the previous 1–2 years) and older properties:
  - first time buyers
  - flat owners
  - families (including an extended group with owners of older family homes at BRE's Innovation Park)
  - retired people
- one focus group with residents of low energy homes located in the 'Energy World' and 'Future World' developments in Milton Keynes, built in the 1980s and 1990s.

The quantitative stage comprised a total of 557 in-home, semi-structured interviews with homeowners, broadly split between those in newly built homes and in older properties. In-home 20–30 minute interviews were considered essential for zero carbon homes concepts and technologies to be properly explained, using show material where appropriate, in order for homeowners to be able to comment authoritatively.

Quotas were set on house type in line with the UK housing stock:

Detached	22%
Semi-detached	23%
Terraced	27%
Flats	17%

Demographic quotas were not set but respondent age and occupational group were collected for analysis.

1.4 Quantitative sample structure

Table 1 shows the composition of respondent households interviewed during the quantitative stage. Those living in newly built homes are more likely to have children and, not surprisingly therefore, higher numbers in each household. They also tend to be younger and more affluent than those living in older homes, with a high representation of ABC1 occupational groups and of those working full-time. Over a third of those living in older homes have been resident for more than 11 years.

TABLE 1

Sample structure

	Owners of new homes (%)	Owners of older homes (%)
Number in household		
1	14	18
2	34	37
3	24	21
4+	29	25
Children (aged <15) in household		
Yes	51	41
No	49	59
Age		
18–34	47	22
35–54	44	44
55+	9	34
Occupational group		
AB	28	16
C1	39	39
C2	19	23
DE	14	22
Length of current tenure		
< 3 years	100	17
3–4 years		18
5–10 years		29
11–20 years		15
21 years +		21
Working		
Full-time	63	45
Part-time	14	22
Not working	23	33

Base: all respondents

Most homeowners interviewed live in detached or semi-detached houses with slightly fewer in terraced houses or flats. Those living in new homes are more likely to own detached houses or flats than their counterparts in older homes. Homes owned by respondents in the older homes sample range in age from pre-1919 to 2005, with a relatively high proportion of modern (1984–2005) homes (Table 2). The homes interviewed for the sample of older housing are broadly in line with the latest Survey of English Housing[2]. Interviews with owners of new homes broadly match those in older homes by type of dwelling.

TABLE 2

Age and type of home

	Owners of new homes (%)	Owners of older homes (%)	Survey of English Housing 2005/6 (%)
Age of home			
Pre-1919	–	15	19
1919–1945	–	14	19
1946–1970	–	21	22[a]
1971–1983	–	15	25[b]
1984–2005	15	35	14[c]
2006–	85	0	–
Type of home			
Detached	27	22	22
Semi-detached	30	33	33
Terraced	24	29	27
Flats	19	16	17

Base: all respondents

a = 1946–1964, b = 1965–1984, c = 1985–
Source: Housing in England 2005/6, Department for Communities and Local Government, London, 2007, p39 [2]

2 Key findings

2.1 Climate change

Nine out of ten homeowners surveyed agree that climate change is happening, with most claiming to base this on personal experience. There is less consensus about the extent of the threat posed by climate change, and only a minority agree that climate change is being driven mainly by CO_2 emissions, with the remainder either disagreeing or uncertain.

Over a third spontaneously mentioned a government initiative to reduce CO_2 emissions from housing, and awareness of some form of government initiative rose to 61% after prompting with some of the key activities. The Energy Performance Certificate (EPC) is the most widely known government strategy. Just under half of homeowners claimed to be aware of the term 'zero carbon home' with most able to provide a reasonable definition of this, although there was some confusion as to the precise meaning of the term.

> "We have to become more responsible, we've become a world of mindless consumers, not thinking of the effect that we're having on our planet."
>
> *Owner of new family house*[1]

2.2 Homeowner priorities and psychology

Those taking part in the qualitative research indicated that the main lifestyle changes they had made to reduce their carbon footprint were relatively minor:

- they recycle, providing their local authority makes this easy for them
- they tend to take more care about switching appliances off in the home when they are not using them and they may turn the heating down slightly

[1] Direct quotations from the research respondents are included throughout this report to highlight particular points of view. They are not necessarily representative of all respondents, and often illustrate the diverse views that are held.

- they have good intentions about their day-to-day personal transport but most continue to predominantly use their cars, perceiving them to be more comfortable, practical and reliable than other modes of transport.

The qualitative research provided an early indication that few are prepared voluntarily to make the radical lifestyle changes needed to reduce their carbon footprint substantially, and in this respect air travel is seen as sacrosanct.

> "Obviously you want to do right by your children, but what's the point in me doing something in my little four bedroom house if all these big industries are just going to go ahead and waste loads of energy anyway? So I'm going to fly and I'm not going to feel guilty about it, because there's three hundred other people on the plane with me also not feeling guilty about it."
>
> *Owner of new family house*

So why does this resistance to make the necessary changes exist? The research suggests that, in reality, homeowners' good intentions are eroded by several key beliefs:

- climate change might not be as bad as people say it is
- climate change might not have anything to do with CO_2 and human activity
- any contribution individuals can make is so small that it is not worth making if it involves a significant deterioration from their current lifestyles.

When it comes to setting these issues into the context of people's homes, their priorities become even clearer. Energy efficiency was mentioned less often than any other factor by homeowners when asked to say spontaneously what is important to them when buying a home. When asked to rate the importance of various factors in the decision-making process, again energy efficiency came bottom of the list, behind seven other factors.

Similarly, when asked how they would most likely spend a £10,000 windfall on their home, the main answer was "on a higher specification kitchen or bathroom". And when asked on what they would spend any savings that might accrue from the lower energy bills generated by an energy efficient home the most frequent answer was "an overseas holiday involving air travel". This latter phenomenon has been described as the 'carbon rebound' effect by the UK Energy Research Centre [3] and demonstrates the gulf that exists between peoples' stated intentions and their real, observed behaviour.

2.3 Energy saving in the home

Further evidence for the divide between theory and practice is provided by the answers given by homeowners in the quantitative research. Some 89% were able to name at least one measure they could take to save energy in their home but only 76% could name one that they had actually put into place in recent years. There is demand for additional measures to make energy saving easier, for example, the majority of homeowners would support the removal of standby functions from new appliances.

It is not always easy for homeowners to understand how best to make an impact. In some areas there seems to be a lack of 'joined-up government' when it comes to energy saving in the home and this causes confusion. For example, the Department for Business, Enterprise and Regulatory Reform's (BERR) Market Transformation Programme for tumble dryers advocates greater use of gas-powered dryers on efficiency grounds, whereas Communities and Local Government's (CLG) Code for Sustainable Homes [1] is likely to severely restrict the number of gas appliances in homes designed to zero carbon or near zero carbon standards.

Although some homeowners still appear resistant to the smallest change in lifestyle to reduce their CO_2 emissions, it is undeniably encouraging that three-quarters have made some effort to save energy and thereby reduce the carbon footprint of their home. It must be recognised, however, that most of the measures taken voluntarily are small or incremental and are not going to make anything like the reductions needed to meet government targets for reducing CO_2 emissions by 50% by 2050.

Homeowners were questioned in more detail therefore on three key factors affecting the largest user of energy in the home – space and water heating. Those with inefficient boilers, inadequate loft insulation and without cavity wall insulation were asked whether they had considered replacing, upgrading or installing these features. In each case the majority had not considered doing so. And most of those considering it had not done so because of the perceived high cost or because they had simply not got round to it.

> "You hear the same things over and over again, the weather's going to do this, the landfills are filling up and it's going to cost this much extra to dump something, but they don't say you can insulate your house for £150."
>
> *First time buyer, older home*

The Energy Saving Trust estimates that about 21 million tonnes of CO_2 emissions could be saved per annum if all homes in Britain had their inefficient boilers and inadequate insulation upgraded to modern standards.

Homeowners stated that cost savings and return on investment are by far the most important drivers of investment in energy efficiency in the home. Concern for the environment is a weak secondary priority for those living in new homes and of even less importance to those in older homes. A further reason for not investing in upgraded boilers and insulation is that most of the homeowners interviewed believe their fuel bills are 'about average' for the type of house they live in. They do not perceive that they are paying over the odds to heat their homes and do not see the predicted savings from energy efficiency as a good return on their investment.

Logic dictates that higher prices for fossil fuels would be the key factor motivating homeowners to invest more widely in energy efficiency. But the government is committed to reducing the impact of fuel prices on households; it has a stated policy objective of eradicating 'fuel poverty' by 2016. Given the support this research provides for the existence of the carbon rebound effect, some of the government's tools for eradicating fuel poverty may have a counter-productive effect on its sustainability objectives.

> "If it's such a big deal to the government then why should it cost the homeowner so much extra? Why don't they subsidise greener energy and put more money in themselves instead of taking it from us? I know everyone has their part to play, but it seems very hard to pay cash out when you're trying to support a family."
>
> *Owner of new family house*

2.4 Microgeneration

In addition to saving energy, homes at Code Levels 4–6 will have to generate electricity and/or heat to offset any mains electricity they consume. Current knowledge in this area is limited. While most homeowners are aware of solar panels and wind turbines, very few are aware of the only technologies that builders believe will come close to delivering the required level of energy generation for a zero carbon home: photovoltaics, ground source heat pumps and combined heat and power. Not many of those few homeowners professing knowledge or experience of microgeneration technology have experienced any meaningful application of it in the UK. Examples of experiences given by homeowners included solar panels on the roofs of holiday apartments in Turkey, solar-powered garden lights and a small wind powered charger for a caravan battery.

Some homeowners expressed a preference for having microgeneration technology at individual property level but this may confer additional service and maintenance responsibilities on them. This research discovered that around a quarter of homeowners do not even get their existing boilers serviced every year so any form of microgeneration should avoid the need for intervention as much as possible.

While owners of new homes expressed tentative interest in purchasing a new home with microgeneration technology, those in older homes showed less interest. Lower cost would be the main reason for exploring the idea but one of the main concerns

homeowners have about microgeneration is that it will be expensive. They are also worried about whether it will actually work as promised.

2.5 Water conservation

Some three-quarters of homeowners claim to take water saving measures. As with energy saving, water conservation steps taken are often on a relatively small scale, eg turning the taps off when brushing teeth.

Other actions which are apparently water saving are in reality more likely to be the happy consequence of a lifestyle choice that has nothing to do with water conservation, eg some people simply prefer showers to baths. The benefits that come from such lifestyle choices are often potential rather than actual, however. As with the carbon rebound effect, it is possible that engaging in an activity that is apparently water saving may not realise the predicted savings. Thus a normal shower saves water compared to a normal bath but people tend to take showers more frequently so that overall consumption does not decrease in a predictably linear fashion [4]. In addition to this change in behaviour, increasing numbers of homeowners are installing or specifying power showers[2] to get an increased flow or sensation of pressure. A power shower can use as much water as a bath so that someone taking frequent power showers may consume more water for their personal hygiene than when a bath was the only option. Nearly half of the owners of new homes interviewed in this study have power showers, so significant changes in either technology or consumer demand will have to be made for the water consumption targets in the Code to be met.

The apparent water conservation success story in recent years is the dual flush toilet. Some three-quarters of owners of new homes surveyed own dual flush toilets and penetration is already up to a third among owners of older homes. While the use of such cisterns has been widespread in other countries they have only become commonplace after building regulations changed in 2001. With toilet flushing traditionally the biggest single use of water in the home, this should be excellent news. But there are several issues surrounding the application of this technology, particularly leakage (because leaks flow into the toilet bowl and may go undetected).

From a technical perspective, dual flush toilets are undeniably more efficient in each flush, but they require higher levels of maintenance and intervention than traditional toilets in order to fulfil their water saving potential. And this places a greater responsibility on the homeowner, which most homeowners would rather not accept, given their busy lives.

Per capita water consumption has continued to increase in recent years, except during periods of drought when hosepipe restrictions come into force, and few homeowners have any conception that they use, on average, 150 litres per person per day in their homes. Seven out of eight involved in this study estimated this daily amount wrongly, mostly falling short of the average figure.

Water meters provide homeowners with the opportunity to measure their water use and to pay for the amount of water they actually use, and so they could have a role in reducing water usage. While water meters have been compulsory in new homes for over 20 years, across the UK as a whole only about 30% of homes have water meters fitted. Three-quarters of owners of new homes believe that all homes should be metered but this proposition has significantly less support from owners of older properties where only half support it. Those opposed to compulsory metering fear it would result in higher bills, while those in favour think it would save water and also be fairer. A financial incentive is seen as the main factor likely to encourage water saving.

Recent research suggests that a target of 105 litres per person per day is the lowest that can be achieved with this country's existing infrastructure. In order to meet the 80 litre target set for potable (mains) water usage at Code Level 6, future new homes will need to employ either grey water recycling or rainwater harvesting systems to cover the

[2] Throughout the report, 'power showers' refers to electrically pumped showers and pressurised hot water systems.

25 litre per day shortfall. Homeowners are surprisingly receptive to the concept of using either grey water or rainwater for toilet flushing or outdoor use, with around four out of five positive. There is less willingness to use this water for washing clothes, however, with only about 40% willing to use rainwater and about 20% grey water. Some three-quarters have concerns about re-using grey water, compared to about 60% worried about rainwater. In the main, homeowners' concerns vocalise the 'yuck!' factor with fears, about grey water in particular, that this would be neither clean nor hygienic.

2.6 Homeowner acceptance of features in Code homes

Homeowners expressed a clear preference for the external appearance of 'traditionally styled' new homes compared to the sort of energy efficient new homes found at BRE's Innovation Park.

Of the specific features within a Code home, the majority of homeowners said that the lack of gas appliances and power showers would discourage them from purchasing. They also show a great deal of antipathy towards a new home built to high levels of airtightness (76% find this discouraging). They are less concerned about the idea of 'upside-down living' with bedrooms on the ground floor, although they show no real enthusiasm for it.

2.7 The Code for Sustainable Homes

Four out of five homeowners believe that the aspirations of the Code, to achieve a 25% reduction in carbon emissions by 2010 and to be zero net carbon at 2016, are desirable. But they simply do not believe that such aspirations are realistic: fewer than half believe the 2010 target can be met with fewer than a third thinking the 2016 target realistic.

As previously noted, the key driver of homeowner investment in energy efficiency and CO_2 reductions is return on investment. Overall, few homeowners believe that, on this basis, the projected costs and resulting savings associated with Code Levels 3 and 6 make sense. It should be noted that the costs given to them by the interviewers were the government's published additional build costs and were not marked up to represent any margin for the housebuilders, so in reality these figures represent a rather optimistic best-case scenario for homeowners.

At Level 1, where additional costs of £700 would give a return of about £50 per annum, 46% of owners of new homes believe the returns to be reasonable, with 20% disagreeing. Fewer owners of older homes agree, but at Level 1 the additional build costs probably would, on balance, be accepted by purchasers of new homes. This view is reinforced by the finding that, given a straight choice, the majority of new homeowners would choose a Level 1 home over a new home built to current building regulations, despite the premium.

At Level 3, however, the level which builders taking part in the study said was the entry level most likely to be demanded by local authorities, the picture is reversed. The majority of homeowners of new homes (54%) believe that the annual savings of about £120 are not reasonable, given the additional build cost of £6000, with only 18% considering the returns rational. The costs associated with Level 3 are clearly not acceptable to homeowners.

At the zero carbon Level 6, only 9% of homeowners believe that savings of £400 represent a good annual return on an investment of £35,000, with some 60% disagreeing. Not only would the vast majority of homeowners prefer to purchase a home built to 2006 standards at this level, but three times as many new homeowners would actually be likely to purchase an older, less efficient home than a zero carbon home.

Homeowners believe it would be reasonable to extend energy efficiency regulations for new homes to extensions on older properties, but not to the rest of the home when an extension is added, and not to the entire housing stock.

The majority of homeowners would prefer national standards for the introduction of the Code for Sustainable Homes rather than the current arrangement whereby individual

local authorities can bring forward elements of the code in an ad-hoc fashion due to the Merton Rule [5].

There is less agreement that we should have national guidelines for recycling policy, despite the frustrations caused by inconsistencies in policies between neighbouring authorities.

2.8 Factors that would encourage reduction of carbon usage

Homeowners agree that the most effective ways of encouraging a reduction in energy use are to focus on the potential cost savings of energy saving and to raise awareness of the relevant issues.

> "I think the message needs to be about the present. I know this is all about the future, but we need to be told how things are going to affect us now in terms of money. We either need incentives or they have to make us pay for it and discount our council tax in return, but it has to affect us now in order for us to actually do anything."
>
> *Owner of new family house*

2.9 Raising awareness

Television is seen as the most effective means of communicating information about energy saving and CO_2 emissions. Leaflets and communications from local authorities were also mentioned.

> "I think however you communicate it, what you need to communicate is the fact that it's not just a series of individual things that you do to your house, that make it carbon neutral or more environmentally friendly or whatever it is, it's about how all those things work together and then work within the community."
>
> *Resident of Energy/Future World, Milton Keynes*

3 Attitudes to climate change

3.1 Climate change

Nearly nine out of every 10 homeowners interviewed agree that climate change is threatening the world, although they are fairly evenly divided about whether climate change is a major threat or some threat. Only small numbers believe the threat to be minor or non-existent (Figure 1).

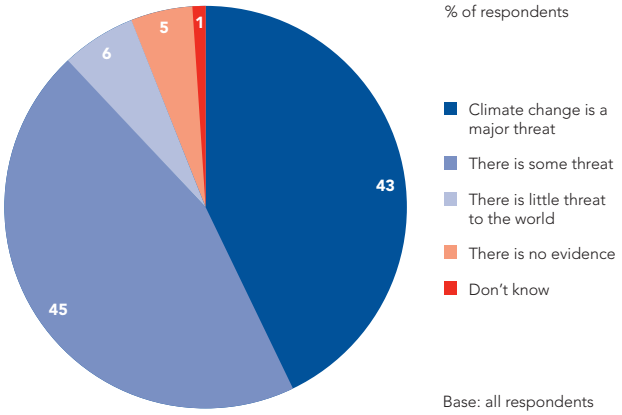


Figure 1 Attitudes to climate change

People tend to be more convinced by the evidence of their eyes, rather than listening to or reading news, government announcements or commentators on the situation.

"You can actually see it now. When someone just spouted figures at you and said, 'Oh, 10% of this, that and the other', I didn't take much notice but if it's 90 degrees in October and it's pouring with rain in August there's got to be a reason for it."

Owner of older flat

"I think it's probably much more substantive than we realise at the moment. I think all the scientific evidence across the world suggests that this is only the start of a much bigger change. I think the immediate impact that we see is fairly minimal in this country, but it will be much more substantial. Individually we can make a very small difference, but I think if everybody makes a small difference, it will make a bigger difference."

First-time buyer, new house

3.2 CO_2 emissions as the main driver of climate change

There is less agreement that CO_2 emissions are responsible for climate change, however. While 45% agree, almost half this number disagree, with the remainder uncertain (Figure 2).

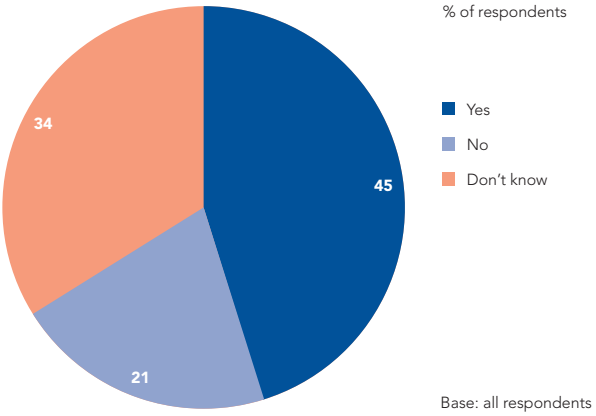


Figure 2 Whether CO_2 emissions considered the main cause of climate change

> "I agree that the climate is changing, but if you look back over history it always has done, it's constantly in change, so I'm sceptical about the man-made global warming."
>
> *Retired owner of older home*
>
> "I'm not totally convinced that it's caused entirely by CO_2 emissions. There are other possibilities. Activity of the sun, for example has varied over the centuries. I don't think that it's as clear cut as it's been made out."
>
> *First-time buyer, new house*

3.3 Awareness of CO_2 emissions from UK housing

After prompting, only a minority (25%) claimed to be aware that 27% of UK carbon emissions come from the housing stock.

3.4 Awareness of government initiatives to reduce CO_2 emissions

Just over a third of those interviewed were able to spontaneously recall one or more government initiatives designed to reduce CO_2 emissions from housing. The recently introduced Energy Performance Certificate, a required item in Home Information Packs, was most widely mentioned (15%), followed by the government's policy for all new homes to be zero carbon by 2016. Relatively small numbers mentioned stamp duty exemption on zero carbon homes, perhaps not surprisingly, considering that a written response from the Financial Secretary to the Treasury revealed that only six homes had qualified during the first four months of the scheme's operation [6].

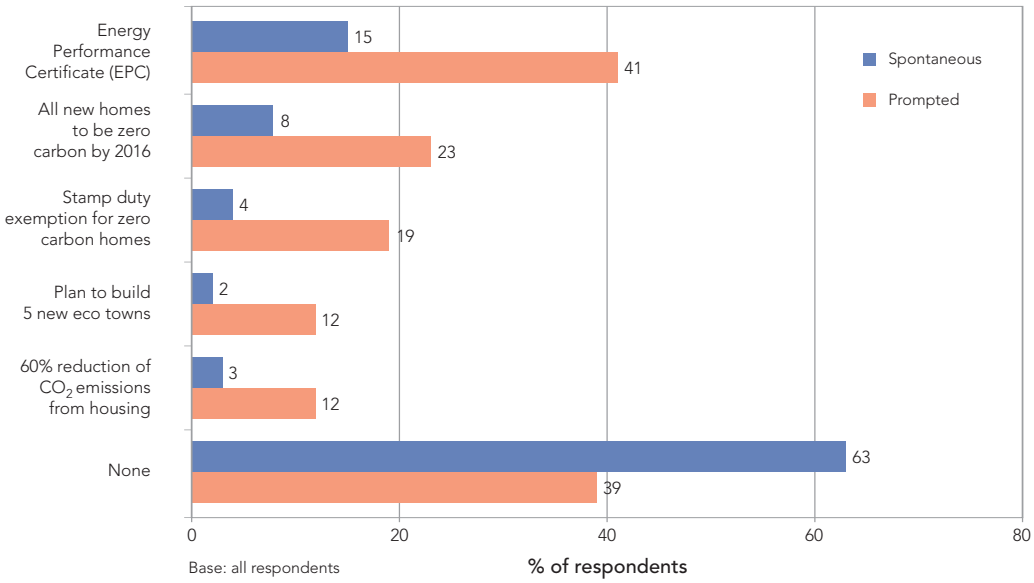


Figure 3 Awareness of government initiatives to reduce CO_2 emissions from UK housing

After prompting with the five initiatives listed in Figure 3 , 61% of homeowners were able to recall at least one government initiative. Figure 3 shows total awareness (ie spontaneous and prompted) and demonstrates that over 40% of homeowners are aware of the EPC. There is also reasonably good awareness of the zero carbon homes programme and stamp duty exemption. Those living in new homes were significantly more likely to be aware of the latter two schemes than those living in older homes.

3.5 Zero carbon homes

Almost half of the homeowners interviewed had heard of the term 'zero carbon homes', with those living in new homes significantly more aware (53%) than those in the older stock (40%). There is less certainty about exactly what the term means, with only a third defining it accurately.

The qualitative stage allowed for in-depth discussion about the concept of a zero carbon home. The majority agreed that this is a good idea.

> "Well, it's got to be good, anything to save, I mean if you save power and it's more efficient, it should save you money, but also it should be saving the world."
>
> *Retired owner of older home*

They did, however, find the idea unrealistic, at least in terms of 2016.

> "I'd love an energy efficient home or a carbon zero home, I think it'd be ace, but if I have a big wind turbine in my garden and solar panels in my roof and things like that, I'd be cool with that, but my neighbours sure wouldn't."
>
> *Owner of new family house*

Those in Milton Keynes saw the concept of the zero carbon home as just one aspect of reducing emissions:

> "But I don't think it's that straightforward, because it's to do with where you build the houses as well. If people have got to travel for miles to get to work, even though their home is zero carbon, they're still using a lot of the planet's energy resources, so you have to site houses carefully as well as make them energy efficient."
>
> "And it's also about the way you live your life when you're in that house as well, it's not just a house, it's the life that you live within the house."
>
> "You can become complacent and say, well, actually I've got this zero rated home and forget about everything else that goes along with it, that's somebody else's problem."

3.6 Carbon offsetting

Qualitative respondents were asked if they had encountered the term 'carbon offsetting'. Very few had heard of the concept and for those that had, the main example discussed was flying.

> "It's a mixture of some good ideas and some not. I'm quite happy to pay a little bit extra for flying ***as long as it was a little bit extra***."
>
> *Owner of new build flat*

Some felt it should be the airline's responsibility, not the individual passenger's, but some had actually offset previous flights.

"Last time I went away with Last Minute, they said do you want to add this onto your bill and we'll plant trees. It was a very small amount of money on the end and I thought why not, so I've planted a tree somewhere."

First-time buyer, older house

There is little support for widespread use of carbon offsetting in place of carbon savings.

"To me it's like going to a burger bar and then having a banana later to offset it – eating something healthy just because you've already eaten something unhealthy! But it doesn't really make any difference, does it? Because it doesn't compensate for what you've done wrong in the first place."

Owner of older flat

4 Homeowner priorities and psychology

4.1 Willingness to change lifestyle to reduce carbon emissions

Recycling

Respondents involved in the focus groups were asked if they had made any changes to their lifestyle in order to reduce carbon emissions. In almost every group, the spontaneous response referred to recycling. Almost all claim to recycle more these days, partly because of council regulations. Water butts and composting were also mentioned.

> "I tend to recycle more garden waste now. I've got compost at the back of my garden, whereas before I didn't, so I suppose that is helping the environment."
>
> *Owner of older family house*

Flat dwellers would like to recycle but appear to have no facilities provided, even though houses in the same local authority area do have facilities. Inefficient or haphazard council recycling services also frustrate homeowners.

> "The Council here has imposed recycling requirements on residents but they don't seem to apply to flats. It's very odd, they really clamp down on people in houses, but if you live in a flat it seems it doesn't matter. And there's hundreds of flats going up now, aren't there?"
>
> *Owner of new build flat*

> "I'm doing my best with recycling but I feel our council doesn't pick up the recycling often enough. How can people take them seriously if the council don't encourage people by doing their job properly? To be honest they haven't quite mastered picking up the normal rubbish properly."
>
> *First time buyer, new house*

Travel

Most of the homeowners at the focus groups had not made any other substantial changes, holiday flights being regarded by most as inviolable.

> "I would love to cut out flights but my partner won't agree with that. He needs his sunny holidays abroad."
>
> *Owner of older family house*

> "It's going to get too expensive to do it in the next few years, so I'm doing it now ... air passenger departure duty doubled in December, I think. It's only going one way so I'm getting my flights in while I can."
>
> *First time buyer, older home*

> "There are things you can cut back on, but there are things you work for, a nice car and a holiday. In my job I travel a lot with work, I go to Europe and need to fly for business."
>
> *Owner of new family house*

Small numbers also cycle, walk or use public transport rather than a car.

> "It depends on the weather for me I'm afraid: if the weather's fine, I can walk, if not I take the car."
>
> *Owner of new build flat*

> "I'm starting to put my son on the school bus, probably not consciously to reduce emissions, but just trying to stop using the car as much, probably more for health benefits."
>
> *Owner of new family house*

For many, public transport or cycling are either not feasible or have negative connotations.

> "I try and cycle, but you take your life in your hands."
>
> *Owner of older flat*

> "If I could get two kids to school and then to work, I'd do it, I'd do it on a bike, but it's just not feasible."
>
> *First time buyer, older home*

> "The car is more reliable, you know what the road conditions are going to be like, you don't know when your bus is going to turn up, you've got to drive to the train station to get a train that's always late so it doesn't make sense to use public transport for me."
>
> *First time buyer, older home*

It was noticeable that the Milton Keynes respondents were not only more knowledgeable about energy issues but had also taken the most steps to reduce their own carbon footprints. Transport was particularly mentioned by these respondents although it is, perhaps, easier to cycle in Milton Keynes than in other conurbations.

> "We made a conscious decision not to use air unless we absolutely had to and there was no alternative. We only go on one holiday a year, so that's not a really big deal anymore, but we use the train where we can."
>
> *Resident of Energy/Future World, Milton Keynes*

> "I've found in a lot of respects, using less carbon goes along with spending less money and improving the quality of life. I use my bike to get round Milton Keynes as much as I possibly can, because it just seems the right thing to do at the time. It's not a conscious effort to reduce my carbon footprint, it just seems the smart thing to do."
>
> *Resident of Energy/Future World, Milton Keynes*

In the home

It is apparent from the focus groups that where homeowners mentioned things they had done to save energy in their homes, these were generally actions that fitted in easily with their lifestyles and did not involve significant expenditure. Low energy light bulbs were mentioned at a number of groups although most users appear to have only one or two, often given out free of charge. Older people particularly mentioned turning off lights and standby switches or turning down the heating. Those in older properties might have added insulation and/or a porch.

"I have energy saving light bulbs, they last longer. I got them because I am sick of changing light bulbs, cheap ones don't last that long."

Owner of new family house

"Last year, the council gave away four of them. They do take a while to crank up but once they get going they're OK and they save energy so you think you are doing your little bit."

Owner of older family house

4.2 Resistance to lifestyle changes

Those not making changes said this is partly because they feel that the UK is only a small overall contributor to global CO_2 emissions and partly because they believe climate change is part of a natural cycle. Many justify their actions by pointing the blame at other parties whom they regard as more culpable than themselves. Thus other countries need to play their part, as does industry and business.

"The government is talking a lot about it, but they don't seem to be doing anything. Take the amount of cars and lorries we've got on our roads today, they talk and talk and talk but do nothing to stop it. What about China? Look at the emissions you'll get from China!"

Retired owner of older home

"I'm concerned, but it's down to responsibilities. Is this country the only one? It looks like the Americans are not concerned ... so all the little countries say, 'you've been pumping out CO_2 for years and years'."

Retired owner of older home

"But what I don't understand is people are always on about saving energy, but if you go up to London or any town, every single office block has got all their lights on and nobody's ever picked that up."

Owner of new build flat

There were also concerns about the lack of central policy and the lack of political leadership. Homeowners feel that local and national government need to set good examples: it is the evidence before people's eyes that counts in terms of leadership.

"The government doesn't make the changes themselves ... every single minister has a gas guzzling large limousine to drive them round."

First time buyer, older home

"I know councils are organised locally and funded locally and all the rest of it, but if the government were to take it seriously, why is there not some sort of national recycling policy? Some places are recycling plastic bottles, some aren't, there's no joined up approach across the country."

First time buyer, new house

In short, two key perceptions are perhaps responsible for UK homeowners' apparent resistance to tackling climate change. The first is that not all of them are convinced that man-made CO_2 emissions are solely responsible for climate change. While that doubt

exists, some homeowners are simply not prepared to take the substantial and costly lifestyle changes required to reduce CO_2 emissions.

The second key perceptual barrier to tackling climate change is that many of those convinced by the theory feel powerless to make any meaningful contribution. Most in this group do what little they feel comfortable with, essentially enough to assuage their guilt, but few are prepared to make any significant lifestyle change.

4.3 Spontaneous mention of factors considered when purchasing a new home

All homeowners were asked what features they considered when purchasing a new home (in this context not specifically a newly built home). The old adage "location, location, location" holds true, with around two-thirds mentioning this, more than any other factor. Half suggested the number of bedrooms was a key criterion, with a third each mentioning the type of home, ie detached, terraced, etc, and its design/appearance. Overall, twice as many homeowners spontaneously mentioned garage/parking and size of garden as mentioned energy efficiency. The only factor significantly more important to owners of new homes than owners of older homes is specification, mentioned by 23% of the former group and 14% of the latter (Figure 4).

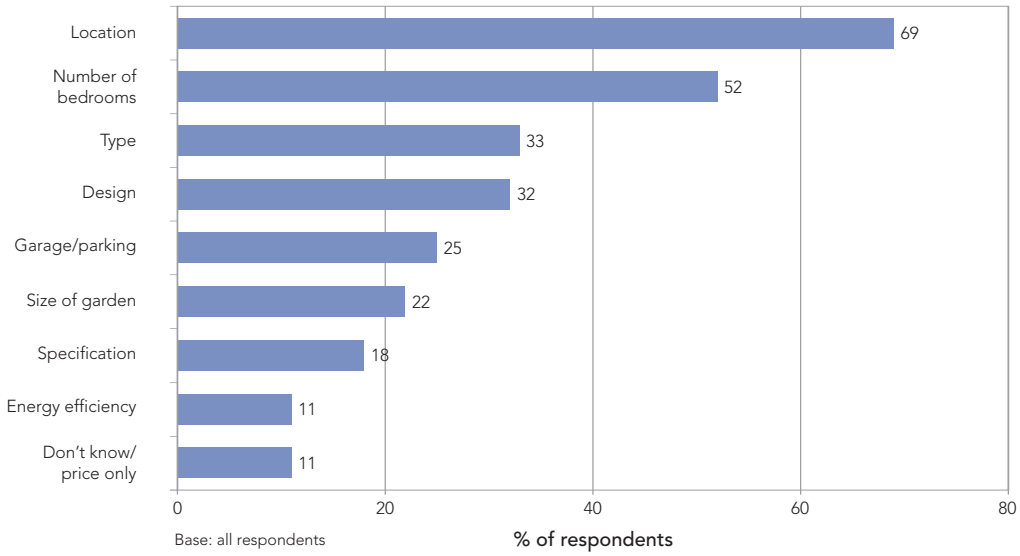


Figure 4 Spontaneous mention of key factors affecting new home purchase.

4.4 Prompted rating of importance

All homeowners were asked to rate the importance of the following factors when purchasing a new home (again, not necessarily a newly built home).

- location
- type, eg detached
- number of bedrooms
- design/appearance
- specification
- energy efficiency
- garage/parking
- size of garden.

The order in which these factors were presented to homeowners was rotated so that ratings were not affected by respondent fatigue. Answers were recorded using a scale ranging from 1, meaning not at all important, to 5, meaning highly important. Answers are shown in Figure 5 in the form of mean scores.

It can be seen that the importance rating of the various factors almost exactly correlates to homeowners' spontaneous comments: most suggested location spontaneously and this was rated the most important factor overall. Similarly, the smallest number of spontaneous comments related to energy efficiency, and this was rated the least important factor by homeowners. There is a significant difference between the views of owners of new homes and old homes on only two factors: owners of new homes regard both specification and energy efficiency as more important than do those owning older homes.

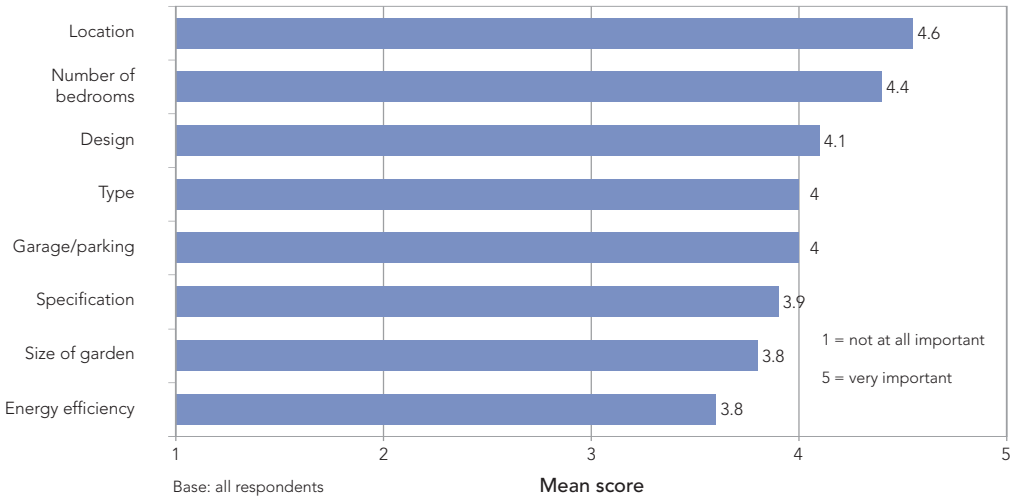


Figure 5 Prompted rating of importance of factors affecting new home purchase.

4.5 Priorities for expenditure of £10,000 windfall

Homeowners were asked which of the following features they would be most likely to spend a £10,000 windfall on if they were buying a new home:

- higher specification kitchen/bathroom
- energy efficiency
- improved decoration
- home cinema/TV, etc
- swimming pool.

As Table 3 demonstrates, a higher specification kitchen/bathroom tops the windfall spending chart for owners of both new homes and older homes. The second answer, recorded by about half as many, was new technology for energy efficiency. Smaller numbers would put the money into better quality interior decoration, gadgets or a swimming pool.

TABLE 3

Priorities for spending a £10,000 windfall

	Owners of new homes (%)	Owners of older homes (%)
Higher specification kitchen/bathroom	47	58*
New technology for energy efficiency	29	25
Improved interior decoration	15	14
Home cinema, TV, etc	9	7
Swimming pool	4	2

Base: all respondents

* = significant difference

It should be noted that there may be some bias in these results as this question was asked towards the end of a lengthy personal interview (about 20 minutes), most of which had discussed energy efficiency. If the question were asked at the beginning of the interview or in a different context it is likely that the number saying they would invest in energy efficiency would be lower.

4.6 The rebound effect

In October 2007 the UK Energy Research Centre published a report [3] which discussed behavioural responses to savings from energy efficiency. This reported the phenomenon known as the energy efficiency 'rebound effect' and identified two main variants:

- **The direct rebound effect** – improvements make energy services cheaper, so consumption of these services increases.
- **The indirect rebound effect** – savings made by drivers of fuel-efficient cars may spend the money saved on petrol on other energy intensive goods and services instead, such as overseas flights.

The sum of the net effects of direct and indirect rebounds represents the 'economy-wide' rebound effect. In some cases improvements in the efficiency of an established technology may result in a net increase in emissions as the increased efficiency stimulates greater uptake: this is known as a 'backfire'. The report argues that few models for predicting net carbon savings from energy efficiency initiatives allow for the rebound effect, so the predicted savings are often not achieved [3]. The report concludes that evidence for direct rebound effects from household energy savings is relatively robust and that they are likely to be about 30%. In other words, it suggests that only 70% of the predicted energy savings result from domestic energy efficiency measures. It also concludes that indirect rebound effects are more difficult to predict.

It was not possible within the constraints of the homeowner questionnaire to undertake a detailed investigation of rebound effects. A question was added, however, to obtain a simple measure of homeowners' likely behaviour in response to any savings that resulted from energy efficiency in their household. They were presented with the following options but other responses were also recorded:

- take less care switching things off
- increase central heating temperature/use the heating more
- buy a bigger TV/another TV
- take an extra holiday by air
- invest in more energy efficiency measures.

As Figure 6 shows, over half indicated that there probably would be a rebound effect from energy savings made in the home. The most popular was an indirect rebound effect

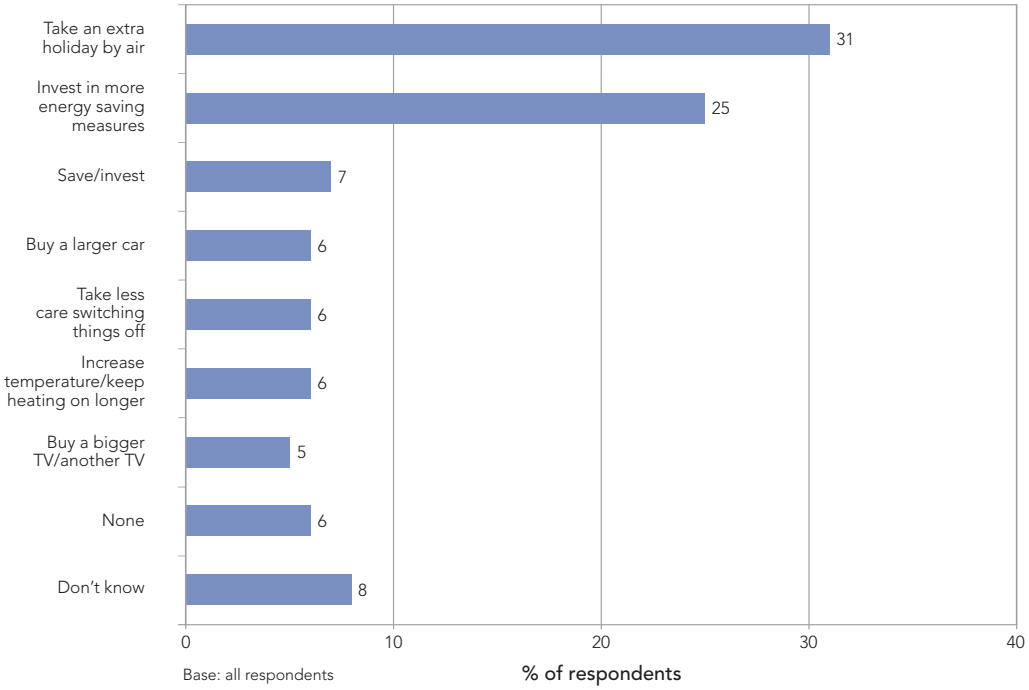


Figure 6 Most likely way of spending any savings resulting from energy efficiency.

– almost a third of homeowners said that they would spend any resulting savings on flying away on an overseas holiday. A quarter said they would re-invest the savings into further energy efficiency measures. This answer may, however, be somewhat over-stated as a result of the question being positioned towards the end of a lengthy questionnaire about energy efficiency in the home.

Direct rebound effects were mentioned by relatively fewer homeowners, eg being less careful switching things off and using the heating less watchfully. Although smaller numbers predicted such direct rebound effects their cumulative effect could be significant, given that such behaviour could be habit forming whereas taking an additional holiday is more likely to be a one-off event. Small numbers also mentioned the other indirect rebound effects such as spending the savings on a television or on a larger car.

5 Energy saving measures

5.1 Perceptions of energy use in the home

UK homeowners appear reasonably well-informed with regard to the main source of CO_2 emissions in their homes, with almost half identifying the boiler. The only other comments of note were gas fire (10%) and coal fire (7%).

5.2 Awareness of energy saving measures (spontaneous)

All respondents were asked where they could reduce energy usage in their homes and lifestyles. Nine out of ten homeowners were able to make energy saving suggestions spontaneously, the most popular being:

- turn the heating down/use it less often
- use low energy light bulbs.

The other main responses were:

- turn lights off when not in use
- turn appliances off rather than leave on standby
- recycle waste
- improve insulation
- save water
- use appliances on full load.

Figure 7 demonstrates that the most popular suggestions are for relatively small, easy measures. Only small numbers mentioned things which would require significant investment, such as installing insulation or replacing windows.

5.3 Energy saving measures taken (spontaneous)

Figure 7 shows the nine most frequently mentioned energy saving measures suggested by UK homeowners and the number who have put each of these into practice. Around 70–80% of those mentioning an energy saving measure have actually adopted it. Perhaps not surprisingly, uptake is higher for actions involving reducing usage or turning things off. There is less follow-through on aspects involving investment, eg only half of those mentioning insulation have improved this in their own home.

Overall, the energy saving measures most likely to have been taken in UK homes in recent years are to:

- use low energy light bulbs
- turn the heating down/use it less often
- turn lights off
- switch appliances off rather than leave on standby
- recycle waste.

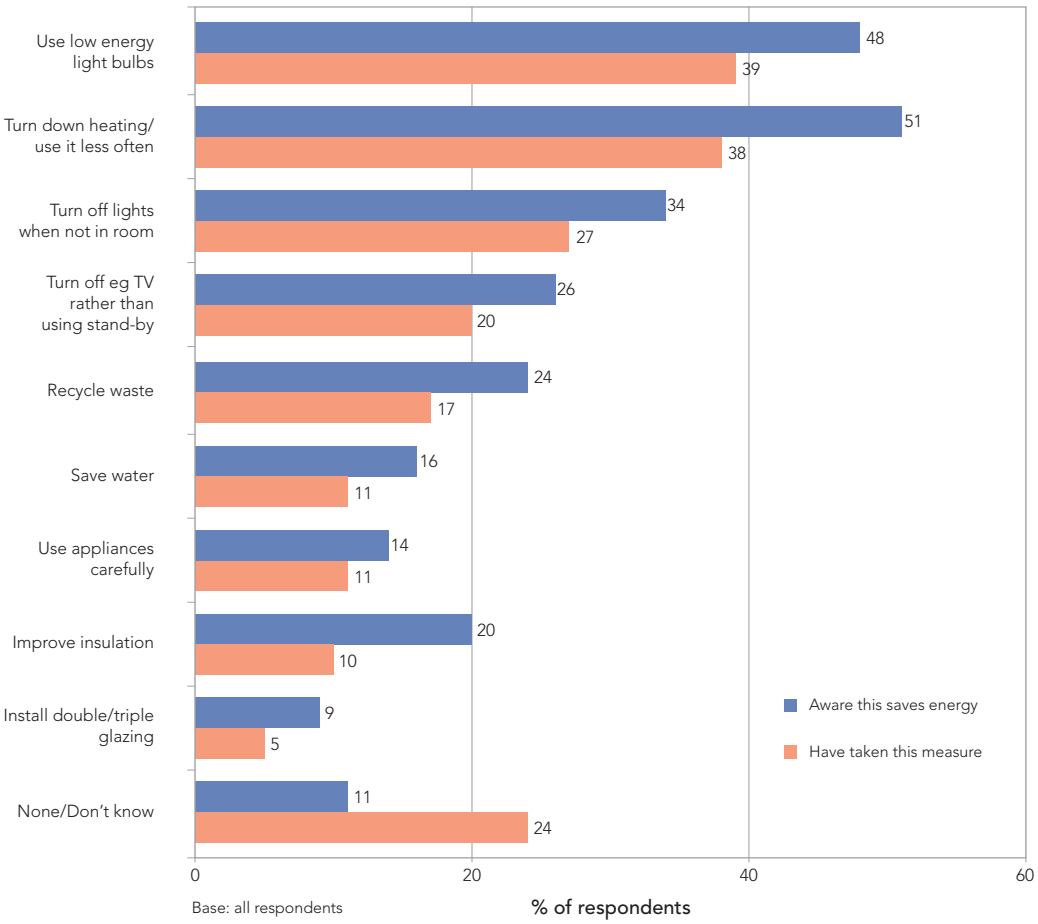


Figure 7 Energy saving measures taken by homeowners.

Interestingly, those living in new homes were significantly less likely to mention a specific action they had taken to save energy (72%) than those living in older homes (80%). Those living in older homes were significantly more likely to do simple things such as switching lights off and washing only on full load.

6 Prompted appraisal of energy saving measures taken

6.1 Boilers

Boiler ownership

Boilers are owned by nearly every home in the survey (95%) and practically all of these were gas fuelled (97%). The majority of homes without boilers have electric storage heaters (3% overall).

Frequency of servicing

Only 70% of those owning boilers have them serviced every year, with little difference by age of property or boiler.

Age of boiler

Before the tightening up of Part L of the building regulations in 2006 [7], relatively few homeowners chose to install condensing boilers due to their cost. Most preferred cheaper but less efficient conventional boilers.

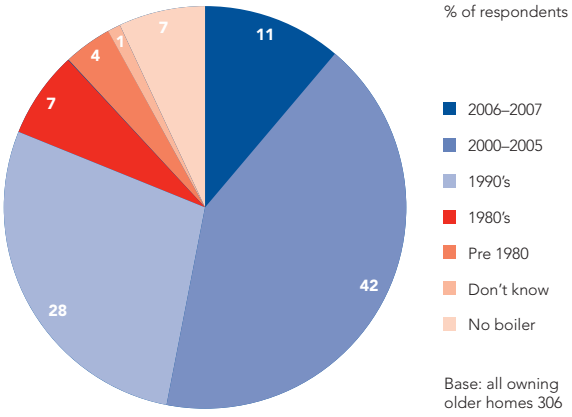


Figure 8 Age of boiler.

Owners of older homes were asked when their boiler was installed. As Figure 8 shows, only about one in eight are highly likely to be of the most efficient type, having been being installed in 2006 or 2007. Slightly under half were fitted between 2000 and 2005, the year in which building regulations advised that condensing boilers should normally be installed.

Replacing inefficient boilers

The Energy Saving Trust estimates that 60% of household CO_2 emissions come from boilers. It estimates that replacing each less efficient boiler with a new condensing boiler would reduce CO_2 emissions by more than 800 kg per home each year, or 13 million tonnes per year if everyone in the UK who could, installed a condensing boiler [8].

About 40% of homeowners in older properties in the survey have boilers that were fitted before 2000 which are likely to be of the inefficient conventional type. A quarter of this group have considered replacing their boiler but decided against it, mostly due to cost but also because some have simply not got round to doing it.

6.2 Perception of heating bills

Homeowners' perceptions of their heating bills are likely to be a key driver of whether they will consider investing in measures such as replacement boilers and upgraded insulation. Overall almost two-thirds of homeowners believe their energy costs are about average for the type of home they live in. Most of the remainder either consider their bills to be low for the type of home they live in or simply answered that they did not know: in other words it was an issue they gave little thought to. Only one in 11 households overall believe their heating costs are comparatively high. As might be expected, those living in new homes are significantly more likely to believe their heating bills are low (Figure 9).

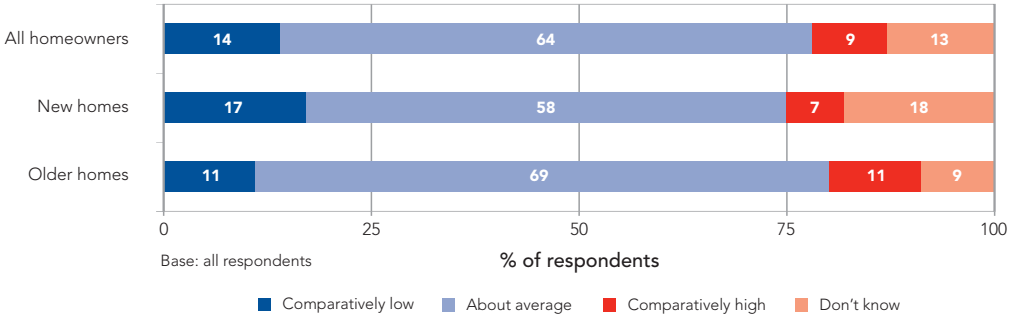


Figure 9 Perception of heating bills.

6.3 Factors encouraging uptake of energy saving measures

Spontaneous mention of factors

Homeowners are most likely to say that saving money on their energy bill is the main factor that would encourage them to take energy saving measures in their homes. The availability of grant assistance is the second most widely mentioned factor for those living in older properties, with environmental concern least often mentioned. In new homes, environmental concern is the secondary concern and grant availability least often suggested.

Most important factor

Figure 10 shows that energy savings are not only the most widely mentioned factor encouraging energy saving but also by far the most important. Grant availability is of importance to a quarter of those living in older homes but to only 8% of those in new homes. Conversely, one in six of those in new homes said that environmental concern is the main factor affecting their behaviour but this is of little concern to those in older homes.

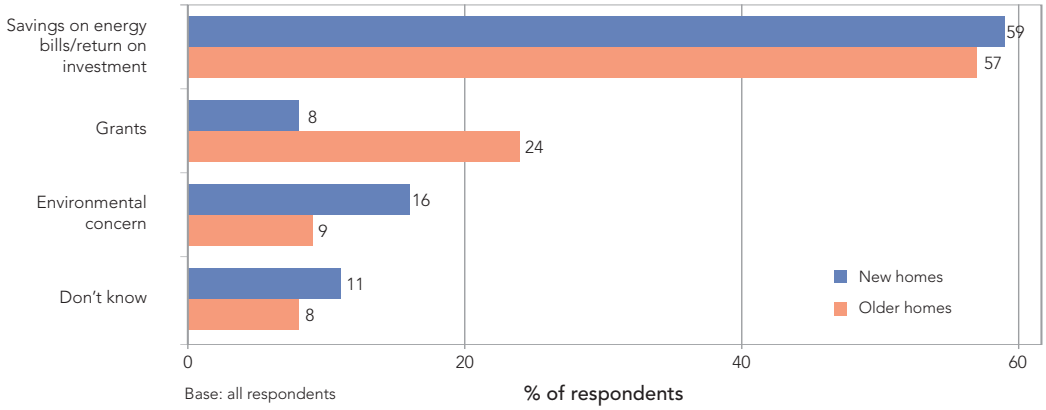


Figure 10 Most important factor encouraging homeowners to save energy.

6.4 Loft insulation

Ownership and date of installation

Just over half of those owning older homes installed or increased their loft insulation after 2000. The remainder are unlikely to have modern levels of loft insulation, most older homes having loft insulation dating from the 1990s, with 15% not having been improved since the 1980s or earlier.

Upgrading loft insulation

The Energy Saving Trust estimates that around half the homes in the UK (12.5 million) have under-insulated lofts and that about 20% of all heat lost by an uninsulated house is lost through the roof. It estimates that upgrading loft insulation in under-insulated homes to modern standards would save 3.7 million tonnes of CO_2 per annum [9].

Owners of older homes with insulation installed before 2000, together with those without any loft insulation at all, were asked whether they had considered upgrading this. Only a quarter of this group had considered this but most had simply not got round to doing it. Cost and disruption were also mentioned as barriers to upgrading loft insulation. This is in spite of the fact that it is comparatively cheap, indicating a clear need for a wide-scale information programme.

6.5 Cavity wall insulation

Ownership

Most homes built since 1983 have cavity wall insulation installed as standard. Just over half of the older homes in the survey are thought to have cavity wall insulation, with 15% having uninsulated cavity walls. The remaining homeowners either believe their homes have solid walls or simply do not know what sort of external walls/insulation their home has.

Upgrading cavity wall insulation

The Energy Saving Trust estimates that over a third of homes in the UK have un-insulated cavity walls (9 million). It also estimates that a third of the heat lost from an uninsulated home is lost through its walls and that insulating these to modern standards would save 5.8 million tonnes of CO_2 per annum [9]. Just under half of the homeowners with uninsulated cavity walls involved in the survey had considered installing this type of insulation. Most mentioned price as a barrier to installation but almost as many said they simply had not got round to it. A small number fear the disruption involved. Again, many do not appear to realise the comparatively low cost involved.

6.6 Low energy light bulbs

Ownership

Energy efficient light bulbs use about 20% of the energy of a conventional tungsten filament bulb.

Most homeowners surveyed have at least one energy efficient light bulb in their home, although, as Figure 11 demonstrates, those living in new homes are significantly more likely to own them than those in older homes. Those in new homes are also significantly more likely than those in older homes to have them fitted in all rooms, although for both groups, having some energy efficient bulbs is the norm rather than having all such bulbs.

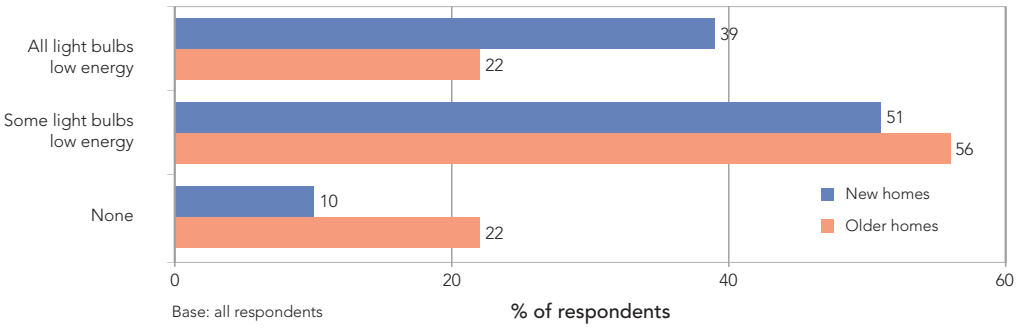


Figure 11 Ownership of low energy light bulbs.

Upgrading to energy efficient bulbs

All those without energy efficient light bulbs in all rooms were asked why this was. Figure 12 reveals that the main barrier to change is simply inertia, with people saying they have never considered doing this, they are getting round to it or do not know why they have not done it already. The other main barriers are concerns whether low energy bulbs will be compatible with existing light fittings and the perception that the quality of the light from them is poor, with a few minor complaints about cost or the speed of ignition.

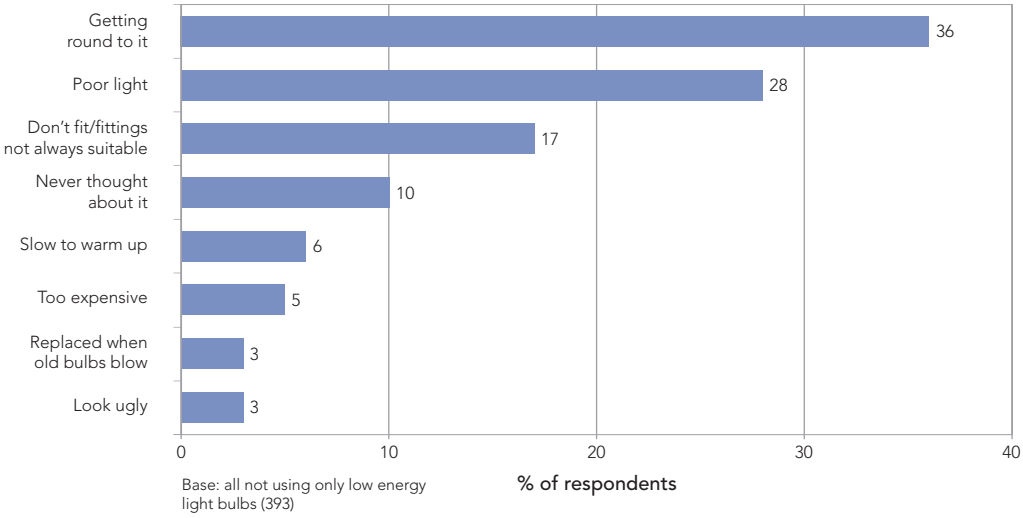


Figure 12 Reasons for not using low energy light bulbs.

"I've got two, but I haven't actually put them in yet."

Owner of older family house

"Half heartedness, I'm afraid, we've got some low energy light bulbs but not through the whole house. When I've had to replace a light bulb I've opted for low energy as opposed to normal."

Owner of new family house

6.7 Clothes drying

Overall almost 70% of the homeowners interviewed own tumble dryers. Tumble dryer ownership is significantly higher among the new homeowners (75%) surveyed than among those living in older properties (65%). Penetration of tumble dryers in this survey of homeowners is slightly higher than the latest Family Spending report from the Office of

National Statistics (ONS) [10] estimates (59%, an increase from the 2003 figure of 56%). This may be because the ONS survey covers all consumers, homeowners and tenants alike.

Both the ONS report and this survey suggest that tumble dryer ownership correlates closely to household composition, ie households with children are more likely to own tumble dryers than those with no children. There is no apparent correlation in the ONS figures between geographic location and tumble dryer ownership: those in the drier East of England region are just as likely to own these appliances as those in the much wetter South West or Northern Ireland [10].

DEFRA's Market Transformation Programme (MTP) for tumble dryers aims to reduce their environmental impact. It quotes a much lower ownership figure of just 42% but this figure is for all households not just the owner-occupied households represented in this study. The DEFRA figure also excludes washer-dryers [11]. DEFRA's assumptions include that tumble dryers are used for 60% of washing machine cycles and this correlates well with the data recorded by homeowners in this survey (see Table 4) [11].

TABLE 4

Frequency of using tumble dryer

Every washing load	19%
Some loads	51%
Occasional loads	29%
Never	1%
Total	100%

Base: all tumble dryer owners

DEFRA's MTP for tumble dryers includes a policy encouraging greater uptake of gas-powered tumble dryers as they are 'more effective in terms of carbon savings' [11]. This appears to contradict the aims of the Code for Sustainable Homes, however, which is likely to severely limit the use of fossil fuels in high level Code homes. The policy also assumes that consumer behaviour in relation to tumble dryers will not change, eg how often they are used, size of load, extent of drying [11]. There therefore appears to be a conflict between what CLG is trying to achieve via the Code programme and what DEFRA is trying to achieve via its MTP.

Environmentally, the best approach to clothes drying is to dry clothes outside and this is what two-thirds of homeowners do, in addition to or instead of, tumble drying. As Figure 13 shows, however, over a quarter of homeowners normally dry their clothes inside and this will have implications for the design of the whole house ventilation systems required for Code homes built to high levels of airtightness. Those working, especially those who have children, said it would be hard to function without a dryer and those with children were the most likely group to use their tumble dryer for all loads. It is also harder for people in flats to dry washing outside.

> "My oldest one comes in wet from games one day and needs his kit again the next day, so it tends to get thrown into a quick wash and then thrown in the dryer for the next morning."
> *Owner of older flat*

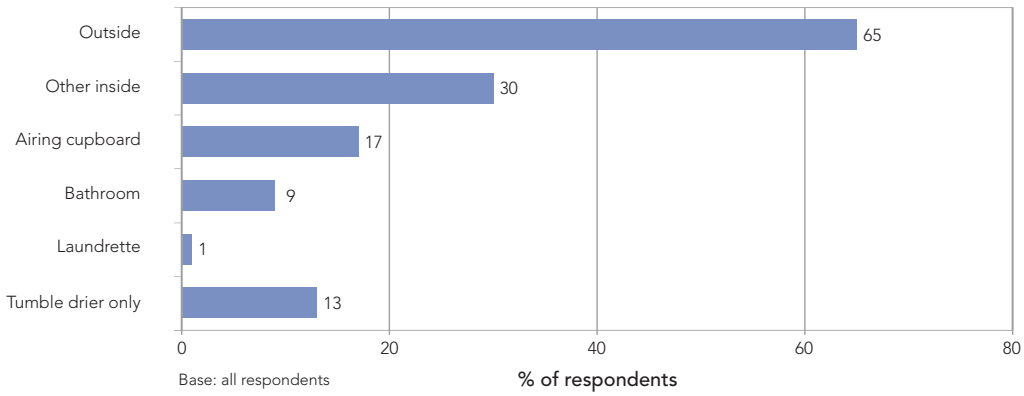


Figure 13 Means of drying washing (in addition to tumble drying).

6.8 Standby functions

The 2005 study by the Energy Saving Trust *Energy and waste in an age of excess* estimated that the average UK home had as many as 12 separate electrical devices either on standby or on charge at any one time. It also estimated that the resulting combined emissions across the UK from devices unnecessarily left on standby could total as much as 4 million tonnes of CO_2 per annum [12].

Switching appliances off was one of the key energy saving measures homeowners said spontaneously that they had taken in recent years (see above). Not surprisingly therefore, when asked in detail, some 60% said that they normally switch things off rather than leave them on standby. The remaining two-fifths are evenly divided between those who normally leave appliances on standby and those who do a mixture of leaving things on standby and switching them off altogether. As Figure 14 shows, those living in new homes are significantly less likely to leave electrical equipment on all the time.

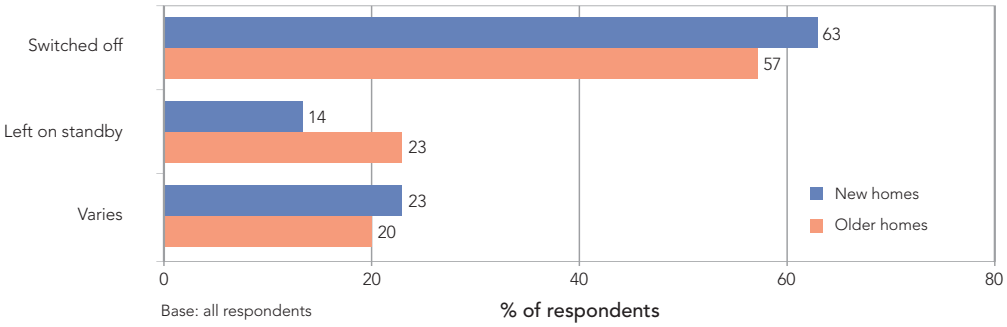


Figure 14 Whether TVs and computers usually switched off.

Four out of five homeowners surveyed would be happy if manufacturers did not include a standby function on new appliances. Overall, about three-quarters would be interested in a single switch that could switch off all non-essential appliances from one place. Although respondents themselves tend to turn things off, the anecdotal evidence from the qualitative stage indicates that children, especially teenagers, may not always be so careful!

7 Microgeneration

7.1 Introduction

Microgeneration is defined by BERR as "the production of heat and/or electricity on a small scale from a low carbon source". For low and zero carbon homes it effectively means a source of heat and/or power that is not drawn from a national grid, eg electricity or gas, and which is low carbon, eg as far as possible uses renewable energy sources such as solar, wind, hydro, biomass, thermal mass, etc.

The housebuilders in the accompanying survey outlined three scales of microgeneration technology which they are currently considering for building Code homes in the future and these are discussed briefly below. The main types of microgeneration technology discussed with homeowners are described in Section 7.2.

Domestic or individual property level microgeneration

Property level microgeneration is where the energy/heat is generated on site at each individual property. Individual property scale microgeneration sits well with the typical freehold model of ownership – the infrastructure is on the homeowner's property and the homeowner is directly responsible for operation, maintenance and repair. There is concern, however, whether current microgeneration technology is efficient enough for these types of system to be compatible with the typical plot sizes possible under current planning guidelines for density. In other words, planning constraints may not allow sufficiently large plot sizes for enough microgeneration infrastructure to generate the energy/heat required by the property. There may also be planning implications in terms of the visual impact of the microgeneration infrastructure, eg how appropriate would 25 micro-wind turbines be on a development of 25 homes?

> "The biggest problem is that to get to Code Level 5 we need 40 square metres of roof space, all south facing. You might get that on a large detached house but a lot of the houses we build now are three storeys, two and a half storeys or even two beds and they haven't got that kind of roof area. So where do you put the PV tiles to generate that amount of electricity?"
>
> *Housebuilder*

Community or development level microgeneration

At the community or development level, economies of scale are exploited by having one larger energy/heat source, still on the footprint of the residential development, and a local distribution system. A typical example might be a 'district heating scheme' in which a combined heat and power plant provides both heat and electricity for a community. There is no conclusive information on the scale of development for which such a scheme is suitable but it is likely to be hundreds of units rather than tens. This sort of scheme would be more efficient in terms of energy generation and therefore cheaper than property level schemes. Operation, maintenance and repair will be co-ordinated so further efficiencies will result.

These cost savings could be offset to a certain extent, however, by the need to have a local distribution system. A management company will be required to operate the microgeneration and distribution infrastructure and to own the property on which the infrastructure is situated. This would add to the costs and would be more likely to require leasehold or commonhold tenure than freehold and so is likely to be less popular with homeowners. The properties immediately adjoining the microgeneration technology may also be subject to price blight in the same way that properties are blighted by overhead power cables, electricity sub-stations and mobile phone masts.

Offsite, private-wired solutions

The third option is for an offsite, private-wired solution. For example, this might be a large wind turbine situated not on the residential development but on a nearby hill to maximise potential energy generation, or a combined heat and power station some distance from the development, for example in an industrial or commercial zone.

> "We've done a biomass CHP scheme in London with two other builders. I'm told it's huge, the size of a small industrial unit – and it needs a full-time caretaker employed at £20,000 per annum to get rid of all the ash. I can't see that it's very green when you've got 20 tonne trucks bringing loads in and out all the time."
>
> *Housebuilder*

It was not entirely clear at the time of the research that offsite, private-wired solutions would be acceptable in the Code. The advantages are that they could use lower value land, could reduce the potential for property blight and mitigate the planning impact of the residential development. But they will still require a management company, with its associated leasehold or freehold ownership, and planning concerns might simply be displaced to a remote location rather than removed altogether.

In both the community and private-wired approaches there will be the issue that homeowners may no longer have a choice over their energy supplier. This is against the practice of the past 20 years or so, when consumers have been encouraged to switch suppliers to reduce their energy bills. There may also be concerns about the resulting monopoly of supply and the need for regulation.

7.2 Microgeneration technology

The following technologies were covered in the homeowner research.

Solar thermal

The traditional 'solar panels' consisting of tubes of liquid that absorb solar power and are then used to heat/pre-heat water.

Photovoltaics

Solar panels or tiles that convert solar power directly into electricity.

Wind turbines

Small windmills.

Combined heat and power

Units that burn a high energy fuel, eg gas, oil, biomass. The resultant heat is used to generate both heat and electricity. Micro-scale units using a Stirling engine are currently being trialled and these would replace the traditional gas/oil boiler in individual homes. Most builders involved in the study, however, are more interested in larger scale units that serve a development or a whole community.

Ground source heat pumps

Systems that pump a coolant through horizontal pipes buried near the ground surface in trenches or through a deep-level vertical pipe in a well or borehole. The coolant absorbs the heat from the sub-soil and this is pumped through underfloor heating systems continuously to provide space heating and in some cases hot water pre-heating. In the summer the system can work in reverse so that heat absorbed from the home is transferred to the sub-soil. For each unit of electricity required to pump the coolant material around the system, three to four units of heat are recovered.

7.3 Awareness of microgeneration technology

Figure 15 shows that solar panels and wind turbines are the only forms of microgeneration that are widely known among homeowners. The forms of microgeneration most favoured by housebuilders in the accompanying study (combined heat and power (CHP), photovoltaics and ground source heat pumps), are relatively unknown among UK homeowners.

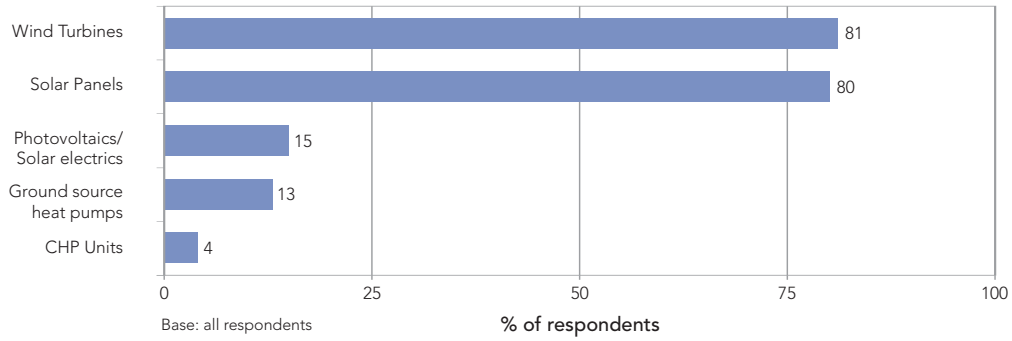


Figure 15 Awareness of microgeneration technology.

There is little difference in knowledge between those in new homes and those in older homes, suggesting that very little of this technology is commonplace in either new or older homes.

7.4 Penetration of microgeneration technology

All homeowners were asked if they had any experience of using the five microgeneration technologies discussed in Section 7.3. The vast majority (92%) have no experience of microgeneration, which is not surprising as there are believed to be only some 100,000 household installations in the UK, 0.5% overall [13].

> "A lot of these things that we're discussing, no offence, seem a bit rose tinted, a bit like Star Trek, I don't think it's feasible, I don't think it's realistic."
>
> *First time buyer, older home*

Amongst the few who claim familiarity with this technology, solar panels are by far the most likely to have been experienced (6%). Smaller numbers have experienced photovoltaics (3%) or wind turbines (2%) but only a handful are familiar with ground source heat pumps (1%). Only two respondents had experienced CHP. Owners of new homes were more likely to be familiar with each technology, with the sole exception of wind turbines.

It should be recognised, however, that very few of those claiming to be familiar with microgeneration technology actually had direct experience of using it in a domestic setting in the UK. Several of those mentioning solar panels had experienced these in warmer, sunnier countries such as Turkey or the Dominican Republic. Others referred to photovoltaics but in only fairly insignificant applications, eg garden lights, caravan battery charger and hand-held calculators.

7.5 Factors encouraging interest in microgeneration

Lower energy costs is the main factor that would encourage homeowners to explore the idea of microgeneration, mentioned by a fifth (Table 5). Almost as many, however, spontaneously expressed concerns about the cost of installing microgeneration technology. Around one in seven would like more information.

TABLE 5

Factors encouraging interest in microgeneration

Lower energy costs	20%
Concerns about cost	18%
More information	15%
Other	33%
Nothing/Don't know	36%

Base: all respondents

Over a third, however, felt that nothing would encourage them to investigate microgeneration, especially those aged 55 or more.

7.6 Concerns about microgeneration

Cost is the main factor giving rise to concern about microgeneration (Table 6), mentioned by almost a third. Just under a fifth referred to the dangers of untried or untested technology.

Over half, however, could think of no concerns about microgeneration. Interestingly, there was little variation across the age groups.

TABLE 6

Concerns about microgeneration

Cost	31%
Untried technology	18%
Other	11%
No concerns/Don't know	51%

Base: all respondents

Learning from past experiences: Energy World and Future World

Energy World (1986) and Future World (2004) in Milton Keynes were exhibition sites of newly constructed energy efficient and innovative homes, 51 at Energy World and 19 at Future World. The exhibitions were open to both professionals and the public for a period of time before the homes were either sold on to private purchasers or occupied by housing association tenants. Energy features included a significant improvement upon the then current energy requirements in the building regulations, with additions to some plots of new technology which included: mechanical ventilation, heat recovery and rain water harvesting. Construction techniques from brick and block to panel construction were employed as well as some plots taking advantage where possible of solar gain and passive ventilation.

Those living in Energy World and Future World in Milton Keynes were generally pleased with their home in terms of having low fuel bills. This is because of the construction methods, high level of insulation and use of passive solar energy.

> "You need to leave the boiler on all the time, but even so, my gas bills are very low and I notice that at this kind of time of year I'm using much less heat than other people."
>
> "Yes, well, I haven't used any heating this year, not at all, my conservatory keeps my little house extremely warm."
>
> "From an energy point of view it's fantastic. It's a Canadian design, it's a very high tech timber frame with a very advanced external wall … which allows very high levels of insulation without condensation."

With regard to the energy and rainwater technology, however, almost all said that they no longer used the original installation, either because it failed to work properly or because of excessive maintenance costs. It should be noted that every home used a different technology: this is not a fault of any one system.

> "I would be extremely wary of a prototype somewhere else with my experience. If it works wonderful, but when it goes wrong, something that should cost you a tenner costs you £750."
>
> "Our house has a ventilation system which the original owners put in when they built it. But then they disconnected everything because it didn't work and it was too noisy. Perhaps technology has moved on now but it's another thing that can go wrong and never work properly again. Or work properly in the first place."
>
> "Although the water is filtered it's impossible to remove and replace the UV bulb, given the way it's been installed. Filters just remove solids and sediment from the water, they don't treat any bacteria like a UV bulb does."

These homes were, of course, designed to be experimental and had little or no back-up in terms of supply chain or maintenance arrangements. The owners interviewed in this research accepted that this was the case but felt that lessons need to be drawn from their experiences if microgeneration and rainwater/grey water systems are to be used as part of the normal housebuilding programme.

> "I'd rather make sure the property was well insulated in the first place, because I think it's easy to sell something on the basis of a gimmick and then skimp on something that's actually more important, such as having it well insulated. If you're going to leak the heat that you've got from your system out through the doors and windows, it's pointless."

7.7 Preferred scale of microgeneration technology

Homeowners were advised that microgeneration technology would probably be installed into new homes either at individual property level or at community level and asked whether they had a preference between the two models.

Overall, the main answer recorded was that homeowners would prefer microgeneration technology at the individual property level (45%). Slightly fewer said they had no real preference (36%) with only a minority favouring community schemes (19%). Opinions were similar among owners of both new and older homes.

7.8 Overall interest in purchasing new homes with microgeneration technology

Respondents were informed that by 2016 all new homes would incorporate the kinds of microgeneration technology which had been discussed with them, and asked to express their level of interest in purchasing such a home, assuming they were interested in a new home.

Those owning new homes would be fairly interested in purchasing a home incorporating microgeneration, with over half expressing interest and an overall mean score of 3.6 (Table 7). Those currently owning older homes showed significantly less interest, with only 35% interested and an almost neutral mean score of 3.1. Among owners of older homes over a quarter said they would not be interested, most of them saying they would not be at all interested.

TABLE 7

Interest in purchasing new home with microgeneration technology

	Owners of new homes (%)	Owners of older homes (%)
Very interested	21	17
Fairly interested	31	18
Neutral	27	32
Not very interested	6	9
Not at all interested	6	18
Don't know	9	5
Total	**100**	**100**
Mean score	**3.6***	**3.1**

Base: all respondents

1 = not at all interested; 5 = very interested

* = significant difference

8 Water conservation

8.1 Water saving measures taken by homeowners

Almost three-quarters of homeowners (73%) claim to save water in some way in their homes. The main ways in which homeowners save water are shown in Figure 16. Behaviour is mostly consistent in both new and older homes, except that older homes are more likely to collect rainwater in water butts.

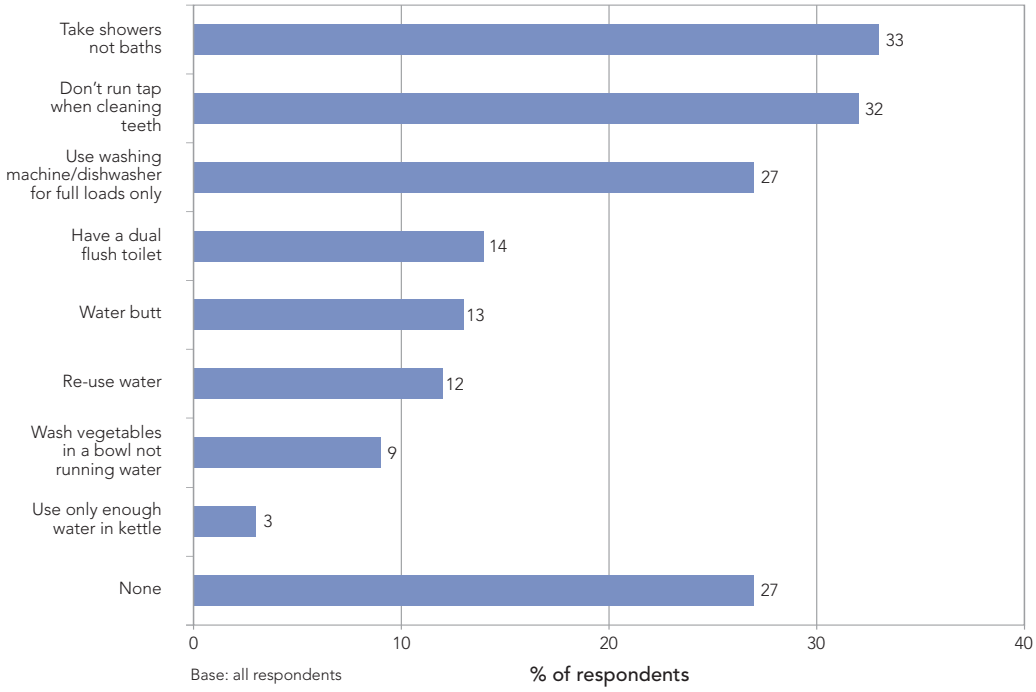


Figure 16 Main water saving steps taken by homeowners (spontaneous).

8.2 Ownership of fittings

Dual flush toilets

Dual flush toilets have been permitted in the UK since 2001. They allow the user to choose between a full flush of, typically, 6 litres or a reduced flush of about 4.5 litres. This compares to an average flush from a traditional cistern of 9 litres. Toilet flushing has historically been the largest use of water in the home so reducing the volume of each flush is key to reducing domestic water usage [4]. Further environmental benefits include reductions in CO_2 emissions from treating and pumping smaller volumes of water to households.

Figure 17 shows that three-quarters of new homes have dual flush toilets compared to only about a third of the older housing stock.

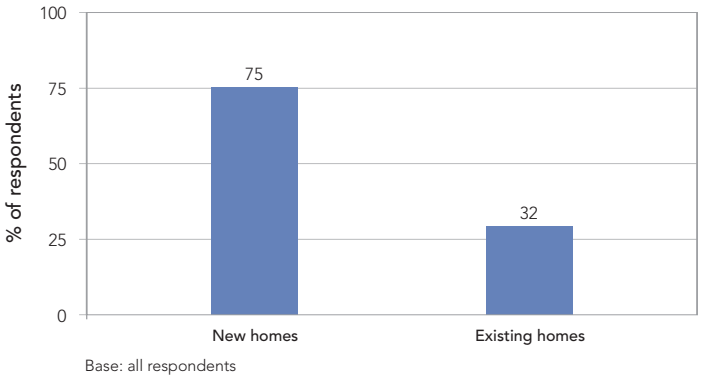


Figure 17 Ownership of dual flush toilets.

One of the key reasons why dual flush toilets were not previously used in the UK is that they employ a drop or flap valve and have no external overflow, so any leakage is likely to run down the back of the pan into the toilet bowl. Such leakage is difficult for homeowners to detect and this difficulty is compounded by the fact that the leakage is of an entirely different nature to that experienced with siphonic action cisterns. With siphonic action an external overflow pipe gives a clear indication when there is a problem and the nuisance caused by either the noise of the leak or splashing prompts the homeowner to take action to rectify the matter. The nature of the seals in dual flush toilets means that they will wear out and need replacement. Without a culture of undertaking regular maintenance it is likely that the seals in dual flush toilets will actually leak for some time before the homeowner notices or puts it right. Flap and drop seals are also more sensitive to hard water and likely to need more frequent replacement in hard water areas.

In addition to the behavioural factors that may limit the potential for water saving from dual flush toilets, there are also technical constraints. If a dual flush toilet or low volume cistern does not have an effective flush then there is a risk that the homeowner will flush the toilet twice, which could use more water than a single 'traditional' flush. The challenges do not end when the effluent leaves the toilet bowl: some advanced toilet designs currently being tested have such low flow requirements that the water discharged is not sufficient to transport solids the length of a conventional sewer into a main. Ultimately, therefore, smaller diameter sewers may be required to fully exploit the potential water saving benefits from toilet flushing [4].

Power showers

Showers and baths consume as much as 45% of the water used in a modern home.

A shower can use as little as one-third of the volume of a typical bath in the UK (70 litres) [4]. But power showers with pumps can use significantly more water than baths. In order to meet the requirements of Code Levels 5 and 6 it is likely that builders will have to stop installing power showers and fit reduced flow showers instead. They are also likely to have to fit reduced capacity baths, ie narrower or with lower overflow outlets.

Nearly half of the new homeowners interviewed have power showers (45%), compared to less than 30% of those in older homes. Overall about two-thirds of all respondents were not aware that a power shower can use as much water as a bath.

8.3 Awareness of average daily per capita water usage

Only 15% of homeowners were aware that the average person in the UK uses 150 litres of water (about 33 gallons) every day.

8.4 Ownership of water meters

Overall, about 30% of homes in England and Wales have water meters: these have been compulsory for dwellings built since 1989.

Meters allow homeowners to measure how much water they use and studies undertaken in the 1990s suggested that water usage reduced by up to 15% after meters were installed [14]. The potential for meters to encourage water saving depends on the cost of the water, however. Those living in affluent areas may use more water after being metered if they do not perceive the unit charges to be very high.

Three-quarters of owners of new homes believe that it is reasonable for all homes to have water meters to encourage water conservation but this figure drops to 52% for owners of older homes.

The two main grounds for considering compulsory metering to be reasonable are that it would save water and that it is the fairest system, each mentioned by around two in five. Just under a quarter felt that a meter makes people aware of the water that they are using while a small proportion mentioned cost savings (Table 8).

TABLE 8

Reasons why compulsory metering is reasonable

Would save water	41%
Fair system	38%
Makes you aware of what you use	22%
Cheaper	8%
Other	8%

Base: all considering compulsory water metering reasonable (346)

Among those not thinking it reasonable to have compulsory metering the main factor is cost, mentioned by well over half, with a smaller number stating that such a step should be voluntary. Owners of older properties were significantly more likely to mention cost than those in recently built homes (Table 9).

TABLE 9

Reasons why compulsory metering is not reasonable

	Owners of new homes (%)	Owners of older homes (%)
Cost	50	66
Should be voluntary	10	13
Other	31	24
Don't know	16	6

Base: all not considering compulsory water metering reasonable (206)

8.5 Factors encouraging water conservation

Cost is by far the most important driver in encouraging water conservation, with over a quarter mentioning this (Table 10). A period of water shortage, being metered, availability of suitable systems and concern for the environment were each mentioned by a small number.

Overall however, a quarter felt they already save as much water as possible and a similar number could not think of any further measures.

TABLE 10

Factors encouraging water conservation

Financial incentive	28%
If there was a water shortage	5%
Being on a water meter	4%
Environmental concern	2%
Ease of obtaining suitable systems	15%
Other	8%
Nothing – don't waste water	26%
Don't know	28%

Base: all respondents

8.6 Attitudes to grey water recycling

Grey water is household waste water other than that from toilets (which is known as black water). In practical terms grey water also excludes waste water from kitchen sinks and washing machines. Grey water can be stored and re-used to flush the toilet and thereby save water. With appropriate treatment it could also be used in washing machines and in the garden. High level Code homes will probably require some form of grey water recycling and/or rainwater harvesting in order to meet the tough water consumption guidelines.

Over three-quarters of homeowners would be happy to use recycled grey water to flush the toilet (78%) with almost as many also happy to use grey water in the garden (73%). There is far less interest in using grey water in washing machines, with fewer than a quarter signalling their approval of this application (24%).

"With a toilet it doesn't really matter, because it's not like you actually come into contact with it, but with washing clothes you'd have to be a little bit more careful, even with soap and stuff, unless there was something they could put in with the soap powder that purifies it somehow, like a purification tablet."

Owner of older flat

"What, after you've had a bath, then use it to wash your clothes? Really? That's disgusting. Have you got to leave it all stagnant in the bath?"

First time buyer, new house

8.7 Attitudes to rainwater harvesting

The Environment Agency estimates that up to 60% of rainfall on domestic roofs could be captured for use in the home [4].

There is little difference in consumer acceptance of using rainwater to flush the toilet or outside compared to using grey water. Twice as many homeowners, however, would be prepared to use rainwater in washing machines, as demonstrated by Figure 18.

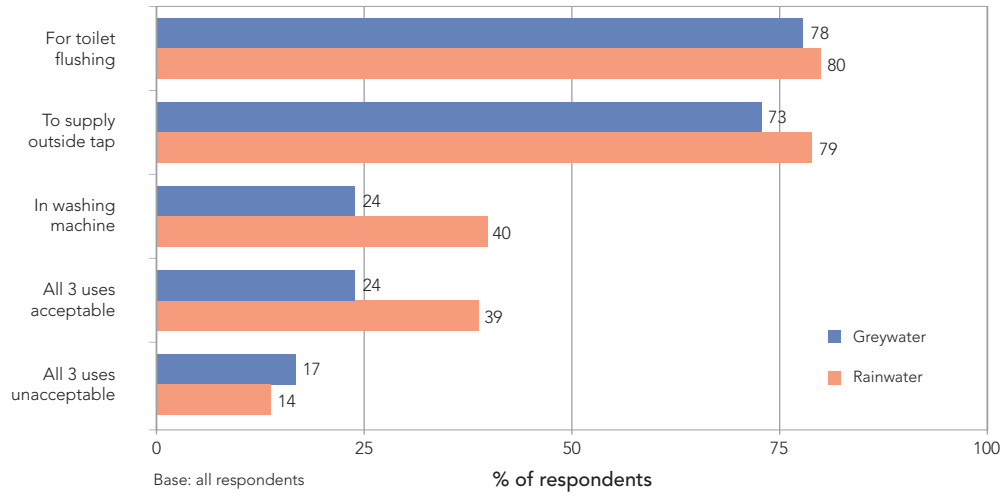


Figure 18 Acceptability of using rainwater/grey water.

8.8 Concerns about grey water recycling and rainwater harvesting

Although a significantly higher proportion of homeowners expressed concerns about grey water (76%) than about rainwater (62%), it should be noted that the majority of homeowners have concerns about both concepts (Figure 19). The nature of their concerns appears similar, both for re-using grey water and for rainwater, and largely reflects the 'yuck!' factor. The two main comments are that usage of such water would be neither clean nor hygienic. Smaller numbers said they were simply uneasy with the idea or raised specific concerns about diseases.

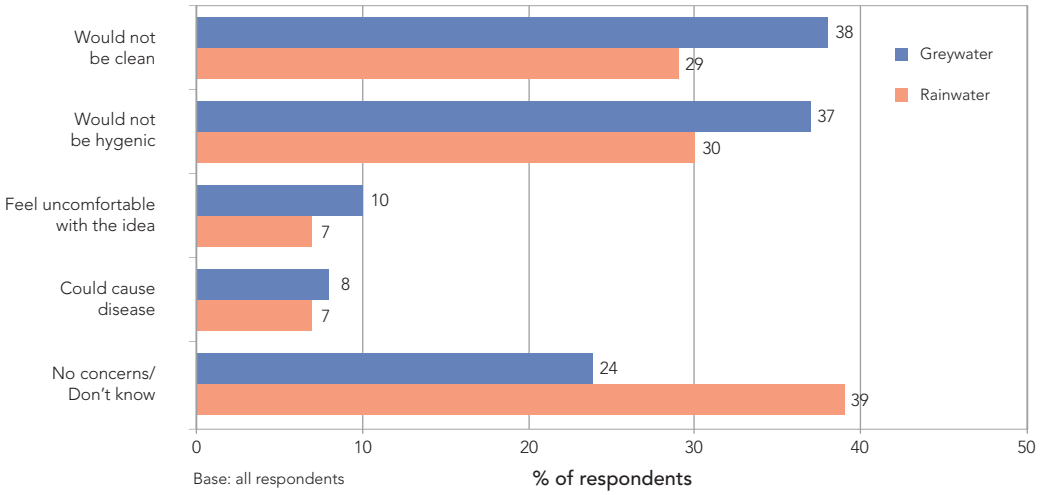


Figure 19 Concerns about using grey water/rainwater.

9 Acceptance of features in Code homes

9.1 Aesthetic appeal

All homeowners were shown two pictures, one of a 'traditionally' styled new home and one of an 'energy efficient' high level Code home from BRE's Innovation Park and asked which they found more appealing. Overall there is a clear preference for the familiar, with over 60% preferring the traditionally styled home and only 19% the energy efficient home. Purchasers of new homes, while still expressing a clear preference for the traditional style, were significantly more likely to find the energy efficient home appealing (Figure 20).

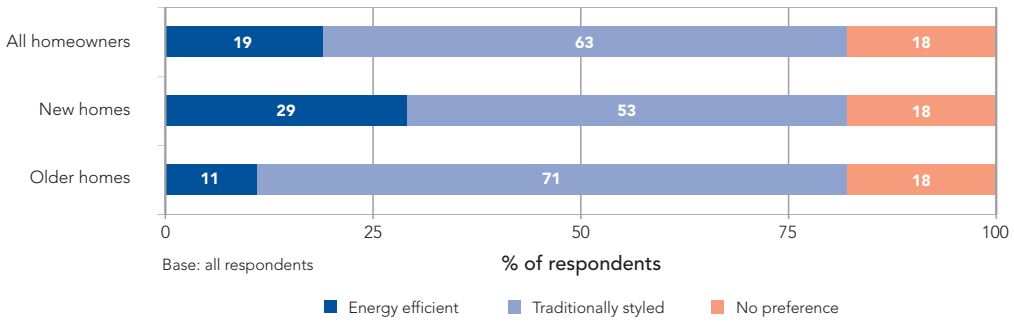


Figure 20 Preference between appearance of energy efficient and 'traditionally' styled new homes.

9.2 Appraisal of specific features

Homeowners were asked to rate the extent to which certain features likely to be found in a high Code level home would encourage or discourage them from buying such a property. Answers were given on a scale from 1, meaning very discouraged, to 5, meaning highly encouraged, and are expressed in Figure 21 in the form of mean scores. Alongside the homeowner responses are builders' perceptions of what homeowner responses would be.

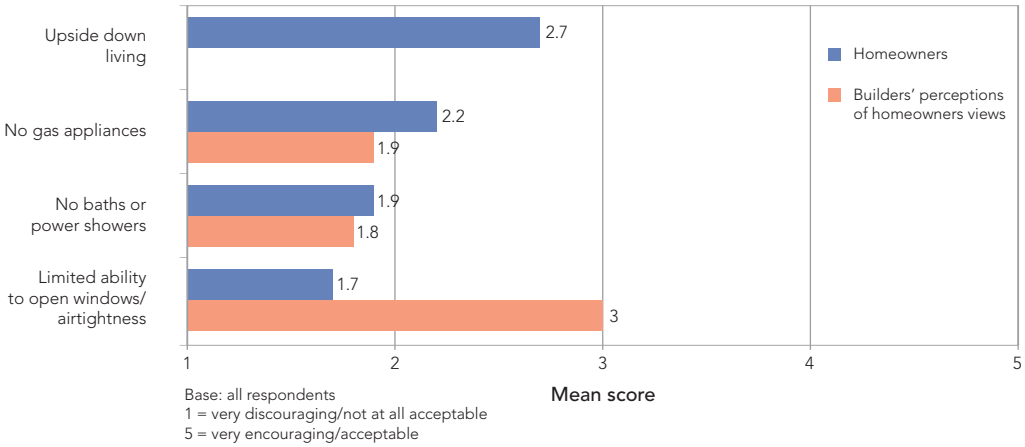


Figure 21 Homeowner acceptance of aspects of Code homes.

It can be seen that, overall, none of the features described are likely to encourage homeowners to purchase high level Code homes. Indeed, the lack of gas appliances and the more stringent airtightness are likely to have significantly negative impacts on the desirability of new homes. There is less concern with the 'upside-down living' concept although even here more owners of new homes would be discouraged (38%) than encouraged (26%). Contrasting comments on this topic are:

> "I think it'd be okay, I think a lot of the things that we have been discussing are different from what we are used to. But if all new houses were built like that you'd get on with it, wouldn't you?"
>
> *Owner of older family house*

> "I personally wouldn't want my bedrooms on the ground floor, a bedroom's a very private space. I don't like sleeping on the ground floor, because I always sleep with the window open"
>
> *First time buyer, new house*

Builders' perceptions appear most accurate with regard to showers/baths and gas appliances.

> "When I was going to buy a property I went to this gorgeous flat. I could have moved in and not had to do anything to it except it had a shower and it didn't have a bath. So I just walked away, because that to me wasn't even a compromise, that was a non-starter."
>
> *First time buyer, older home*

Builders' perceptions are least accurate with regard to airtightness, where they appear to have significantly under-estimated resistance from their customers.

> "I think there's a psychological barrier to overcome. I've worked in offices where people haven't been able to open windows and it makes people feel uncomfortable, even if the ventilation is efficient"
>
> *Owner of new build flat*

> "I like having the windows open at home, like in the bedroom, for instance. I always sleep with the window open, because I like fresh air in the room, so I don't know if I'd be over keen on that"
>
> *Owner of new family house*

Part of the problem is that almost no-one had come across the term airtightness. In the qualitative research, most respondents associated the term with draughts, eg under the door. The topic caused a lot of discussion, mostly critical about the idea of artificial ventilation. There are a number of factors in play here. Some had a fear of disease, partly

by reports of problems in air-conditioned offices. Others have a preference for open windows, especially at night. Respondents could not conceptualise the idea that ventilation would keep the home cool in hot weather: indeed, some asked what would happen if the air outside was hotter than that inside. Older people particularly have been brought up with the idea that fresh air is needed in a house to combat dampness and condensation.

> "But we can't be shut in with the air we're breathing in and out circulating round with no fresh air, surely? It's not healthy. And it's not healthy for a house either"
>
> *Retired owner of older home*

> "I think there's something about the term 'airtight' as well. Airtight rooms are where people go when they're in quarantine and things like that.
>
> *Owner of older flat*

10 The Code for Sustainable Homes

10.1 Appraisal of overall aims of the Code

Respondents were informed that all new homes are currently planned to achieve Code Level 3 by 2010, representing a 25% reduction in CO_2 emissions compared to a home built to Part L of the 2006 building regulations. They were also informed that by 2016 the plan is for all new homes to achieve Code Level 6, ie to be zero carbon.

As Table 11 demonstrates, around four out of every five homeowners interviewed believes each of these aspirations is desirable. It should be noted, however, that a significantly higher proportion of those living in older homes, who represent the vast majority of homeowners in the UK, commented in each case that this was not desirable.

However laudable homeowners believe these aims to be, they do not consider them to be at all realistic. Fewer than half believed that such a reduction in carbon emissions could be achieved by 2010, with less than a third regarding the 2016 zero carbon date as feasible.

TABLE 11

Homeowner perceptions of adoption of Code Levels 3 and 6

	Code Level 3 by 2010		Code Level 6 by 2016	
	Owners of new homes (%)	Owners of older homes (%)	Owners of new homes (%)	Owners of older homes (%)
Desirable	84	78	82	76
Not desirable	14	21*	16	23*
Realistic	45	41	31	31
Not realistic	51	56	66	66

Base: all respondents

* = significant difference

10.2 Detailed appraisal of effects of the introduction of Code

Perceptions of return on investment

Using the information provided in the CLG consultation document *The future of the Code for Sustainable Homes* [15], homeowners were informed of the estimated average additional build costs for Levels 1 (£700), 3 (£6000) and 6 (£35,000) of the Code and the predicted annual savings on water and fuel bills for each (£50, £120 and £400, respectively).

They were then asked to comment on how reasonable they believe each of these Code levels to be in terms of the return on investment. Answers were given using a five point scale from 1, meaning not at all, to 5, meaning highly reasonable, and are shown in Tables 12 and 13.

Overall, only new homeowners regarded just Level 1 of the Code as being in any way financially reasonable. In doing so they recorded a significantly higher score than did owners of older homes. Even so, only 46% of new homeowners regard the £700 investment as very or fairly reasonable, along with 36% of owners of older homes (Table 12).

TABLE 12

Homeowner perceptions of financial rationality of Code Level 1

	Owners of new homes (%)	Owners of older homes (%)
Very reasonable (5)	19	10
Fairly reasonable (4)	27	26
Neutral (3)	27	29
Not very reasonable (2)	8	14
Not at all reasonable (1)	12	15
Don't know	7	6
Total	**100**	**100**
Mean score	**3.4**	**3.0***

Base: all respondents

* = significant difference

Owners of both new and older homes tend to believe that the financial returns for Level 3 are not very good, with a strong indication that the returns for Level 6 are not at all reasonable (Table 13).

TABLE 13

Homeowner perceptions of financial rationality of Code Levels 3 and 6

	Level 3 (%)	Level 6 (%)
Very reasonable (5)	2	1
Fairly reasonable (4)	13	7
Neutral (3)	24	12
Not very reasonable (2)	24	17
Not at all reasonable (1)	31	57
Don't know	6	6
Total	**100**	**100**
Mean score	**2.3**	**1.7**

Base: all respondents

> "But how much would you save on your bills? If I'm putting an extra six grand into a house, I'd have to know I'm going to recoup that within five years."
>
> *First time buyer, older home*

At Level 6, only 8% of homeowners believe that the investment required to achieve the stated energy savings represents good value, and almost 60% consider this represents very poor value.

> "An extra £35,000, which nobody else is paying, to have a totally different lifestyle to all your friends and family....? Most people borrow as much as they can to start with, so they'd want to know whether they'd ever get that extra 35 grand back"
>
> *First time buyer, older home*

Preference between Code homes and new homes built to current regulations

Given the choice of two new homes, one built to Code Level 1 and one built to current building regulations, the majority of those already living in new homes would choose the slightly more expensive Level 1 home. Those living in older homes were divided, almost equally, between those who would pay the £700 extra and those who would not.

Moving up to Code Level 3, the picture becomes far more clear-cut: only about a fifth of homeowners would choose to pay the additional £6000, whereas four out of five would not (Figure 22).

And only a tiny minority (about 4%) would choose to pay the £35,000 required for a Code Level 6 home. In other words, whatever their feelings about the desirability of owning a zero carbon home from the environmental perspective, 24 out of 25 homeowners in the UK would not be prepared to pay for one.

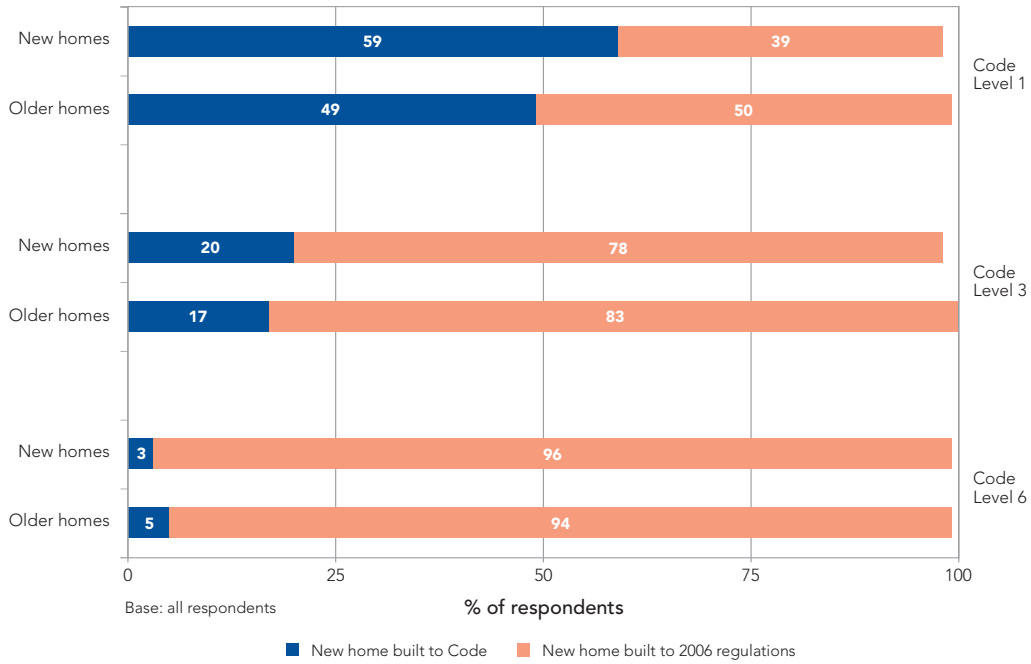


Figure 22 Preference between Code home and new home built to 2006 Regulations

Preference between Code homes, new homes built to existing regulations and older, less energy efficient homes

Homeowners were informed that older properties are generally much less energy efficient than newly built homes and then asked to state their preference between an older less efficient home, a newly built home to current regulations and a new Code home.

At Code Level 1, half of the owners of new homes and over a third of owners of older homes would choose the Code property. Over a third of each group would choose a new home to current regulations and only 9% and 27%, respectively, would go for an older, less efficient home.

Given the choices for Level 3, fewer respondents selected the Code home, with hardly any picking the Code home at Level 6. Interestingly, however, in both cases the displacement

is largely to the new home built to current regulations, rather than to the older less efficient homes (Figure 23). This is perhaps partly because respondents had become somewhat biased towards energy efficiency by this late stage of their interviews. It should still be noted, however, that at Level 6 three times as many current owners of new homes would actually choose an older, less energy efficient home than a zero carbon one. Current owners of older homes expressed an even stronger preference for the inefficient older home, with 18 times as many choosing such a home over the zero carbon alternative.

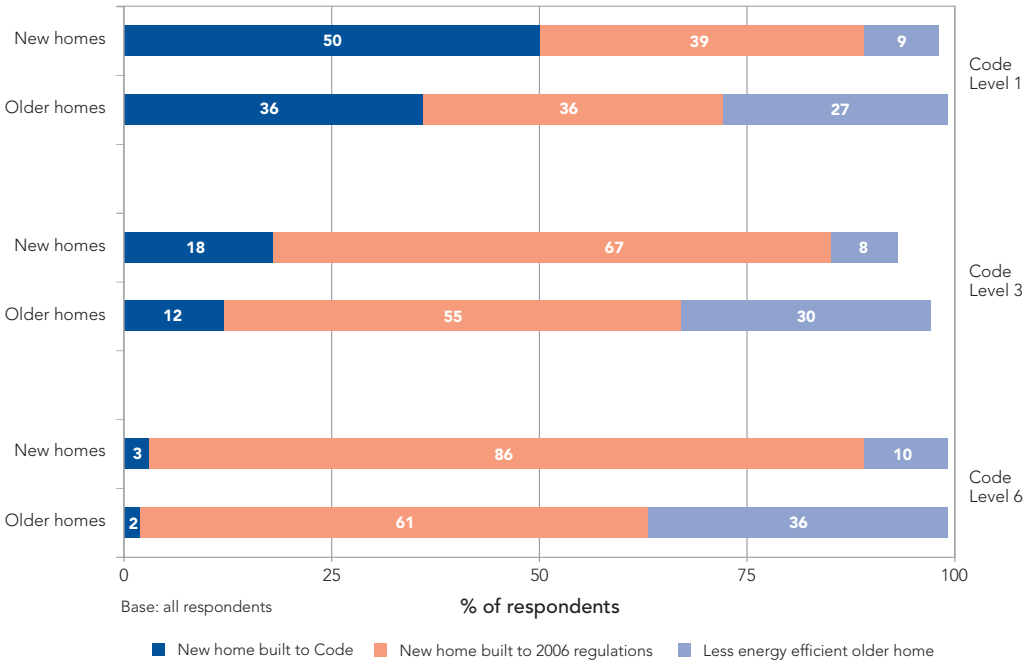


Figure 23 Preference between Code home, new home built to 2006 Regulations and less efficient older home.

10.3 Application of the Code to older housing stock

Homeowners were asked to what extent they agreed or disagreed that regulations relating to new build properties, such as the Code, should also apply to the older stock. They were given three levels of application:

- should apply to future extensions only, on older properties
- should apply to the whole property, when extension undertaken in future
- should apply to all of the entire older built stock.

Answers were given using a scale from 1, meaning disagree strongly, to 5, meaning agree strongly, and are summarised in Figure 24 in the form of mean scores.

It can be seen that, while homeowners generally agree that extensions on older properties should comply with current regulations for new build, there is little enthusiasm for extending new standards of energy efficiency, more widely across the built stock. Not surprisingly, owners of new homes agree significantly more strongly that extensions should be built to new standards. Owners of older homes disagreed even more strongly than owners of new homes with the proposition that new regulations should apply to all older buildings.

> "Like your building now, if you say it's 200 years old, what if something happens and it doesn't actually become zero carbon, are they going to knock it down and say, no, sorry, can't have it. You can't make it completely carbon neutral."
>
> *Owner of older flat*

"How are all the pensioners going to afford a new boiler? Their old boiler might be in perfect working order, but it's not energy efficient. How are they going to be able to afford to put a new boiler in, they can't afford it and are the government going to pay for them? Of course they're not."

First time buyer, new house

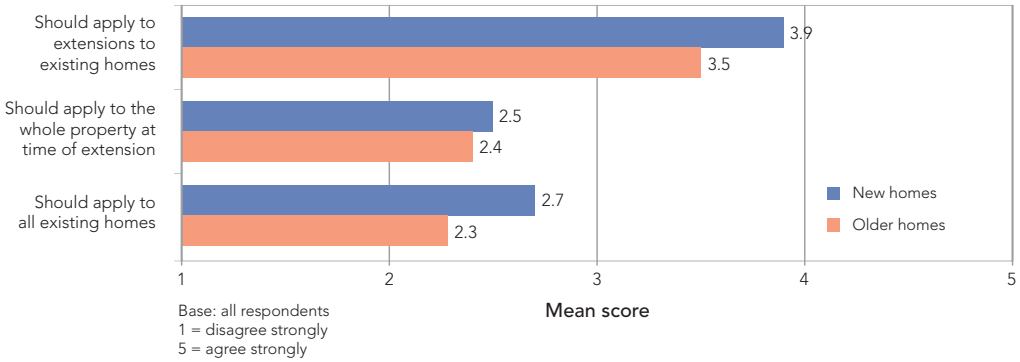


Figure 24 Extent of agreement that energy saving standards should be applied to existing homes.

10.4 Administration of national energy efficiency standards

Homeowners were informed that "at present, standards for newly built homes are to some extent set by local authority planners who can specify levels of energy efficiency and use of renewable energy above current building regulations". They were then asked whether they agreed with this approach, made possible by the Merton Rule, or whether they would prefer national standards. The majority of homeowners (55%) would prefer national standards.

10.5 Administration of recycling policies

Homeowners were informed that local authorities currently set recycling policies and were asked whether they agree with this or whether they would prefer national policies. In this respect, the consensus was that recycling policies should be set by local (53%) rather than national (46%) authorities.

Several of those involved in the qualitative research spoke at length of their frustration with the fact local authorities can and do have differing recycling policies, arguing that this confuses homeowners and undermines the authority of the overall recycling ethos. Nearly all homeowners reported that their local authority provided them with kerbside recycling facilities (93%).

11 Factors that would encourage reduction of carbon usage

This was the final question asked of both the focus group respondents and the main sample, ie once all the other topics had been discussed.

Qualitative respondents considered that a combination of 'carrot and stick' would be needed to encourage energy efficiency.

> "Well it would be done by putting costs up for certain things, to force you into ways of saving, even if it's on petrol, you know, that's the only way it will be done."
>
> *Retired owner of older home*

> "And thinking about seatbelts in cars as well, it was never required. Then they became a legal requirement and cars were made with seatbelts. So it became part of your mindset that when you get in your car you put your seatbelt on."
>
> *Owner of older family house*

Financial savings was the principle factor mentioned by the main sample together with the need to raise awareness of the various issues. A fifth were unable to make any suggestions (Table 14).

TABLE 14

Factors that would encourage homeowners to save energy and reduce CO_2 emissions

Saving money	42%
Raise awareness	34%
Other	19%
Nothing/ Don't know	21%

Base: all respondents

12 Raising awareness

Focus group respondents were asked how the government and others could communicate with the population about climate change, carbon emissions and related topics. TV is seen as the most realistic way of reaching people (Table 15).

"I suppose so, but not a lot of people read a newspaper, do they? I think television would be better."

First time buyer, older home

"Could they have a documentary on TV about it? They have these reality programmes, but they could have an eco-friendly one, giving out information and showing you what they can do."

Owner of older family house

TABLE 15

Potential sources of information about energy saving and CO_2 emissions

TV programmes	56%
TV advertisements	54%
Leaflets	38%
Local authorities	29%
Local radio	20%
Internet	17%
Utilities and water companies	15%
National radio	13%
Magazines	12%

Base: all respondents

Others suggested that they would like to see their local authority take a lead in providing information on this issue, perhaps as they do with waste and recycling. In this respect local government appears to be regarded as a more trustworthy source of information than Westminster. Some suggested providing information with the council tax bill.

These answers were mirrored by the main sample, with TV seen as most effective.

The key messages need to be financial savings plus assisting the environment. Financial benefit is, however, by far the more important. Messages with local relevance and impact are more influential than dire warnings about the planet being doomed.

> "Yes, I think people respond most to financial incentives. I think people are a bit tired of the environmental message, nobody understands."
>
> *Owner of new family house*

The education of children is seen as important.

> "Yes, it's educating other people from an earlier age as well, isn't it? Telling them about changes in the way they should be living in their homes and the reasons why they need to change. Mostly because it's going to help the environment but also that it's going to help them financially as well"
>
> *Owner of older family house*

Some qualitative respondents, however, felt that there is already sufficient information and that anything more would be counter-productive.

> "I'm not sure a message is going to get through to everybody when you can turn on the television any day of the week and see the level of emissions countries like China are putting out. Or when you can see what the major industries are pumping out. You sit there and think, okay, so I should have recycled the plastic bottle I've just thrown away but what difference will that actually make in the grand scheme of things?"
>
> *Owner of new family house*

> "It's that dose of reality thing again, people are concerned with their own lives and whether they have enough food for their children, can they pay the mortgage, can they pay the bills? Any message has got to be something to do with savings because they might have one eye on the news while they're cooking dinner and getting the kids to bed. But actually it's that reality of looking at what effect it has for the family and the home that would really have an impact on people"
>
> *Owner of new family house*

PART TWO
HOUSEBUILDERS' ATTITUDES

13 Introduction

13.1 Context

This section of the report discusses the results of the work undertaken with housebuilders and:

- investigates their attitudes towards climate change and sustainability
- assesses the way in which the Code works as the key driver of the zero carbon homes agenda
- presents attitudes to and perceptions of the technologies that will be required to deliver a zero carbon home
- covers housebuilders' perceptions of homeowners' likely reaction to the features likely to be found in a zero carbon home
- investigates further strategies for reducing carbon emissions.

The remainder of Section 13 provides:

- guidance on how to interpret these results
- a detailed explanation of how the research was undertaken
- the sample structure for the housebuilders represented in this research.

Section 14 summarises the key findings for the builder research, and Sections 15–22 provide the detailed industry responses to each topic

13.2 Interpretation of results

The findings in this report are reported in a number of ways, depending on the type of question. In some cases answers are given in % terms, for example questions which relate to awareness or behaviour. In other cases results have been given in the form of a mean score or average, for example in relation to ratings of importance, or levels of interest, in

new ideas. Mean scores are a reliable way of measuring differences in perceptions, taking into account both positive and negative responses. Each rating scale runs from a lowest or least positive score of 1 to a maximum of 5. A rating of 3 is therefore to be interpreted as neutral, ie neither important nor unimportant. A mean score of 4 or more is normally regarded as important and, in EPR's experience, it is unusual to see a mean score of higher than 4.5. Mean scores of less than 3 express factors of less importance.

The housebuilder quantitative survey comprised 100 interviews and answers based on this sample size are accurate to ± 5.9–9.8%. It should be noted, however, that, together with those included in the qualitative stage, these builders constitute a very high proportion of the industry in terms of numbers of homes built and they should therefore be considered as highly representative overall.

Note that some charts may not total 100%, the omissions being those unable to express an opinion. Others may total more than 100% where respondents were able to record more than one answer to a question.

13.3 Method of work

The work was undertaken in two stages. The first stage involved qualitative research to investigate the issues and understand the attitudes of housebuilders. The second stage involved a larger, quantitative study to establish the relative importance of the issues and attitudes identified in the qualitative work.

All work was undertaken with housebuilders registered with NHBC. For administrative and communication purposes, NHBC categorises its 16,000 registered builders into seven Peer Groups, define by the number of homes (units) that each builder registers each year. The Peer Groups and the proportion of total units completed by each Peer Group are shown in Table 16.

TABLE 16

NHBC Peer Group classification (2006 UK data)

Peer Group	Builders (number)	Registrations per year (number)	Registrations (%)
One	24	1001+	51
Two	34	301–1000	9
Three	36	201–300	5
Four	251	51–200	13
Five	1200	11–50	13
Six	5365	1–10	9
Seven	9131	0	0
Total	**16,038**		**100**

Base: all respondents

As can be seen, the vast majority of new homes in the UK are built by a relatively small number of builders. At the other end of the scale, a large number of registered builders are responsible for relatively few homes. The challenges faced by NHBC in communicating with housebuilders are illustrated by the fact that Peer Group 7, which accounts for over half of all registered builders, entirely comprises firms which did not register (build) a single home in 2006. For the purposes of this study, most attention was paid to canvassing the opinions of builders in Peer Groups 1–4, responsible collectively for nearly four out of every five homes constructed. A few of the larger Peer Group 5 builders (35+ homes per annum) were also included.

13.4 Sample structure

In total, 115 of the UK's leading housebuilders contributed to this research:

Qualitative research:

Peer Group 1	7	In-depth personal interviews of 1–2 hours each
Peer Groups 2–4	8	Extended focus group at BRE Innovation Park[3]

Quantitative research:

Peer Group 1	10	Semi-structured telephone interviews
Peer Groups 2 and 3	33	
Peer Groups 4 and 5	57	

Details of the homes built by the 100 housebuilders participating in the quantitative telephone study are given below in Table 17. The number of homes built in 2006 ranged from 20 to 4000. Those involved in the qualitative research build up to 20,000 units pa. It can be seen that all volume builders are involved in the social housing sector, mostly as a result of agreements made to meet obligations under Section 106 of the Town and Country Planning Act [(16)]. Larger builders, perhaps not surprisingly, build a higher proportion of their homes in the social sector and are more likely therefore to have built to higher standards of sustainability than those mainly involved in the private sector.

Given the current planning environment it is not surprising that flats are the dominant type of home built, with around a fifth of properties detached or terraced respectively. Semi-detached houses, once the mainstay of the industry, are now in the minority. The proportion of leasehold properties corresponds closely to the proportion of flats built suggesting that few houses are currently sold on a leasehold basis.

TABLE 17

Sample structure: units built in 2006

	Peer Group			All
	1	2 and 3	4 and 5	
Total units built (mean n)	1870	555	145	**438**
Private sector units (mean %)	64	71	72	**71**
Social sector units (mean %)	36	29	28	**29**
Freehold units (mean %)	81	50	59	**58**
Leasehold units (mean %)	19	50	41	**42**
Detached (mean %)	9	22	19	**19**
Semi-detached/other (mean %)	23	12	15	**14**
Terraced (mean %)	26	18	22	**21**
Flats (mean %)	42	48	44	**46**

Base: all respondents

Development size is likely to be a key factor affecting the homes built to the levels of the Code for Sustainable Homes. Much of the existing technology is thought to only work effectively at a reasonably large scale, ie bigger than at individual property level. Thus microgeneration technologies and water conservation systems need to be developed that are applicable to the common sizes of development actually built. There is enormous diversity in the range of development sizes in England, from just 1 unit up to 5000. There is less variation in the average size of development, which ranges from about 50 to 100 units, but any new technology will need to cope with small developments of about 10–15 units (Table 18).

[3] Innovation Park, at the centre of BRE's Watford site features a number of demonstration properties showcasing Modern Methods of Construction (MMC), zero carbon homes, and over 200 innovative and emerging technologies. It is an exemplar for the sustainable technology and integrated design that is required under the Code for Sustainable Homes. Further details are provided at www.bre.co.uk. Enquiries about visits can be made by telephone 0845 223 2966 or email *innovationpark@bre.co.uk*

TABLE 18

Sample structure: typical development sizes (2006)

	Peer Group			All
	1	2 and 3	4 and 5	
Smallest (mean n units)	29	15	11	**14**
Largest (mean n units)	1111	338	160	**306**
Average (mean n units)	104	55	48	**55**

Base: all respondents

Given the different legislative agendas of the devolved administrations in Wales and Scotland, only builders who operate in England were interviewed in the quantitative study and the data therefore relates only to the English housing market.

14 Summary of key findings

14.1 Climate change

The larger volume housebuilders, responsible for the majority of new homes, are mostly well aware of the proportion of CO_2 coming from the housing stock and nearly all have the reduction of CO_2 emissions as a key business objective. Indeed, some of those participating in the study have already taken measures to reduce carbon emissions in their own homes and several of the firms involved have invested substantially in low carbon developments and research.

> "We have to address climate change. I do think it is credible and I do believe we need to reduce CO_2 emissions from all our new build houses. We have addressed the need and have a strategy in place."

Awareness among the smaller housebuilders is somewhat lower.

The housebuilders' key concern about reducing emissions from housing is that government priorities appear to focus almost exclusively on the approximately 160,000 new homes built each year rather than the 21 million homes already built. Builders recognise the need to further reduce emissions from new homes but cannot see how this is the best return on investment in terms of reducing CO_2 emissions from the UK housing stock as a whole.

> "New houses today are 70% more efficient than they were in 1992."

The concerns expressed by housebuilders echo those of the government's own independent advisory body on sustainable development, the Sustainable Development Commission, which stated in its 2006 report *Stock take: delivering improvements in existing houses* [17].

> "Houses already built account for 99% of our total housing stock – a conservative estimate is that 86% of the current stock will be in use in 2050. The SDC strongly favours programmes for improving the resource efficiency of existing homes, rather than seeing widespread new build as the more appropriate option." [2]

14.2 The Code for Sustainable Homes

All housebuilders are aware of the Code for Sustainable Homes [1] and of its broad objective to achieve zero carbon as the standard for all new homes by 2016. Considerable confusion exists, however, about the dates by which various levels of the Code should be adopted.

This is in part because relatively few builders (15%) are able to accurately relate the Code to the houses that they were building at the time of the research, which conform to Part L of the building regulations covering energy use and heat loss. But the confusion also occurs because different dates apply for social and private sectors and because of the 'voluntary' status of the Code. While the Code has six stepped Code Levels, dates have been announced for the introduction of only three of these, adding further to the uncertainty.

The fact that many local authorities have used the Merton Rule [5] to bring forward the nationally agreed dates for voluntary adoption of Code levels is likely to have diluted the authority of the Code and the strength of its objectives. Thus one local authority within a national housebuilder's operational region may be stipulating Code Level 3 two or even three years ahead of a neighbouring local authority in the same region. And neither of them may be working to the dates that the government, industry and BRE have jointly agreed, at the national level, as being technically feasible.

A quarter of all builders surveyed reported incidences of local authorities pulling forward Code dates under the Merton Rule. They report higher build costs and higher house prices as the main consequences; it is not clear how either outcome is consistent with wider government policy for delivering more houses or for more affordable housing.

The average estimates housebuilders gave for the additional build costs to meet Levels 3, 4 and 5 of the Code were in line with the government figures published by the Department for Communities and Local Government (CLG) [15]. It should be noted that such averages conceal a wide range of actual estimates. Housebuilders quoted a somewhat lower average value than CLG for Level 6 but this figure should not be regarded as representing an informed opinion. Many of the smaller builders in particular could not provide even a rough estimate, so the average value is calculated from a smaller number of respondents. It is also noticeable that the largest housebuilders estimated substantially higher costs for achieving Level 6 and these are the respondents most likely to have calculated the costs accurately.

Whatever the precise costs, housebuilders strongly believe that the additional costs of the Code will have counter-productive effects on four key areas of government housing policy, as well as on the profitability of their own industry. Their greatest concerns are for affordability, speed of development, the number of units they will be able to build and, to a lesser extent, land supply.

Housebuilders do not expect that homeowners will be willing to contribute much to the additional cost of meeting the requirements of the Code and this view is validated in the accompanying research with homeowners. Housebuilders therefore predict that the additional costs will be financed by reductions in land values. While this prediction may be fine in theory there is widespread concern that landowners may not be willing to sell land at significantly lower prices and this could lead to shortages in land supply and a consequent reduction in the number of homes built.

In short, the perception of the industry is that, whatever the merits of the Code itself, it is being severely undermined by the muddled and incoherent way in which the Code agenda is currently being driven. Builders would prefer a level playing field to be introduced so that the requirements of the Code are incorporated into building regulations, introduced across the whole market at the same time and enforced by building control rather than by planning professionals.

> "If it was in the building regs you'd be working in a more controlled manner and everybody would be working on a level playing field."

Housebuilders' views on this subject are consistent with the view of the Sustainable Development Commission, which based the following conclusion on 'the broad range of its work':

> "Setting statutory standards, through regulation with proper enforcement, is necessary to ensure that a minimum standard is being met by all actors in a market…we therefore cannot rely on voluntary standards to deliver the great improvements in resource efficiency that are necessary." (17)

14.3 Microgeneration technology

Microgeneration is the small-scale, off-grid production of energy and/or heat, using renewable resources. Although smaller in scale than the current energy generation and distribution infrastructure, microgeneration encompasses a wide range of scales of technology. Application at the smallest scale is for the individual property, in which each home on a development has its own microgeneration infrastructure. Next in scale is a community or development scheme, such as a district heating scheme, which could benefit from economies of scale. The third option is for an offsite scheme, wired directly into a local distribution system for a community or development.

Housebuilders are currently considering all three scales of microgeneration scheme. Property level schemes are favoured by the largest number of builders, but will not necessarily be employed in the largest number of homes because the biggest builders are also interested in community and offsite schemes.

Of the technologies that homes aiming to meet the highest levels of the Code are most likely to employ, there are four front-runners at this stage: solar thermal (to heat water), photovoltaic (to generate electricity), ground source and air source heat pumps (for space and possibly water heating). There is much less interest in wind turbines or combined heat and power (CHP). From the point of view of meeting the requirements of Levels 5 and 6 of the Code it is worrying that only one of the four favoured technologies generates electricity; the other three require electricity to capture heat.

The preferred technologies fit reasonably well with the fact that the majority of housebuilders are looking at property-scale solutions. Builders still have a number of concerns about microgeneration technology, however. The first is the expected cost for what the builders believe to be relatively modest returns in terms of energy generation and carbon savings. This leaves the builders concerned that if anything goes wrong with this technology, homeowners will simply disconnect it and install a cheaper but less energy- and carbon-efficient alternative.

The second major concern is that three of the four technologies are space intensive and are unlikely to generate sufficient energy on anything other than a plot for a large detached home. Indeed, at a time when the trend in the industry is for homes to have smaller footprints, most of these technologies are likely to actually require more space than is permitted under current planning guidelines.

> "For solar and PV you will need every building to face the south with large monopitch roofs and that just isn't practical, quite apart from the issue you'd have with planning. And they work best in the summer, not when you have the high energy loads in the winter."

The third concern builders raised is the visual impact of these technologies and the consequent implications for meeting current guidance on masterplans and initiatives such as CABE's *Building for Life* (18).

There are also concerns about the reliability of the technology and whether a credible supply chain exists to service it.

In short, builders do not believe that viable property-level microgeneration technology currently exists which would enable them to build large volumes of zero carbon homes efficiently and costeffectively.

Some of the larger builders are attempting to meet the microgeneration requirements through community and offsite technologies. These bring their own challenges, however. The first is that such schemes require local distribution networks, land for the generation plant and an operating company. All of this is beyond most builders' realm of experience. It may also require a major shift to leasehold or commonhold tenure arrangements when the trend within the industry over recent years, encouraged by successive governments, has been for a shift towards freehold ownership. Running costs, property blight and the need for additional land are further issues raised by the larger scale microgeneration schemes.

14.4 Thermal efficiency and airtightness

Builders are considering four main materials for the building envelope of high level Code homes. They are most likely to use timber frame or traditional brick and block technologies. There is less interest in the relatively novel technology of lightweight panel systems or panel system masonry.

While the preferred materials have the benefit of being familiar to most housebuilders, homeowners in England have a very clear preference for brick and block over timber frame.

Compared to some of the other technical aspects of constructing Code homes, builders appear relatively optimistic about their ability to meet the required standards of airtightness.

That is not to say that more stringent airtightness requirements are unreservedly welcomed by the industry. Builders' main concern is with the environment they will be required to create within new homes in order to meet Code standards. Their concerns are very much for the welfare of purchasers, with comments relating to air quality, condensation and mould. The air quality is likely to be so poor that mechanical whole-house ventilation systems are likely to be required to ensure the air remains safe for habitation and healthy for the fabric of the building itself. Such a requirement seems counter-intuitive to builders at a time when homeowners are being encouraged to switch off as many electrical devices as possible within the home. There are also concerns that not all homeowners will properly maintain such systems. This may both prejudice their health and result in their taking alternative measures (such as opening windows and doors to increase air circulation), which would seriously reduce the thermal efficiency of the house and lead to an increase rather than a decrease in carbon emissions.

> "When you seal a house up that tight you have to ventilate it 24/7 whether the property is occupied or not otherwise you will have stagnant air and mould. My concern is that some people will go in, see the fan working all the time and may turn it off. That house will suddenly become an unhealthy place to live."

Finally, there is also concern that highly insulated lightweight structures built to high levels of airtightness will be uncomfortably warm in the summer and might require mechanical airconditioning.

14.5 Water conservation

Nearly all housebuilders are aware that the Code covers water use. Awareness of the average volume of water used in this country per person per day (150 litres) is low, with only one in six builders providing the correct answer to this question and most of the remainder providing underestimates. Awareness of the target consumption figure for Level 6 of the Code (80 litres) is better but still only represents a minority of housebuilders (30%).

Builders' views about water conservation are similar in some respects to their views on airtightness. Technically it provides a challenge, albeit an achievable one, but realistically they believe it poses potential risks to human health and they question whether homeowners will accept the lifestyle changes that will be required to meet the water use targets.

As with microgeneration schemes, builders tend to favour property level schemes for both rainwater harvesting and grey water recycling. But, as with microgeneration, this gives rise to concerns about the additional service and maintenance responsibilities these systems will place on homeowners and about whether current plot sizes are adequate to accommodate the required infrastructure. The comparison with microgeneration is not valid, however, when it comes to homeowners failing to discharge their maintenance responsibilities. Not only might lack of maintenance threaten the ability of the technology to work efficiently but in the case of water systems, particularly where these involve grey water, homeowners may also unwittingly put their own health at risk.

It is not surprising therefore that four out of five builders are considering rainwater systems compared to just over half interested in grey water.

In addition to these anxieties, housebuilders have a broader concern that homeowners will simply not accept the small volume of mains water a Code home allows and will retro-fit equipment such as power showers or larger baths and remove flow restrictors from taps. In short housebuilders believe that homeowners will adapt their Code homes to meet their lifestyle expectations rather than modify their lifestyles to live within the constraints of a Code home. If they do this, builders feel that the additional cost and complexity of water conservation schemes, not to mention the health risks and the opportunities to further reduce water usage and energy consumption, will have been wasted.

> "We can all build our houses correctly to meet the 80 litre target. I don't think that's a major issue. But purchasers like to have high pressure showers so they'll just go and put a shower pump in to increase the water pressure after they've bought the houses from us."

14.6 Confidence in ability to build Code homes

Figure 25 demonstrates that the UK housebuilding industry has very moderate confidence in its ability to meet Code Level 6 requirements by 2016 in two areas: water conservation and airtightness. Overall it is not confident that microgeneration technology will deliver the required levels of energy by 2016 and this drags down belief in the industry's own technical ability.

> "I have no confidence in it whatsoever. We are currently involved in building a Code Level 6. If the government expects code Level 6 houses in 2016 with the technology that's available today then there won't be any houses built in 2016. It's so complex and so expensive."

There is least confidence in the industry's ability to profitably build Code Level 6 zero carbon homes by 2016 and this finding alone could have serious consequences for the government's stated objective of increasing the number of houses built each year by more than 50%.

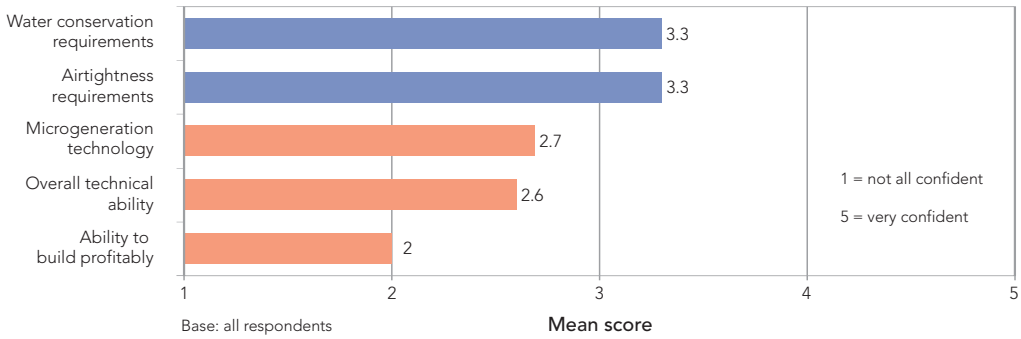


Figure 25 Builder confidence in meeting code Level 6 by 2016

14.7 Consumer acceptance

Consumer acceptance is a key consideration for commercial housebuilders; if they do not build homes that homeowners want to live in and purchase they will not survive. Builders believe that only one of the features likely to be found in a Code home will prove highly attractive to homeowners and that is high levels of thermal insulation. Builders believe that new heating technologies, rainwater harvesting and offsite microgeneration will each be reasonably acceptable.

They are ambivalent about the acceptability of higher standards of airtightness but they tend to believe that consumers will not find the following aspects acceptable:

- grey water recycling
- community microgeneration
- lower water usage
- property level microgeneration
- higher proportion of leasehold homes.

Builders believe that the real 'deal-breakers' for consumers will be:

- additional service and maintenance responsibilities for microgeneration, water conservation and ventilation systems
- the lack of gas appliances
- the lack of power showers.

14.8 Alternative strategies to reduce CO_2 emissions

As stated in Section 14.1, housebuilders have serious misgivings about whether full implementation of the higher levels of the Code is the best way to reduce CO_2 emissions from the UK's housing stock. These apprehensions are largely based on their belief that only marginal savings in CO_2 emissions will result from relatively very high expenditure on unproven microgeneration technology. Many believe that spending some, if not all, of the money required to take a Code home from Level 4 to Level 6 in other ways would return far greater carbon savings and thus contribute more effectively to limiting climate change.

> "We can increase the thermal qualities of a new house and make substantial reductions in carbon reductions, that's fine and we can do it at minimal cost. To go from being highly thermally efficient to carbon neutral is harder, costly and it won't reduce carbon emissions much. That money would have a far more substantial effect on reducing carbon emissions if it was spent on older homes."

Thus four out of five UK housebuilders would rather build to Level 4 and invest the resulting savings in either upgrading the existing built stock or in renewable energy generation schemes at a national level. Again, housebuilders' attitudes appear to be in step with those of the Sustainable Development Commission which recommends:

> "Offset any increase in CO_2 emissions or water consumption in the new Growth Areas by matching this with a commensurate reduction in carbon emissions or water consumption in existing homes in the same region." [17]

Only about one in eight housebuilders consider that Level 6 of the Code should be fully implemented by 2016.

15 Climate change

15.1 Recognising the need to tackle climate change

Most of the homebuilders involved in the qualitative research believe the climate change argument to be compelling and are embracing the drive to reduce CO_2 emissions. The majority accept the need to make lifestyle changes themselves but are concerned at how these can be effected among the wider population.

> "From an environmental perspective, climate change is a very pressing agenda and it's the agenda of the moment but being environmentally aware is basically having a concern for how resources are used and the impact of those resources. So whether it was climate change or not, you should really try and reduce resource consumption. There's no educated argument for wasting resources, it doesn't exist."
>
> "I buy the whole idea, we do have to change, we do waste a lot of energy, but I think we also need to educate the end user. We can build the most energy efficient house in the world but if you've got children coming in and out and leaving the front door open all the heat goes out. If we don't educate the end user, everything we do will be worthless and we will have wasted money and time doing it."
>
> "Yes, we have no choice and we are trying to embrace it but the biggest thing is trying to get everybody, including consumers, to buy into it and understand the reasons for the changes."

Several of the individual respondents have themselves invested in energy saving measures or changes in travelling to reduce their carbon footprint.

> "I am fitting a new high efficiency combi boiler and we have low-flow taps. I've also travelled in the UK a lot more by train this year rather than by plane, almost exclusively so, and it's worked out well. The trains have been more reliable and I can work on them."

"We are looking at moving house and one of the things which I got involved in with our own research is the air source heat pump. I'm a great believer in them, so much so that I'm looking to put one in our new house. There are two benefits to that, one financial because it has quite an old LPG central heating system so it would be cheaper to run and also it's more environmentally friendly."

"With regards to our house, I fitted a very high efficiency boiler, a cross between a combi boiler and a thermal store. I've also put in a water meter, so we can monitor our usage and I monitor our electric and gas consumption, which has gone down drastically since I started monitoring it and turned the thermostats down. It's amazing the difference it makes."

15.2 Awareness of proportion of UK CO_2 emissions produced by housing

Housebuilders' estimates for the proportion of CO_2 originating from the UK's housing stock vary considerably, from as low as 2% of the UK's carbon footprint to as high as 70%. A third of housebuilders simply did not know the carbon footprint of the housing sector (Table 19).

TABLE 19

Housebuilders' estimates of the proportion of UK CO_2 emissions produced by housing

41% +	14%
20–40%	44%
<20%	8%
Don't know	34%
Total	**100%**
Mean	**32%**

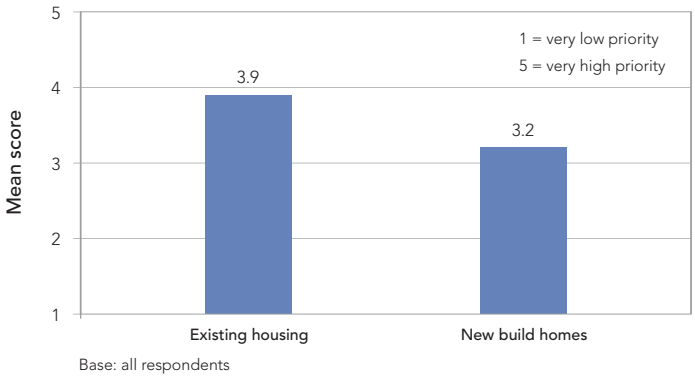
Base: all respondents

The average figure given by those providing estimates is, at 32%, slightly higher than the figure provided by DEFRA of 27%. By comparison, government figures estimate that 28% of UK CO_2 emissions come from road transport and the majority, some 55%, from the commercial, industrial and public sectors.

15.3 Government priorities for further reducing CO_2 emissions from housing

All housebuilders were informed of the proportion of the UK's CO_2 emissions coming from the domestic sector and asked what priority they believe the government should place on further reducing CO_2 emissions from new build homes and from the existing built stock (Figure 26). Answers were recorded using a five point scale from 1 (very low priority) to 5 (very high priority).

Housebuilders believe that the government should place significantly higher priority on improving the carbon footprint of the existing built stock (mean score 3.9) compared to the new build sector (mean score 3.2). The main answer relating to the existing stock was that government should place a very high priority on this sector (39%) whereas the main answer for the new build sector was that this should be neither a high nor a low priority (33%).



Base: all respondents

Figure 26 Builders' priorities for further reducing CO_2 from UK housing.

Larger builders in particular place more emphasis on improving the existing stock. Their key argument for doing this is not self-interest but the impact this will have on reducing the UK's carbon emissions and therefore climate change.

> "First and foremost the government has to look at the existing housing stock. At the moment only about 150,000 new homes are built each year and they are already hugely more efficient than the existing stock. There are 20 million existing homes out there so new build homes are responsible for a small proportion of CO_2."
>
> "You can make a huge impact on heat loss and carbon emissions by spending £2000 on cavity wall insulation, loft insulation and secondary glazing in older homes compared to the carbon reductions you will achieve spending that money in a modern new build house."

15.4 Awareness of government initiatives to reduce CO_2 emissions

The qualitative research revealed good levels of awareness of Ecohomes but less knowledge of the Climate Change Bill [19].

All respondents, in both the qualitative and quantitative stages of the research, were aware of the Code. Most are well aware of the aims of the Code, which are discussed in detail in the following section. The qualitative research did suggest that some confusion does exist, however, with regard to the fundamental issue of what 'zero carbon' actually means. Most work with the definition that this research has employed: "A house that produces no net carbon. It has to generate its own power or be hard-wired into local site developments".

There is clearly some confusion over the precise definition, however:

> "My definition is a net zero carbon dwelling over a 12 month period to include appliances and people's lifestyles."
>
> "All the energy used is produced on site."
>
> "The BRE Code for Sustainable Home assessors do not know whether a 2016 carbon neutral home is carbon neutral for the whole house or is it just for the energy and lighting in the house. If the BRE assessors don't know, how are the housebuilders supposed to know?"

As recently as December 2006 the Energy Saving Trust was arguing that a zero carbon home should emit no carbon dioxide at all which appeared to contradict the widespread assumption that a zero carbon home is in effect a carbon neutral home:

> "We have always taken the view that such a house should generate all its energy from the home itself, whether by solar panels or biomass boilers. Some government organisations or NGOs might define a home as zero carbon if it is part-run by electricity taken off the grid, but sourced from a wind farm. We need some clarity on the matter." [20]

15.5 Involvement in Carbon Challenge

The Carbon Challenge [21] is being delivered by English Partnerships on behalf of the Department for Communities and Local Government and has the principal aim of accelerating the housebuilding industry's response to climate change. It aims to fast-track the creation of a number of new communities designed to meet the highest level of the Code for Sustainable Homes. Over half (54%) of the housebuilders interviewed were aware of the Carbon Challenge and 11% of them are involved in bidding for Carbon Challenge developments.

16 The Code for Sustainable Homes

16.1 How is the Code for Sustainable Homes supposed to work?

"The Code for Sustainable Homes has been developed to enable a step change for sustainable building practice for new homes."

"It is intended as a single national standard to guide industry in the design and construction of sustainable homes."

"In the short-term, Code compliance is voluntary…"

"The Code sits alongside the planning system which guides sustainability in broader locational and aesthetic issues."

"The Code is closely linked to building regulations, which are the minimum building standards required by law…it is intended that the Code will signal the future direction of building regulations."

As can be seen from the above statements taken directly from the Department for Communities and Local Government's own publication [1], the Code is the government's key strategy device for driving the sustainability agenda in the housing industry. It is intended as a national standard, primarily driven by voluntary uptake within the industry and the gradual raising of the statutory requirements contained within the building regulations.

16.2 How is the Code for Sustainable Homes working in practice?

The initial qualitative research undertaken in this project uncovered the fact that, despite the clearly stated intentions outlined in Section 16.1, the Code is being driven:

- not as a single national standard but at a local level, by individual local authorities, on an ad-hoc basis

- not by building regulations and building control officers but by the planning system
- in detail by the planning system, not in terms of broad locational and aesthetic issues.

16.3 Code level of new homes built to 2006 building regulations Part L

All builders were asked what level of the Code a new home built to Part L of the current building regulations would achieve. Fewer than one in six (15% overall) were aware that in fact a new home built to Part L of the current building regulations [7] would not even reach the lowest Code Level, 1. Over a quarter believed it would achieve Level 1 with over a third stating either Level 2 or 3. One believed it would even achieve Level 4. A fifth simply did not know what level it might attain. Reassuringly, given the number of houses they build, the larger builders answered this question correctly in almost every case (Table 20).

The purpose of this question was not to expose the builder's lack of awareness so much as to illustrate the substantial step-change that the Code represents in terms of industry practice.

TABLE 20

Code level attained by new home built to 2006 building regulations Part L

Code level	(%)
Level 4	1
Level 3	19
Level 2	17
Level 1	28
Will not achieve Level 1	15
Don't know	20
Total	**100**

Base: all respondents

16.4 Awareness of nationally agreed dates for Code levels

Publicly funded new homes

It has been mandatory for publicly funded new homes to comply with Level 3 of the Code since April 2007. But only around a third of housebuilders are aware of this. Over a fifth thought the introductory date would be later than this while some 42% simply did not know. The vast majority of the Peer Group 1 builders were aware of this and it might be expected that some of the smaller builders, operating solely in the private sector, would not know this. In fact over 90% of the builders interviewed operate in the social sector, often as a result of planning obligations agreed under Section 106 of the 1990 Town and Country Planning Act [16].

Adoption of Code for private sector

For most of the time during which this research was being undertaken, April 2008 appeared likely to be the date from which the Code would be adopted by the industry in the private sector. As the report was being finalised, however, it was announced that the actual date for adoption of the Code would be 1 May 2008. From this date all privately sold homes will have to have a Code rating, even if this does not meet the requirements for Level 1. There is no prescription as to which specific level should be adopted until 2010. Some 38% of housebuilders were aware of the April 2008 date at the time of the research although 13% thought the date was later and 5% earlier. Again a large proportion either could not answer (39%) or were not aware that this requirement was coming into effect (5%).

During the qualitative research leading housebuilders were also asked if they were voluntarily adopting the Code ahead of any nationally agreed dates, in line with the government's aspirations detailed in Section 16.1. This idea is regarded as naïve given the costs involved.

"Not at all. We are building eco homes to a good standard up and down the land but for private build the Code has not taken effect so we only need to comply with building regs."

"We're not. We don't have to. The cost of producing houses to the Code is so expensive that we can't afford to do it. We won't do it until we are forced to. The government estimate was that Code Level 3 would be 1–2% of build costs but we are finding it is working out at £4,500."

"Do I see the private sector adopting the Code for Sustainable Homes ahead of regulation? There's a big unknown is the honest answer. If nobody else does, we can't afford to adopt the Code."

Code Levels 3, 4 and 6 for the private sector

All respondents were asked if they were aware of the nationally-agreed dates for the adoption of Code Levels 3, 4 and 6 by the housebuilding industry for the private sector. There is currently no target date for the adoption of Levels 1, 2 or 5.

There is considerable uncertainty among housebuilders about the nationally agreed dates for adoption of the various Code levels. Only a minority was able to give the correct date for either Level 3 (2010) or Level 4 (2013), although there is higher awareness (56%) of the Level 6 zero carbon date of 2016. For both Levels 3 and 4 most of those getting the date wrong gave an earlier date than has been agreed or simply did not know. For Level 6 just under a fifth gave a later date with a similar proportion unable to answer. In the main it is the smaller builders who are least certain of the dates and the largest builders who are best informed (Table 21).

TABLE 21

Nationally agreed date for adoption of Code levels in private sector

	Level 3 (2010)	Level 4 (2013)	Level 6 (2016)
Correct date	35%	13%	56%
Earlier	20%	45%	7%
Later	14%	14%	19%
Don't know	31%	28%	18%
Total	**100%**	**100%**	**100%**

Base: all respondents

This level of confusion surrounding the dates for introduction of the Code is compounded by uncertainty as to whether they apply to the whole Code for Sustainable Homes or just certain sections of it such as energy and water use.

"The targets are not for the code, they're for the energy section of the Code. The only targets for the Code are through the Housing Corporation, English Partnerships and any local authorities that make it a mandatory obligation on land sale or through their supplementary planning guidance. So currently there's no national standard, there's nothing saying that you will be Code Level 3 by 2000 and whatever. You might have to conform with the energy part, but not the rest of it."

16.5 Incidence of planning authorities bringing forward nationally agreed Code level adoption dates

The qualitative research revealed that some local authority planners are stipulating Code levels in advance of the nationally agreed dates as requirements for development, so all respondents were asked about their experience of this.

Table 22 shows that almost a quarter of English housebuilders have been asked to build new homes to Code Level 3 in advance of the nationally agreed date of 2010, mostly by two or three years. Large builders reported this much more often than small builders, with the majority doing so.

There is a much lower incidence of planners asking for Levels 4 (5%) or 6 (2%) in advance of the agreed dates. Where these stipulations have been made, however, they involve dates that are far in advance of what BRE believes to be technically possible, in some cases as many as six or eight years before the national dates. Again larger builders are more likely to be involved.

It should be noted that developments in Wales were excluded from this study, partly because of the Welsh Assembly's announcement that it wanted zero carbon homes to be introduced a full five years early, in 2011.

> "I haven't got any confidence in meeting the Welsh assembly deadline of 2011 whatsoever and I think that will effectively kill off the housing market in Wales if the government doesn't intervene."

TABLE 22

Incidence of planning authorities bringing forward nationally agreed adoption date of 2010 for Level 3 at the local level

Yes, dates pulled forward:	**25%**	
3 years		11%
2 years		12%
1 year		1%
Cannot remember		1%
No, have not experienced this	**75%**	
Total	**100%**	

Base: all respondents

16.6 Consequences of early adoption of Code levels

Builders interviewed in the qualitative research reported the following as likely consequences of these differences between how the government intends the Code to work in theory and how it is actually being put into practice:

- higher build costs on land already purchased under the assumption that extant building regulations would prevail on any subsequent development
- additional build complexity
- slower development
- local market 'hot spots' where it will not be profitable to build new homes
- land supply shortages due to landowners not selling at the reduced price builders can afford to pay after subtracting the extra build costs required to meet Code requirements.

> "One of the biggest problems we've got in the industry at the moment is that local authority planners are asking for a higher carbon reduction than the available technology allows. Targets were set in consultation with BRE to enable technology to advance to meet those deadlines. Some of the local authorities we're talking to want Code Level 4 on planning applications being submitted now. If we start building Code Level 4 houses in 2008 when the true guideline for Code Level 4 is 2013, we're building it five years early, we're having to pay a lot more for that."

All those builders interviewed in the quantitative research who had been asked to build to Code levels before the nationally agreed dates were asked what the consequences of this would be (Figure 27). The immediate effects are additional build costs (mentioned by 36% of those involved) and in turn higher house prices (20%). Some also mentioned more profound concerns that this will:

- reduce the supply of land
- reduce the speed of development
- make homes less affordable

A quarter of builders in this group, however, said it was too early to understand the effects and a further fifth said that it made no real difference.

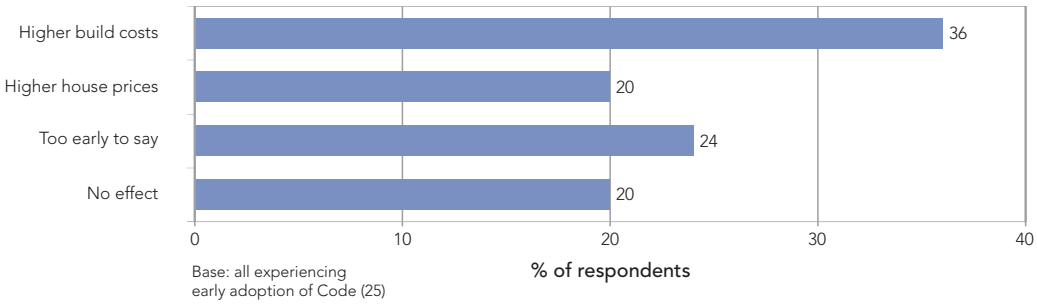


Figure 27 Main consequences of early adoption of Code levels.

"It makes these sites far less profitable for us. The figures for the land purchase have already been agreed and we are having to add costs in for the build. We're not sure if we'll get those costs back."

"This is already having a negative effect on land values and on our ability to make a scheme come to fruition."

"Authorities are trying to out-green each other and the effects are that it slows down the planning permissions and reduces the number of houses built each year because of the added complexity."

16.7 Attitudes to administration of the Code

Is the Merton Rule fair?

The Merton Rule [5] set a legal precedent which allowed individual local authorities to 'improve' or make more exacting planning requirements than laid down by statute. It is this ruling which local authorities are using to bring forward Code implementation dates.

Nearly all housebuilders (86%) consider it unjust that local authority planners can bring forward Code level requirements ahead of the nationally agreed dates, with just 13% considering this reasonable.

Is the current situation in homeowners' interests?

Housebuilders are nearly unanimous (94%) in their belief that homeowners' interests would be better served if all local authorities worked to the same nationally agreed dates.

Are planners the right people to be driving this agenda?

There is a widespread belief that the Code agenda is currently being driven by the wrong group of local authority professionals. There is a clear preference for the agenda to be driven by building control officers (79%) rather than by planners (17%) (Figure 28).

"I think it would be much better if the Code for Sustainable Homes was incorporated into the building regulations. The people who control building regulations are technical people, they know what they're talking about, they understand technology better than the local planners do. If you ask local planners the difference between renewable energy and reduction in carbon emissions, they wouldn't know the difference. The real goal which I think everybody is after is a reduction in carbon emissions, but the local authorities are often asking for renewable energy and the two do not mean the same thing."

"You can go out in the street and ask somebody would they like a house built to a higher environmental standard. They'd all say yes. You could say how much are you willing to pay for that and some people will say I'll pay 5%, I'll pay 1%. You take them into a show house and sit them down with their cheque book and you tell them they've got to pay £5000 or £10,000 extra for a house or they can move down the road and have the same house without the environmental specification for £10k less, you're going to lose an awful lot of your customers. I think that's a real issue and that is a problem with not having this agenda driven by building regulations."

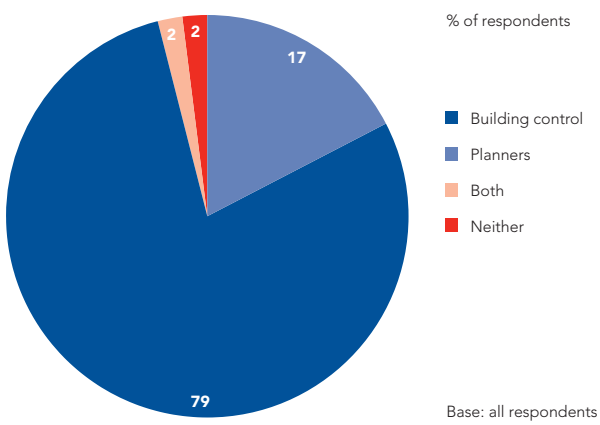


Figure 28 Professionals best placed to drive Code agenda.

16.8 Experience of the Code

Highest level of Code already built

At the time of the survey, about five months before all new homes were supposed to be built with a Code rating, less than a quarter of housebuilders have actually completed a Code level home for the private sector. The proportion is slightly higher in the public/social sector at about one-third. Figure 29 shows that in both sectors Code Level 3 is effectively the entry point, with few houses built to Levels 1 or 2, particularly in the private sector. Four builders have built to higher levels of the Code, one to Level 6 in the private sector. Smaller builders appear to have responded more quickly than larger builders in terms of actually building Code level homes.

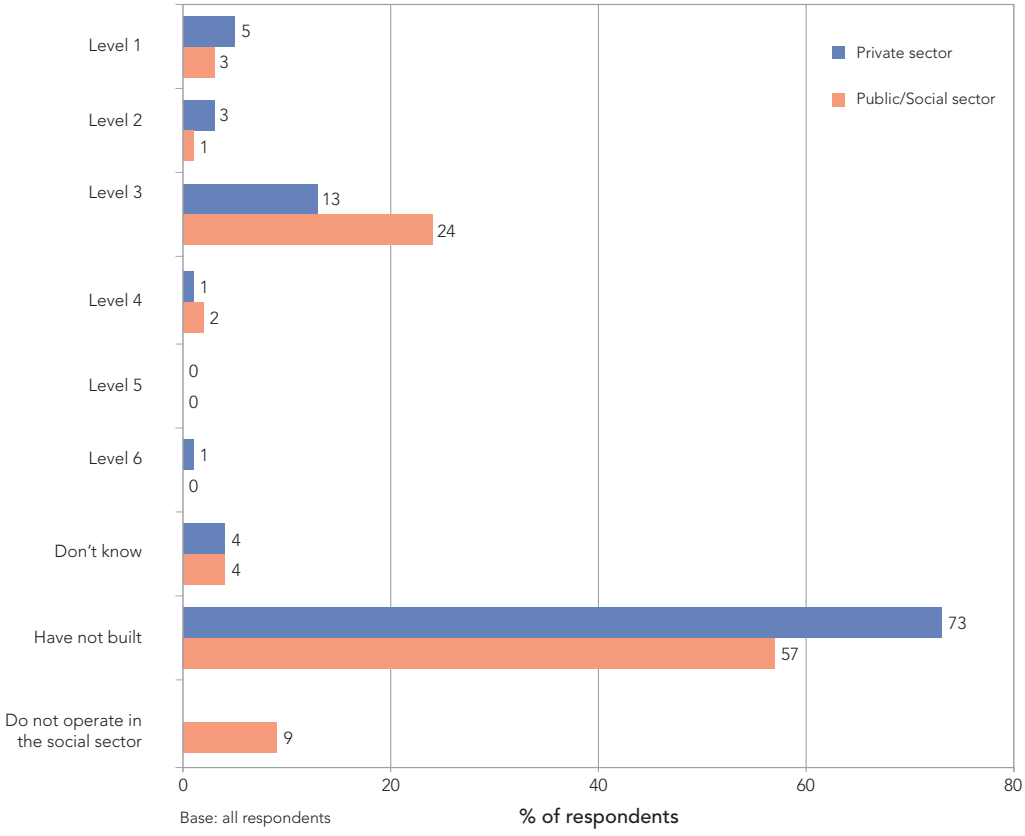


Figure 29 Highest level of Code built to date.

Highest level of Code at the planning stage

The proportion of housebuilders involved with planning to build developments to Code levels is substantially higher than the proportion who have so far actually built to this level (Figure 30). Almost half are planning Code level homes for the private sector and this rises to almost 60% for the social sector. Code Level 3 still dominates in the planning stages

but one in ten is planning Level 4 homes for the private sector and one in nine is doing so in the social sector. Eight builders are planning for the highest two levels of the code, including six working on zero carbon Code Level 6 developments. At the planning stage, the large builders are more likely to be involved than the smaller ones, going some way to reverse the trend seen in the previous section.

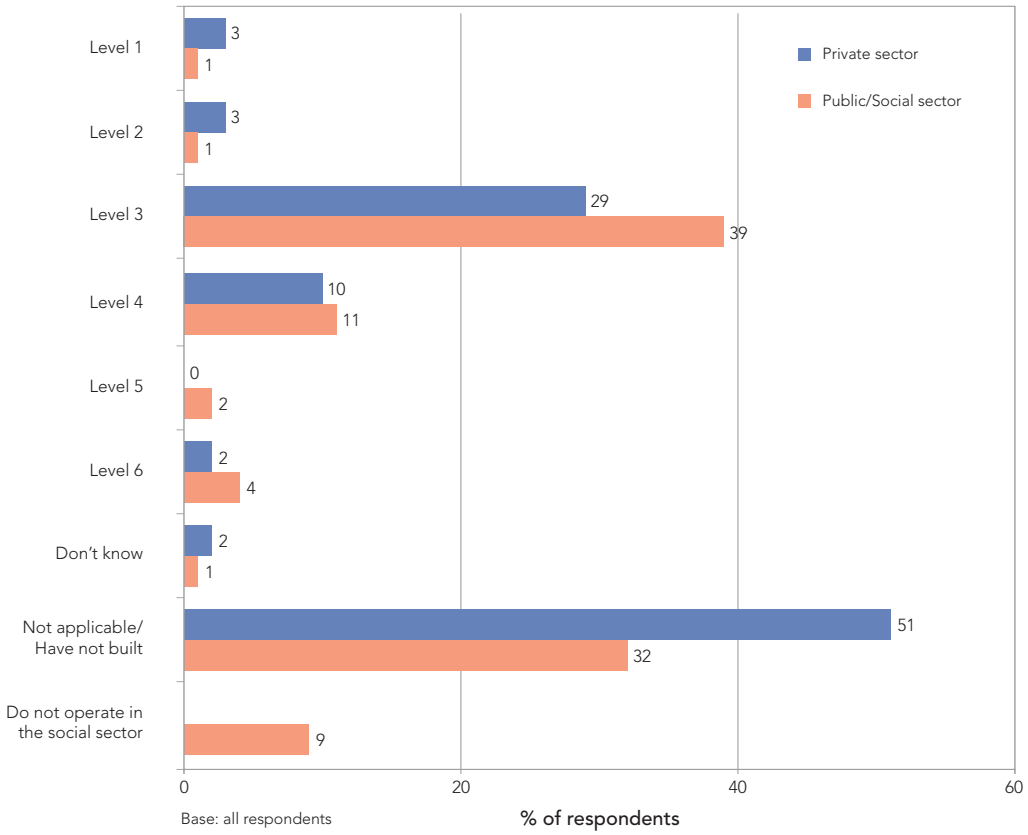


Figure 30 Highest level of Code currently in planning.

16.9 Estimated costs of implementing the Code for Sustainable Homes

Builders were asked to estimate, at 2007 prices, the additional build costs required for an average home to achieve Code Levels 3–6, compared to the cost of a modern home built to Part L of the current building regulations.

Figure 31 shows the average (mean) figures quoted by the builders and compares these to the figures published by CLG. The average values quoted for Levels 3–5 are very close to the figures published by CLG. This is not to say that the builders are simply repeating the government figures, as only a minority quoted the actual figure for Level 3 and none did so for Levels 4 or 5.

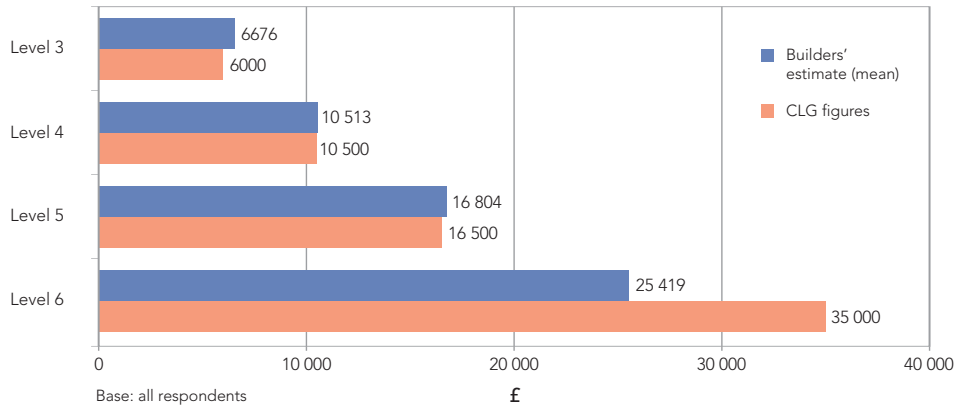


Figure 31 Estimated additional build costs of the Code for Sustainable Homes.

Perhaps because the majority have not yet built a Code level home, the average estimated additional cost for Level 6 is substantially lower than the CLG estimate. Evidence from the more informed respondents suggests that this is not the case. The large housebuilders quote substantially lower figures for Levels 3 and 4 but substantially higher figures for Level 5 and especially so for Level 6. Those with experience of having actually built Code level homes follow a broadly similar pattern, quoting lower than average figures for Levels 3–5 but higher figures for Level 6. The highest estimated additional cost for building a Code Level 6 home was £70,000, twice the CLG estimate.

16.10 Paying for the Code

After they had provided their estimates of the additional costs, the builders were informed of the CLG estimated values and asked how they expected the additional costs to be met.

TABLE 23

Meeting the cost of the Code

Decreasing land values	60%
Homebuyers	42%
Builders	29%
Don't know	2%

Base: all respondents

The majority view is that the additional build costs will be taken off the price builders are prepared to pay for land. Some 42% expect the homebuyer to have to pay more and over a quarter think that housebuilders will have to contribute financially.

It is not clear, however, that simply reducing the price paid for land will fund the cost of the Code, as this assumes that landowners are prepared to subsidise the cost of housebuilding. It is probable that many landowners would not sell their land if values fell. Even where landowners would still consider selling, there may be some areas where land values are too low to allow for the additional build costs to be extracted from the price paid for land.

> "That's great if you live in the South East and land values are £3 million an acre. If you're looking at some of the valleys in Wales or the industrial areas in England and Scotland, there's plenty of areas where you won't have that value in the land to start with. We have to build 20 houses an acre to meet planning requirements and let's say zero carbon costs £40,000 that's £800,000. If that land is worth £1.2 million now is the landowner going to accept £400,000 for it in a few years' time to pay for zero carbon homes? Or is he going to say 'Sod it, it's a fluke this, I'll wait for it to roll over'. If that happens you kill the whole property market."
>
> "It will basically drive down the cost of land, but then you'll probably find that the landowners won't sell, because it would take a huge chunk out of their margins."

16.11 Housebuilder confidence in building zero carbon homes by 2016

Comparatively few housebuilders are confident that they will be able to build a zero carbon home by 2016, from either a technical (26%) or commercial perspective (14%) (Table 24). Indeed, half (52%) are not at all or not very confident in their technical ability to do this and some 70% do not see how they will be able to build a zero carbon home profitably by 2016. Overall, builders have significantly less confidence in their ability to build a Code Level 6 home profitably by 2016 (mean score 2.0) than in their technical ability (mean score 2.6) to do this. Interestingly, those builders with past experience of having built Code level homes for the private sector (mean score 1.8) and the social sector (mean score 1.5) have much lower confidence in their ability to build a zero carbon home by 2016 than those whom have built neither (mean score 2.3).

TABLE 24

Confidence in building Code Level 6, zero carbon homes by 2016

	Technical ability (%)	Ability to build profitably (%)
Highly confident	14	6
Fairly confident	12	8
Neither confident nor not confident	21	15
Not very confident	24	25
Not at all confident	28	45
Don't know	1	1
Total	**100**	**100**
Mean score	**2.6**	**2.0***

Base: all respondents
1 = not at all confident; 5 = highly confident
* = significant difference

Those involved in the qualitative research indicated that it is the requirement to generate electricity onsite that is the real problem for delivery of Code Levels 5 and 6.

"We'd find it difficult to get to Level 6 by 2016. We can get to 3 or 4 with our current houses but we need an energy partner because 5 and 6 are all about generating electricity. So we need to form partnerships with energy service companies to develop district heating or private grid systems – these are things we've never done before."

"I'm not at all confident that we can make our existing product work to Level 5 or 6 of the Code. I just don't think it can be done. If we really have to go that far we will have to completely change what we are doing. We have a research and development team working on this and we're looking at all the options but it will be a year before we know how we're going to be able to get to Code Level 6."

16.12 Predicted effects of additional cost of the Code

In addition to its zero carbon aspirations the government announced a commitment to build 3 million homes in England and Wales by 2020 in the 2007 Queen's speech. This equates to 250,000 homes per year for the next 12 years, compared to the 160,000 built in 2007. Builders were therefore asked what effect (if any) the additional cost of building zero carbon homes would have on the housing market in terms of the following:

- number of units built
- speed of development
- supply/availability of land
- affordability of new homes
- profitability of housebuilding.

As Table 25 shows, on every measure the majority of housebuilders predict that the effect of the Code will be detrimental.

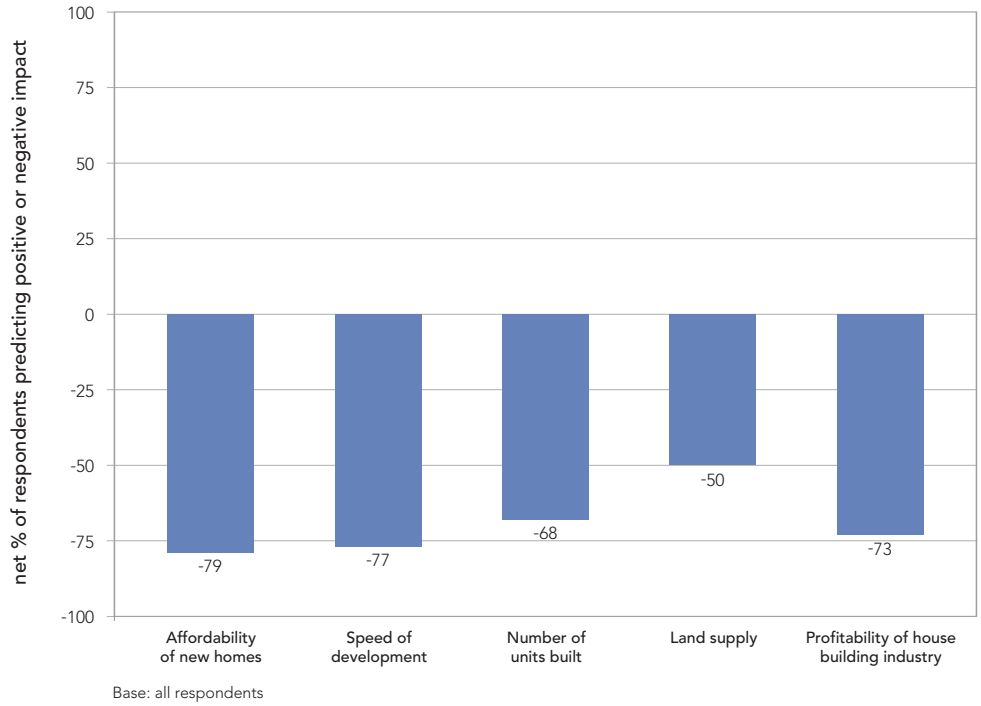
TABLE 25

Predicted effects of additional cost of the Code

	Code will have:		
	Positive effect	Negative effect	No effect
Number of units built	4%	68%	32%
Speed of development	1%	78%	19%
Supply/availability of land	3%	53%	42%
Affordability of new homes	1%	80%	17%
Profitability of housebuilding industry	1%	74%	24%

Base: all respondents

By offsetting the number of those thinking the Code will have a positive effect against those predicting a negative effect it is possible to create an index representing the predicted net effects of the additional cost. Figure 32 shows that on every measure housebuilders predict the net effect to be harmful to the government's stated aims of increasing the number of homes built per year, improving affordability and improving the speed of development. The worst effects are likely to be felt most keenly by homeowners in terms of reduced supply and higher prices.



Base: all respondents

Figure 32 Predicted net impact on housing market of additional Code build costs.

"It will stagnate the market as first time buyers won't be able to afford anything."

"Most people who sell land aren't short of a few quid so if they don't like what we offer they'll just say 'Okay we won't sell the land'. They'll sit tight hoping the whole thing blows over and the land prices recover."

"And then the demand for houses will shoot up, because the supply won't be there and that demand will drive prices up. So inevitably the on cost will go to the customers because they won't have any choice but to buy that house at the higher price."

17 Microgeneration technology

17.1 Definitions

Microgeneration is defined by the Department for Business, Enterprise and Regulatory Reform as 'the production of heat and/or electricity on a small-scale from a low carbon source'. In relation to zero carbon homes, microgeneration means a source of heat or power that is not drawn from a national grid (ie electricity or gas) and is low carbon (ie as far as possible using renewable energy sources such as solar energy, wind, biomass or thermal mass).

Working with this definition, the major housebuilders interviewed in the qualitative research suggested three different scales for the application of microgeneration technology in Code homes, which are described below. The three scales have different implications for planning, land use and the tenure of new housing and these are also discussed below.

Microgeneration for individual properties

Microgeneration at the individual property level is where the energy/heat is generated on the site of each property. This sits well with the typical freehold model of ownership – the generating equipment and supporting systems are on the homeowner's property and the homeowner is directly responsible for operation, maintenance and repair. There is concern, however, whether current microgeneration technology is efficient enough for these types of system to be compatible with the typical plot sizes possible under current planning guidelines for density. In other words, planning constraints may not allow sufficiently large plot sizes for enough microgeneration infrastructure to generate the energy/heat required by the property. The visual impact of the microgeneration infrastructure may also have planning implications – for example, how appropriate would 25 micro-wind turbines be on a development of 25 homes?

"The biggest problem is that to get to Code Level 5 we need 40 square metres of roof space, all south facing. You might get that on a large detached house but a lot of the houses we build now are three storeys, two and a half storeys or even two beds and they haven't got that kind of roof area. So where do you put the PV tiles to generate that amount of electricity?"

Community or development level microgeneration

This approach enables economies of scale to be exploited by installing a single larger energy/heat source, still on the footprint of the residential development, and a local distribution system. A typical example would be a district heating scheme in which a combined heat and power plant provides both heat and electricity for a community. There is no definitive information on the scale of development for which such a scheme is likely to be suitable but it is likely to be hundreds of units rather than tens. This sort of scheme would be more efficient in terms of energy generation and therefore cheaper than property level schemes. Operation, maintenance and repair will be co-ordinated so further efficiencies will result.

These cost savings would be offset, however, by the need for a local distribution system. A management company will be required to operate the microgeneration and distribution infrastructure and to own the property on which the infrastructure is situated. This would add to the costs and would probably require leasehold or commonhold tenure than freehold, which is likely to be less popular with homeowners. There is also the possibility that the properties adjoining the microgeneration technology may be subject to price blight in the same way that properties are blighted by overhead power cables, electricity sub-stations and mobile phone masts.

"We've done a biomass CHP scheme in London with two other builders. I'm told it's huge the size of a small industrial unit – and it needs a full-time caretaker employed at £20,000 per annum to get rid of all the ash. I can't see that it's very green when you've got 20 tonne trucks bringing loads in and out all the time"

Offsite, private-wired solutions

The third option is for an offsite, private-wired solution. This might be a large wind turbine situated not on the residential development itself, but on a nearby hill to maximize potential energy generation, or a combined heat and power station some distance from the residential development, for example in an industrial or commercial zone.

It was not entirely clear at the time of the research that offsite, private-wired solutions would be acceptable in the Code. The advantages are that they could use lower value land, reduce the potential for property blight and mitigate the planning impact of the residential development. But they will still require a management company, with its associated leasehold or freehold ownership, and planning concerns might simply be displaced to another location rather than removed altogether.

17.2 Overall microgeneration strategies

Housebuilders interviewed in the quantitative study were asked which of the three approaches they anticipate using for Code homes. One in eight does not yet know (Table 26).

Almost two-thirds expect to be using property level solutions including, not surprisingly, the smaller builders, especially those typically involved with developments of 20 or fewer units. Overall, some 44% are considering community/development level schemes and 27% offsite, private-wired schemes. Peer Group 1 builders, responsible for building the majority of homes in England, are most likely to be involved in the offsite and community schemes.

Around 30% of builders are looking at more than one overall strategy, with 36% looking only at property level schemes, 15% looking only at development sized approaches and 7% looking only at offsite solutions.

TABLE 26

Overall microgeneration strategies	
Individual property level	64%
Community/development level	44%
Offsite private-wired	27%
Don't know	12%

Base: all respondents

17.3 Microgeneration technologies considered

Practically all builders (97%) have given some consideration to which individual microgeneration technologies they might employ in Code homes. Solar thermal, photovoltaics and ground source heat pumps have been most commonly considered, with each mentioned by at least three-quarters of the nation's housebuilders. Around half have looked at air source heat pumps or combined heat and power (CHP) plants using gas or biomass fuel. Wind power and passive solar are the technologies housebuilders are least likely to have looked at, each mentioned by about 40%. The former is perhaps surprising given its high profile in the media, and in the public's consciousness, but is indicative of the fact that builders are clearly looking seriously at which technologies are likely to be feasible.

> "We were advised by three consultants that the wind turbines that go on a house are only efficient where you've got a wind speed of seven metres per second and about the only place you can get that is on Ben Nevis. So unless we all put our houses on Ben Nevis, it's a bit of a dead loss."
>
> "You've got to have an adequate wind profile and a suitable location, the turbulence distances for wind turbines are very large, 75 metres for a domestic scale turbine. So if you've got another house within 75 metres of it, it'll affect that turbine, so it makes it quite difficult."

17.4 Microgeneration technologies most likely to be employed

Figure 33 shows the microgeneration technologies that housebuilders have considered for Code homes and those which they are most likely to use. There appear to be four front-runners in terms of builder preferences: solar thermal, photovoltaics, ground source and air source heat pumps.

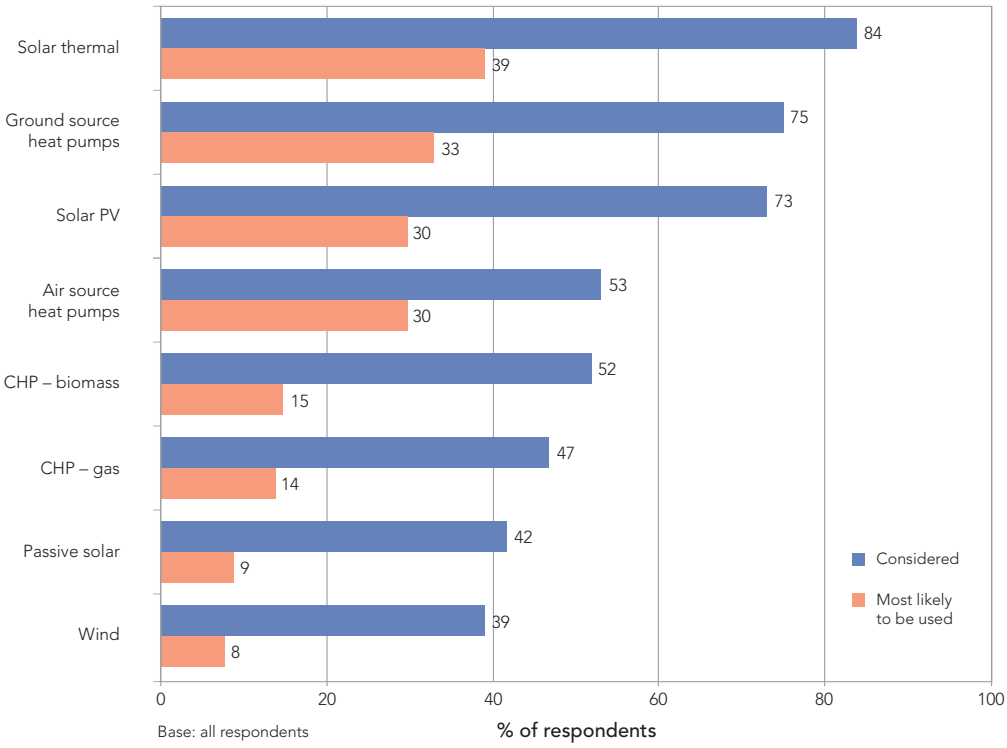


Figure 33 Microgeneration technologies most likely to be employed.

Next come CHP units. Although not likely to be used by as many builders, CHP – biomass units are preferred by the larger, Peer Group 1 builders and so may actually become more prevalent than some of the apparently more popular technologies mentioned above.

Fewer than one in ten builders expect to employ wind or passive solar technology for Code homes.

17.5 Confidence in microgeneration technology

Builders were asked to express their confidence in the ability of the microgeneration industry to deliver the required levels of energy/heat required for Code Level 6 zero carbon homes by 2016, on a scale from 1, meaning not at all confident, to 5, meaning highly confident.

Only a quarter expressed any degree of confidence in the technology delivering in time, with a third ambivalent and over 40% either not very or not at all confident (mean score 2.7) (Table 27).

TABLE 27

Confidence in ability of microgeneration technology to deliver by 2016

Highly confident	8%
Fairly confident	16%
Neither confident nor not confident	33%
Not very confident	26%
Not at all confident	16%
Don't know	1%
Total	**100%**
Mean score	**2.7**

Base: all respondents

1 = not at all confident; 5 = highly confident

"We're steering clear of it. None of it works does it? We've not come across anything that works. A lot of it has been taken off the market because it doesn't work. Some manufacturers are holding things back from the market because they're not sure they work."

"We have two micro CHPs on trial but all our research on this has stalled for 12 months because the manufacturers withdrew their devices because they didn't work. And it's only a short-term fix anyway, isn't it? It's a grey area as to whether it has a long-term future because it runs off gas which is a fossil fuel."

17.6 Main concerns about microgeneration technology

Figure 34 shows the main comments housebuilders made spontaneously when asked if they have any concerns relating to microgeneration technology. Overall, some 85% expressed concerns, with some raising several issues. The main concerns relate to the cost of the technology, its reliability, servicing and maintenance and the availability of the technology, ie whether a supply chain exists to deliver the required volume.

"We've been quoted £7500 for 10 square metres of PV roof tiles. We reckon we'd need about 40 square metres to get to Code Level 5, so just the PV roof tiles themselves are going to take you up to £30,000."

"There are so few manufacturers out there producing what we need."

"I am concerned that there just isn't enough technology out there to cope. When we all start placing orders I think there are going to be real problems getting the stuff manufactured and delivered. The lead times will be long whereas now we can arrive on site one day and get materials delivered the next day."

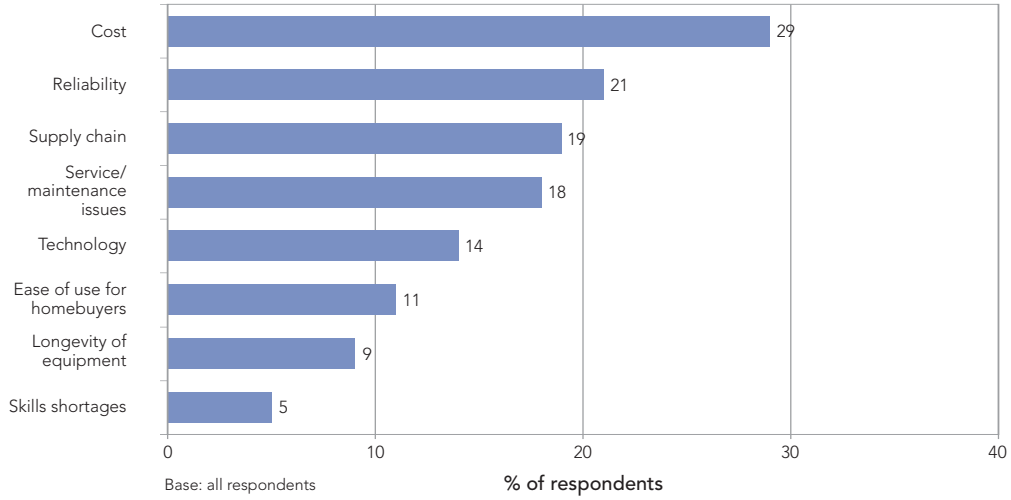


Figure 34 Main concerns about microgeneration technology.

Housebuilders are also worried about the extent to which homeowners will be able to understand and use the technology appropriately and about how long it will last. Given the complexity of using it, questions over reliability and the high cost, some builders question how long homeowners will live with the technology that goes into high level Code homes.

> "We don't know how long the technology will last. Take the PV roof tiles, if you say they have a lifespan of fifteen years and you were coming to buy a house which is seven years old with £30,000 worth of PV tiles on the roof, would you buy that house or not? PV roof tiles might save you £300 a year in electricity, but it's going to cost you £30,000 to replace all your PV tiles. I don't think the purchasers will replace those tiles so they will become redundant. There's nothing in the code about the second hand market."
>
> "And there's very little incentive for selling the electricity to the grid. They sell you mains electricity at 11 pence per kWh but they only buy renewable energy from you at a rate of about 2 pence per kWh."

Those involved in the qualitative research raised the issue of the space required for microgeneration technology.

> "If you did the solar water heating, you wouldn't be able to put any PV roof tiles on, so therefore it wouldn't generate any electricity. The key to Code Level 5 is actually generating electricity, so solar water is snookered, because you need the roof space for your PV tiles to generate electricity."
>
> "The houses at BRE have PV tiles on the walls because they haven't got enough roof space, but that won't work with terraced houses and you won't get planning permission for every home to be detached."
>
> "We're all doing masterplans now that avoid grids but you'd need a grid for PV to work."

Concern was also expressed by builders during the qualitative research that customers have no real awareness of or interest in microgeneration.

> "Virtually nil I'd have thought. No-one has asked us about it and I know that for a fact."
>
> "It's one of those things that you hear about and people find of interest and a good idea but if they really understood they'd be more concerned about the actual cost of it, the infrastructure and the long-term maintenance and running costs."
>
> "One of the builders offered solar heating to customers as an extra if they wanted it and they've been doing that for a year across all the developments. They hadn't had one uptake on that. I imagine the reason for that would be the cost for that compared to the amount of money they would save on their bills, the figures don't add up."

18 Thermal efficiency and airtightness

18.1 Structural materials

The main building envelope plays a major role in the thermal efficiency of a new home. The qualitative research revealed that housebuilders are considering four main structural technologies, which are discussed briefly below.

Traditional brick and block

Brick and block construction is commonly used now, with an insulated cavity between the inner and outer leaves, so is likely to be popular with homeowners and builders alike. The inherent thermal mass regulates temperatures inside the structure more efficiently than lightweight materials. The disadvantage is that it can be difficult to achieve the high levels of airtightness required using conventional techniques in the challenging environment of a traditional building site.

> "I see brick and block as being important because I do think cooling and thermal mass will be an important part of climate change – probably the most important – and the tests we've done so far suggest a high mass house will be 6–8°C cooler than the outside temperature compared to a lightweight system house in the summer."

Panel system masonry

Panel system masonry looks superficially like traditional brick and block and uses similar materials. An advantage is that the panels are manufactured in the controlled environment of a factory. Defects are less likely to occur and more likely to be rectified before erection. The disadvantage is that this remains a novel approach for homeowners and builders alike. Costs of transportation in both monetary and CO_2 terms are likely to be higher than for lightweight systems. But the mass of this sort of structure, like traditional brick and block, provides good thermal mass to retain heat in the winter and slow down the unwanted absorption of excess heat in the summer

Timber/other frame

A timber or other lightweight frame carries the structural loads with partition wall panels and cladding used to infill and create the building envelope. This form of construction uses sustainable materials and costs of transportation are lower due to its lower mass. It can be highly effective at retaining heat if highly insulated and the build costs are relatively inexpensive due to the speed of assembly. However, it can be difficult to control excessive heat build up in the summer due to the highly insulated nature of the construction, the lack of thermal mass and high degree of airtightness resulting from the close tolerances achieved in offsite manufacture. Technological interventions may therefore be needed to maintain a habitable temperature in warm weather.

> "We have had 50% failure rates on air leakage using traditional construction and I think that is pretty standard but we can get a 100% pass rate on timber frame houses."

This is a proven technology in Scotland and elsewhere in Europe and is familiar to most of the volume housebuilders, some of whom already own their own manufacturing facilities.

The credibility of timber frame construction among homeowners in England and Wales was severely, and perhaps unfairly, damaged by a single episode of the TV documentary series World in Action in 1983. The programme alleged that timber frame construction was not a sound method because of failings in a particular group of timber framed houses in south west England where the envelope had failed, allowing ingress of water and subsequent damage to the timber structure.

The credibility of timber frame construction for multi-storey buildings, eg flats, was further damaged by a severe fire at a large timber frame building under construction on a site at Colindale in north west London in July 2006 which destroyed the whole structure in minutes. Concerns centre not on the viability of the technology in use but on the health and safety of the workforce and the security of neighbouring properties during building.

> "Colindale has put the timber frame industry back 20 years in terms of large buildings. What was it – less than 10 minutes from ignition to a complete inferno? I'm a carpenter by trade and if I had been on that roof I wouldn't have had a chance of surviving, no-one would. You are basically sitting on a big bonfire."

More fire resistant materials such as lightweight steel or even precast concrete can be used for the structural framework in place of timber although neither are commonplace in the UK housing industry.

Lightweight panel systems

Like timber frame, lightweight panel systems use lightweight structures and (usually) sustainable materials, so are likely to score well on the Code criteria. The panels fit together in modular fashion, forming the building envelope and carrying the structural loads. Also like timber frame houses, they are largely manufactured offsite and assembled onsite so high levels of conformity/quality control should be possible in terms of airtightness. They are less familiar to both homeowners and builders than timber framed homes and perhaps less adaptable due to the often complex combinations of materials and membranes used in the panels.

18.2 Structural materials considered for high level Code homes

Introduction of the Code is clearly stimulating a radical re-appraisal of the fundamental materials from which new homes will be constructed. More than three-quarters of housebuilders have considered timber frame technology, slightly ahead of the 70% still thinking about traditional bricks and blocks. Around 40% have looked at lightweight panel systems, with a quarter considering panel system masonry, although the latter is being considered by a higher proportion of the large, Peer Group 1 builders.

Many builders are clearly pursuing several lines of enquiry at the moment, with 13% looking at all four materials, a quarter considering three and a further quarter considering two. Small builders are most likely to be restricting their outlook to one material.

18.3 Structural materials most likely to be used in high level Code homes

Figure 35 shows that, while housebuilders are open to considering relatively new technologies such as panel system masonry and lightweight panels, they are most likely to use existing and established technologies when actually building high level Code homes. Over half said they were most likely to use timber frame, with slightly under half expecting to use traditional masonry. Smaller numbers expect to be building using lightweight panel systems or with prefabricated masonry panels.

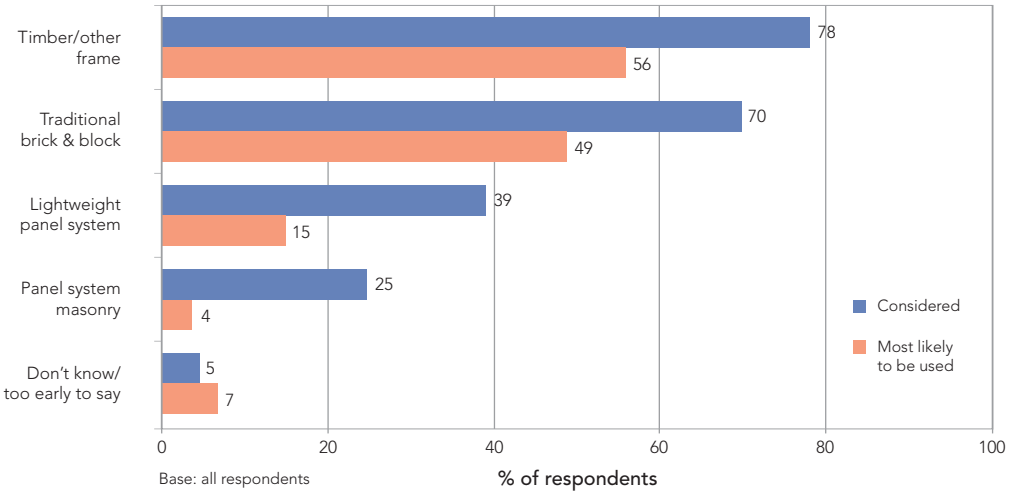


Figure 35 Structural materials for high level Code homes.

The builders' apparent conservatism was echoed by homeowners, both when visiting BRE's Innovation Park as part of the qualitative research and in the main quantitative research. A further concern is the effect that material choice will have on space requirements. Some materials are thought to require as much as 50 mm additional depth of insulation in each external wall so that plot sizes may need to increase to provide the same internal floor space as existing new homes.

18.4 Confidence in ability to build to high levels of airtightness

A standard for air permeability was introduced into the building regulations in April 2006 to control air leakage from buildings. Part L2, 'Conservation of fuel and power' [7] stipulates that all buildings with a floor area of more than 500 m^2 must pass airtightness performance testing and that homes will be subject to sample testing. The current minimum standard is a permeability or leakage rate of 10 $m^3/h/m^2$ (ie cubic metres of air lost per hour per square metre of floor) at 50 Pa.

Controlling airtightness is seen as a key plank in the strategy for reducing the heat lost from domestic buildings and therefore reducing CO_2 emissions. Code homes have airtightness standards, with the figure for a Code Level 6 zero carbon home being 3 $m^3/h/m^2$ at 50 Pa.

Builders were asked how confident they were that they would be able to meet the Level 6 airtightness figure by 2016. Builders appear significantly more confident in their ability to meet airtightness requirements in the Code (mean score 3.6) than they are in their technical ability to build a complete zero carbon home (mean score 2.6) and in comparison to their confidence in microgeneration technology (mean score 2.7). Overall, some 61% are either highly or fairly confident that they will be able to meet airtightness requirements (Table 28). A note of caution is warranted, however, as the builders most confident of their abilities with respect to airtightness are those who had not actually built any homes conforming to Code standards at the time of the research.

TABLE 28

Confidence in ability to build to levels of airtightness required in zero carbon homes by 2016

Highly confident	31%
Fairly confident	30%
Neither confident nor not confident	14%
Not very confident	14%
Not at all confident	9%
Don't know	2%
Total	**100%**
Mean score	**3.6**

Base: all respondents

1 = not at all confident; 5 = highly confident

18.5 Concerns about high levels of airtightness

More than four out of every five housebuilders expressed concern about the high levels of airtightness in a high level Code home (Figure 36). Their primary concern is whether they will be constructing a healthy environment, both for the homeowners living in it and in terms of the fabric of the building.

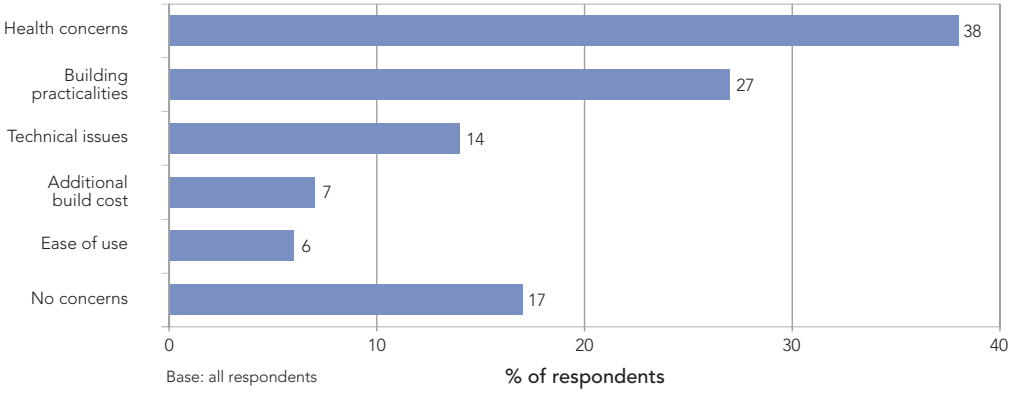


Figure 36 Main concerns about building to high levels of airtightness.

Some 38% expressed concerns about health, the main ones being the lack of ventilation and the resulting potential for condensation. Some went further to question what the air quality would be like, whether damp and mould would form and whether the overall environment in a highly airtight home would lead to a rise in chronic respiratory conditions such as asthma.

> "The environment that you create when you are putting in more insulation and sealing up the property for air leakage will be one of stale air. People in Canada with asthma had problems with this a few years ago."
>
> "We'll have to install mechanical ventilation systems because once we get air leakage down to such a low level the air quality will become relatively poor."

One in four builders are concerned about the practicalities of actually building to high levels of airtightness, in particular whether the skill levels in the industry are sufficiently high to consistently achieve good performance in this area.

> "Failure is my biggest concern. We can't do the final test until the house is finished, up for sale and with people ready to move in. I worry about what happens when we test the house at that stage and it doesn't work."

One in seven mentioned technical challenges, such as the complexity of ensuring adequate ventilation to meet building regulations, the lack of suitable technology, the increased potential for buildings to overheat and the heightened requirement that will exist for maintenance of ventilation systems.

"What happens as and when it breaks down? I doubt they will be maintained properly by homeowners or left running all the time."

"We're looking at buying a second-hand house and we know that the housebuilder originally put in extractor fans to take the condensation away from the wet areas. Three out of the four fans do not work and the current owner hasn't bothered replacing them. He just opened the windows and I think that's what will happen with some of the new technology."

"I do have issues with the levels of insulation the Code is seeking. If we are designing buildings for solar gain so that we benefit from the heat from the sun and then sealing and insulating the building so the heat can't escape we are in danger of creating a very uncomfortable environment in the summer. It is already an issue in some of our developments now and they're not even Code Level 1. The reality is that we might have to start putting air-conditioning units in and that will obviously use lots of energy which seems ridiculous."

19 Water conservation

19.1 Awareness of average daily per capita water usage

Nearly all housebuilders (91%) are aware that water use in the home is covered by the Code.

Few, however, have an accurate idea of how much water the average person in Britain uses per day, indeed only 16% were able to answer correctly (150 litres). Over a quarter could not even offer an estimate and most of the answers provided were underestimates. The mean figure given by housebuilders was 135 litres per person, 10% below the actual figure. Those with previous experience of building Code homes were likely to overestimate and those without this experience were likely to underestimate.

There is, however, better awareness of the target figure for daily per capita water use in a Code Level 6 zero carbon home, with almost twice as many (30%) providing the correct answer of 80 litres. Again, the majority of the remaining answers were under-estimates leading to a mean figure of 70 litres (Table 29).

TABLE 29

Awareness of average daily per capita water usage

	Current usage (150 litres)	Target usage (80 litres) for Code Level 6 (2016)
Correct volume	16%	30%
Lower estimate	44%	41%
Higher estimate	12%	13%
Don't know	28%	16%
Total	**100%**	**100%**
Mean estimated volume (litres)	**135**	**70**

Base: all respondents

19.2 Confidence in ability to build low water usage home by 2016

Overall, the builders are fairly ambivalent about their ability to build a home that would restrict water usage to 80 litres per person per day by 2016. Almost 30% gave a neutral response, with a similar proportion only fairly confident (Table 30). Comparatively they exhibit greater confidence in relation to water conservation (mean score 3.3) than they do in relation to microgeneration (mean score 2.7) but less than for airtightness (mean score 3.6). Again, those builders who have not actually built to Code standards expressed greater confidence in their ability to meet water usage guidelines than builders who have completed Code homes.

TABLE 30

Confidence in ability to build a home that will reduce daily water consumption to 80 litres per capita by 2016

Highly confident	17%
Fairly confident	30%
Neither confident nor not confident	28%
Not very confident	15%
Not at all confident	10%
Total	**100%**
Mean score	**3.3**

Base: all respondents

1 = not at all confident; 5 = highly confident

These findings reinforce those of the qualitative research in which builders expressed the view that consumer acceptance of such a reduction in water usage is the main challenge relating to the water conservation aspirations of the Code. The technical challenges, while not insignificant, are considered less difficult to overcome than those in the microgeneration field.

> "I think this is a major issue and it's going to be a real humdinger of a story to tell to your purchasers. I would guess the most popular option we offer customers is a power shower. We can put flow meters on showers to reduce consumption but how long is it going to take the purchaser to go down to B&Q and get a bit of pipe to replace the flow meter?"
>
> "Customers will be very disappointed with the flow rates for showers and baths."
>
> "People still want to use more and more water but we'll be giving them showers that let them use less and we'll be adding a yearly maintenance cost for the rainwater harvesting system. They'll be changing the taps and showers after they've moved in to get what they want. They'll just rip them out and there's nothing to stop them."
>
> "A power shower is one of the single biggest things we can do to sell a house easily."

Most housebuilders already install low-flow taps, dual flush toilets and water-efficient washing machines and dish washers. Some include water butts for the garden. None have gone beyond these measures other than on an experimental basis.

Housebuilders specialising in flats have an advantage in that they are more likely to have rainwater attenuation schemes in place as a high proportion of their site is covered by hard surfaces. They plan to use larger such systems to provide the water for toilet flushing and perhaps for communal facilities. Developers of flats also already have leasehold arrangements in place so that servicing and maintenance will be less of an issue. There are concerns, however, about the reaction from the water companies to the need for rainwater tanks to be replenished from the mains when there is no rainfall, as this will introduce a potential source of contamination to the mains system.

19.3 Water conservation systems

As with microgeneration technologies, water conservation systems can be planned either at the individual property level or at a larger community/development size to achieve

greater economies of scale. The two main technologies involved are rainwater harvesting and grey water recycling. Neither would be suitable for uses where potable water is required (eg dishwashing, drinking, food preparation, hand washing, showers and baths). Respondents were therefore asked to comment on the suitability of rainwater and grey water for the most likely domestic applications (toilet flushing, outside use, clothes washing).

Rainwater harvesting

Rainwater harvesting is the collection of surface water run-off which would otherwise be discharged to drains, soakaways, Sustainable Urban Drainage systems (SUDs) or water courses. The obvious source of rainwater in the domestic setting is the downpipe leading from the gutters draining the roof area. The accompanying homeowner research provides evidence that consumers are more receptive to the use of rainwater in the home than grey water, largely because it does not have the 'yuck!' factor. The simplest application will require collection and storage infrastructure and a pump to transport it out of the storage tank into the house. Simple coarse screening to remove particulates would probably provide adequate water quality. Rainfall in Britain is variable, however, and the UK has less water available per person than most other European countries. London is drier than Istanbul and south east England has lower per capita rainfall than Sudan and Syria [22]. Unreliability of supply is therefore a risk with rainwater systems.

Much effort is being made to better manage the drainage of surface water from other hard, impermeable surfaces in the domestic setting such as driveways, roads, pavements and patios. Such initiatives mostly have the aim of attenuating the risk of flooding by increasing the permeability of these surfaces and the amount of run-off into the sub-soil or into urban balance ponds rather than into water courses and the sewerage system. Diverting some of this water into community level rainwater recycling schemes might provide additional sources of rainwater but would probably also require more water treatment facilities to cope with contamination from roads, pavements etc. Large-scale collection of rainwater for recycling may compete with SUDs for land use in densely developed areas.

Grey water recycling

'Grey water' is commonly defined as household wastewater that has not been contaminated by toilet discharge. It includes wastewater from baths, showers, bathroom wash basins, clothes washing machines, sinks and laundry tubs. It comprises 50–80% of household wastewater, the remainder being toilet discharge ('black water'). Grey water currently appears a more reliable source of supply than rainwater. Its utility in this respect may decrease, however, as an unintended consequence of the reductions in mains water usage required in the higher level Code homes.

Grey water has greater health risks than rainwater as it 'still contains human faecal indicator bacteria in concentrations high enough to indicate a health risk from the potential presence of pathogenic micro organisms'. [23] This effectively rules out safe use of grey water in the home unless it is subject to ultra-violet filtration. Historically, individual homeowners do not have a good record of maintaining and servicing such filtration systems (23). Communal schemes may therefore be better from the public health perspective but would require a managing company and leasehold arrangements.

19.4 Overall strategy for water conservation systems

Half of the housebuilders interviewed in the quantitative study expect to be using property level water conservation schemes, with about a third looking only at community or development schemes. A further quarter are considering both at present.

19.5 Preferred water conservation technology

Rainwater systems (42%) are considerably more popular than grey water systems (15%) although some 38% are expecting to use both technologies (Figure 37).

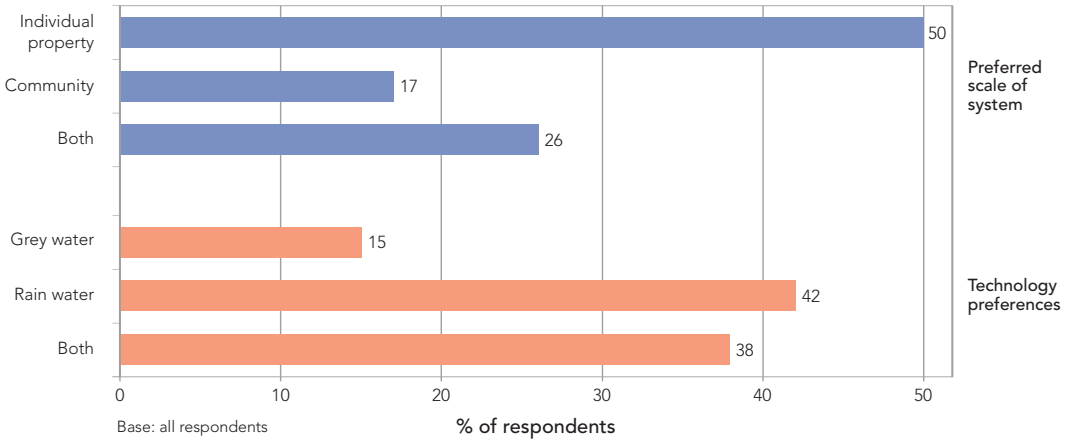


Figure 37 Overall strategies and technologies used for water conservation.

19.6 Concerns about water conservation systems

Figure 38 shows that two-thirds of housebuilders have concerns relating to water conservation systems. Their main concern is cost but they also have serious concerns about contamination, service and maintenance and consumer acceptance.

"It'll be a lot more expensive and the yearly maintenance of the rainwater system is another cost. We will avoid it like the plague until we have to do it because it is expensive and because customers don't want the hassle of the maintenance."

"Grey water is highly sensitive in many technical circles because of hygiene concerns. We're only looking at rainwater at the moment because of this."

"They've taken grey water out of the equation altogether in Belgium. We can't get people to maintain their central heating boilers as it is let alone maintain something that has grey water in it. These systems need looking after and my fear is that people just won't do it."

"Reducing flow rates in taps can result in the introduction of bacteria into pipes if the installation is not done properly."

"How are you physically going to stop people from flushing the toilet every time they use it or from having a long shower? You just can't do it."

Smaller numbers raised issues such as how proven the technology is, the space required and the life of the equipment.

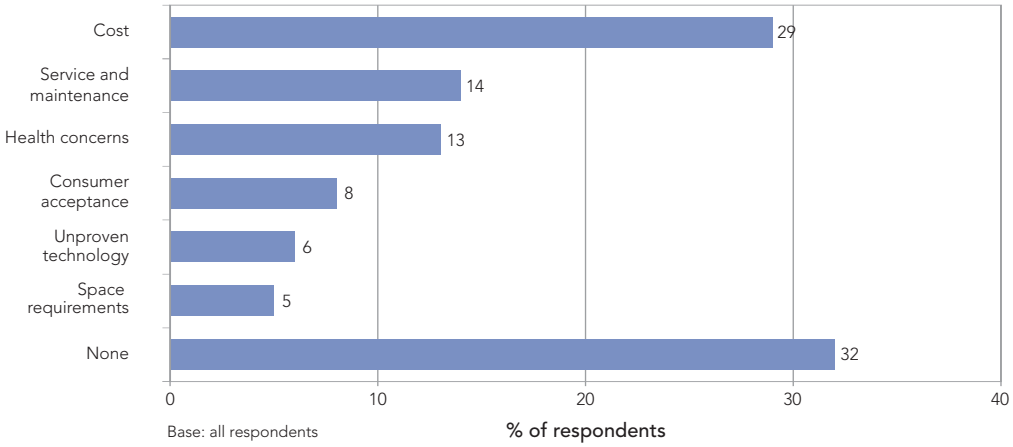


Figure 38 Main concerns about grey water and rainwater systems.

20 Consumer acceptance of features in Code homes

All builders were asked to comment on the extent to which they anticipate homebuyers will accept the features found in high level Code homes. Answers were given using a five-point scale from 1 ('not at all acceptable') to 5 ('highly acceptable'). For ease of comparison, answers are shown in Figure 39 in the form of mean scores.

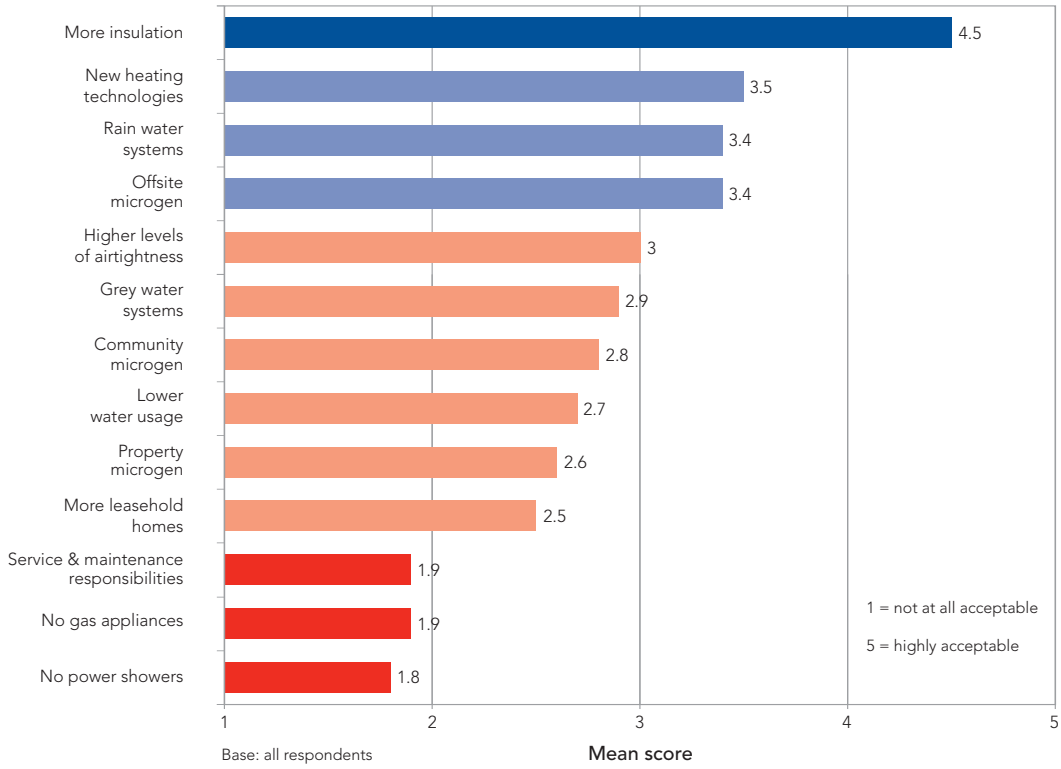


Figure 39 Builders' perceptions of consumer acceptance of Code features.

To aid interpretation further, the mean scores have been categorised in terms of acceptability, together with quotes made by consumers during the accompanying homeowner research:

Mean score 4.1–5.0 "Sounds good, marvellous."

- high levels of insulation

Mean score 3.1–4.0 "If it became the norm, I think you'd get used to it and it'd be fine."

- new heating technologies
- rainwater harvesting
- offsite microgeneration

Mean score 2.1–3.0 "Oh that's going to be so hard for me."

- airtightness
- grey water recycling
- community/development level microgeneration
- reductions in water usage
- property level microgeneration
- higher proportion of leasehold homes

Mean score 1.0–2.0 "No way, I wouldn't be interested in that whatsoever."

- additional service and maintenance responsibilities for microgeneration and water systems
- lack of all gas appliances
- lack of power showers

Clearly, housebuilders consider that few of the features of a high level Code home will be attractive to purchasers. These perceptions are based on their understanding of their customers' current needs and wishes when choosing a new home. These may change in time so that, by 2016, some of the features might have become more acceptable than they are at present. But for that to happen there clearly needs to be a substantial step-change in the purchasing criteria of homebuyers in the UK. It is this perception of homebuyer attitudes that is likely to limit the extent to which builders will voluntarily introduce aspects of the Code ahead of agreed national dates. A comparison between housebuilders' perceptions of consumer attitudes and consumers' actual attitudes can be found in the accompanying homeowner research (Section 9.1).

21 Alternative strategies to reduce carbon emissions

The nation's leading housebuilders were interviewed during the qualitative research. Several questioned whether enforcing the very tight timeline for the introduction of zero carbon homes by 2016 would actually be the most effective way of reducing total CO_2 emissions from the built stock. Their concerns are essentially pragmatic.

The technologies required to make a new home much more efficient in terms of energy use and heat loss are known, established and are not prohibitively expensive. The builders foresee no major problems building houses that would attain up to Level 4 of the Code. But at the higher levels of the Code, Levels 5 and 6, microgeneration is required and they do not believe that the technology is sufficiently developed for 2016 to be a realistic date for the introduction of the requirement to generate electricity.

That certain local authorities have pulled forward this date engenders a belief that these authorities simply do not understand either the technology or the economic realities of the housing industry. In short, such actions undermine the credibility of the entire Code agenda in the eyes of the industry tasked with delivering it. As a consequence, some might question whether the primary motive of those authorities bringing dates forward is the reduction of carbon emissions or whether this is actually a useful and PR-friendly mechanism that can be employed in the pursuit of other agendas.

Builders also consider the reduction in carbon emissions from a Code Level 4 to a Code Level 6 home to be relatively modest for the significant expenditure and complexity involved. The term 'zero carbon' is something of a misnomer in this respect. It does not, in the context of the Code, mean that a Code Level 6 zero carbon home will emit no CO_2. Rather it means that any emissions will be offset by energy or heat generated by that property. Thus a Level 6 zero carbon home is not truly zero carbon; a more accurate description would be carbon neutral. Given this, builders question whether the significant investment and expenditure required to achieve the 'zero carbon' label is in fact the best use of that money in the battle to reduce CO_2 emissions from the housing stock. Their

belief is that the investment required to take a Code Level 4 home to a Level 6 home would give far greater, and far quicker, returns in terms of carbon reductions if it was used to improve the existing stock.

In addition to the concerns that builders have about technology and about the return on investment at high levels of the Code (measured both financially and in CO_2 emissions), builders have concerns about consumer acceptance of the lifestyle changes that these high level Code homes will demand from homeowners.

Even if the builders manage technically to build and sell a Code 6 home, they have grave concerns whether the homeowners will learn to adapt and live with these lifestyle changes. Most believe that the homeowners will find it easier to adapt their zero carbon homes to meet their own expectations and lifestyles. In doing this they may not only make their homes less carbon efficient than a Code Level 4 home but also endanger their health in the process. There is nothing in the Code that prevents homeowners from adapting or changing a home built to Code standards after they have purchased it.

Several builders interviewed in depth suggested alternative strategies to the introduction of Code Level 6 by 2016. One is for the Code to be capped, for the time being, at Level 4 and for the resulting savings to be invested in improvements to the existing housing stock. The second is for a similar capping of the Code, until such time as Code Levels 5 and 6 are acceptable in technological, financial and lifestyle terms, and for the resulting savings to be invested in improving the sustainability of the existing electricity generation and supply network. This could mean either large-scale renewable energy plants or more localised renewable energy plants.

> "I would rather we stopped at Code Level 4 and then paid a levy of several thousand pounds per unit which could go to reducing the carbon emissions from the existing electricity generation system and developing practical renewable energy. If we're contributing £2000 per unit, 150,000 units a year that's £300 million a year, a billion in three years. That would have a much more significant effect on our carbon emissions. After all, there are 20 million dwellings in this country and all the government's efforts are focused on the 150,000 new build houses a year because it's high profile politics."

Builders interviewed in the quantitative research were therefore presented with three options and asked which they would support:

- full introduction of Code Level 6 homes by 2016
- capping the Code at Level 4 and investing the resulting savings in reducing carbon emissions from the existing housing stock by way of a sustainability levy
- capping the Code at Level 4 and investing the resulting savings in reducing carbon emissions from the existing electricity generation and supply system by way of a sustainability levy.

Figure 40 shows that there is only minority support from the housebuilding industry in England to fully introduce Code Level 6 homes by 2016. Seven out of eight builders interviewed would prefer to cap the Code at Level 4 and invest the resulting savings into reducing carbon emissions elsewhere, with a slight preference for investment in the existing power infrastructure.

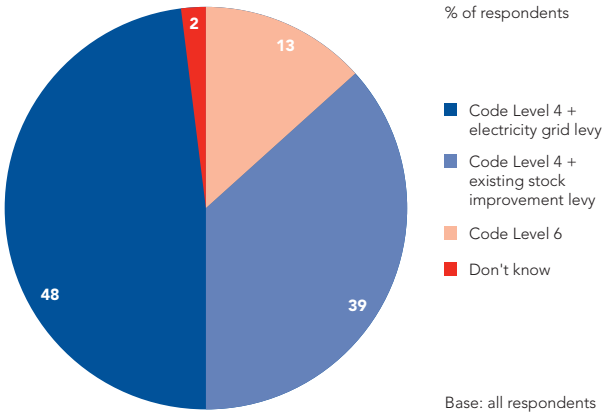


Figure 40 Preferred strategy for reducing CO_2 emissions from UK housing stock.

22 Further topics covered in the qualitative research

22.1 Lifetime Homes

Opinions were mixed about the extent to which homes built to high levels of the Code will be adaptable and able to meet the Lifetime Homes agenda [24]. This is "the incorporation of 16 design features that together create a flexible blueprint for accessible and adaptable housing in any setting. The Lifetime Homes concept increases choice, independence and longevity of tenure, vital to individual and community well being."

Some housebuilders do not see any difference between system homes and traditional build in terms of the ease of changing internal layouts through moving of non-load-bearing walls or building an extension. Others consider that homes built to higher Code levels will be considerably harder to adapt, in part because of the additional and complex services that the homes will have, and in part because of uncertainty about the consequences of changes to the building envelope on the building's thermal performance.

> "They are not adaptable. They will be so precisely engineered that any deviation from the original design will fundamentally affect the performance of the house. There will also be so many services involved that will be difficult to adapt."
>
> "I'd worry about that. Some of these spaces are not meant to be altered because there is a chance of thermally weakening the structure."

Others commented that, given the current planning regime, where few homes are built with a conventional unoccupied loft or have sufficient land for an extension, the Lifetime Homes agenda is academic in any case. This view reflects the belief that UK homeowners are far more willing to move than adapt their home in response to a major change in lifestyle.

"It's not a major issue because people have moving cycles which make a mockery of lifetime homes."

"It's not that much of an issue because they will just move. We have customers who are on their second or third purchase which is amazing."

"If you look at houses now, the way they're plotted, it's almost impossible to do an extension, all you can do is put a conservatory on the back maybe."

22.2 Lifecycle of materials

More of an issue is the expected lifecycle of the materials used to build the home. Most expect the structural elements to be good for the 60-year design-life currently in use. There is, however, less certainty about the new technologies needed to deliver the higher levels of the Code. One major builder in particular has concerns about the projected life of photovoltaic roofing tiles. The consequences are serious for the future marketability of the property and in terms of whether owners will bother to replace failing or failed technologies, given the costs involved. These views were echoed among the consumers, particularly those with first hand experience at the Future/Energy World developments as reported in Section 7.6.

22.3 Supply chain

Builders are not in a position to comment authoritatively on the strengths and weaknesses of the supply chain because none of them have tried to purchase large volumes of any of the technologies under discussion. The perception recorded in the qualitative research is that the supply chain is under-developed and would not be able to supply a large order quickly.

There are also concerns whether there would be enough skilled installers. Ease of installation is a concern, particularly with some of the microgeneration and water recycling technology.

"Some bits are easy, some are difficult. An aeration cartridge on a tap is easy but a 1500 litre tank into the ground could be very difficult. We are building more and more on brownfield sites and they could be contaminated. There could be a capping layer which we would breach putting the tank in."

22.4 Marketing and customer priorities

Few of the big housebuilders interviewed in the qualitative research make a significant play of energy efficiency when selling and marketing mainstream homes.

"We do educate our marketing people and tell them our homes are very energy efficient but the message doesn't seem to get through to the customer unfortunately."

For those operating in niche markets, such as retirement properties, energy efficiency and the low and predictable cost of heating and hot water can be a major attraction.

"Our residents are very concerned about it because a lot of them are coming from big draughty old houses with inefficient systems and we can prove that they will only spend about £5 a week on hot water and heating in one of our developments."

The qualitative research indicated widespread awareness of the inclusion of Energy Performance Certificates (EPCs) in Home Inspection Packs among the large builders and some awareness among Peer Groups 2–4. Most believe that this will increase the importance of energy efficiency in the marketing of new homes and will enable homeowners to easily compare the relative energy efficiency of new and secondhand homes. At least one major builder already has plans to ensure that its products will achieve a 'B' rating rather then the standard 'C' predicted for new build. Others consider that the EPC will help drive the carbon neutral agenda but that it will take some time to gather momentum.

The builders interviewed in depth believe that the key messages for 'selling' the zero carbon agenda to the consumer are global warming and financial savings from energy efficiencies. The problem with the financial savings message is that many of the measures needed for the Code do not make sense for an investor so they need to be combined with other potential benefits to the homeowner:

> "To get the energy savings, you spend more on putting in double glazing than you might actually save on the energy. Customers would say 'It's going to cost me £2000 to do that, I'm going to save £100 a year, therefore it's going to take me 20 years to get my money back and I'm only going to be here for 10 years'. So the customers wouldn't do it."

Energy efficiency was rated as the least important factor that consumers take into consideration when purchasing a house by all but one of the major housebuilders in the qualitative research (Table 31) and this finding was validated by the quantitative phase of the accompanying homeowner research (see Section 4.4).

TABLE 31

Builder perceptions of homeowner priorities

	Mean score
Design	5.0
Location	5.0
Character	4.8
Size	4.6
Parking	4.0
Garden	3.0
Energy efficiency	2.6

Base: all builders involved in qualitative research
1 = not at all important; 5 = very important

22.5 Builder information requirements

The large builders interviewed in depth consider that there is plenty of information available but that little of it is of an independent or authoritative nature. The difficulty is therefore in finding appropriate, trustworthy information. There is a deal of scepticism with regard to the information provided by microgeneration manufacturers.

> "There's lots and lots of information and a lot of it is of dubious content because it comes from the manufacturers and the people selling their wares. Lots of people out there will listen to B&Q and buy a wind turbine but people in the know are aware that they'll never generate enough electricity to even power the converter in the home let alone generate anything meaningful. We need a kitemark standard or an energy efficiency rating just as we have for white goods – a benchmark that will give confidence."
>
> "There's so much of it but we have to employ a consultant to make any sense of it because we don't have the time or the knowledge to make sense of it."

22.6 Skills training

Practically all of the major housebuilders involved in the qualitative research have concerns about the skills training that will be needed to ensure that zero carbon homes can be built efficiently by 2016. Their concerns do not relate just to the technological aspects such as the services but also to the fundamental shift in build quality that is required to improve airtightness. And this predominantly requires a cultural shift.

> "The trades are improving. We got air leakage down to about five and that came purely from educating the trades. It hadn't really cost us that much more, it was just training the trades that they need to be a little bit more careful every time they cut a hole, to make sure they seal it up well to reduce air leakage every time."
>
> "I think all of us if we are honest are concerned about the trades and that's without adding all of the complexity that's included in the Code. In this country we have relegated anything manual to the bottom of the heap. You can sit in front of a computer and earn a fortune as an IT consultant but someone who can physically build something is paid a fraction of that. We don't respect the trades and that's why we have the problems with not enough people coming into the trades and moving up through them."

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NHBC Foundation publications

A guide to modern methods of construction
NF1, December 2006

Conserving energy and water, and minimising waste
A review of drivers and impacts on house building
NF2, March 2007

Climate change and innovation in house building
Designing out risk
NF3, August 2007

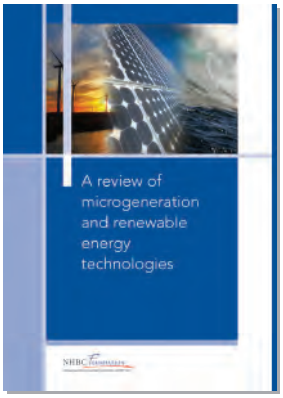
Risks in domestic basement construction
NF4, October 2007

Ground source heat pump systems
Benefits, drivers and barriers in residential developments
NF5, October 2007

Modern Housing
Households' views of their new homes

This review compares Modern Housing (homes built since 1991), older housing stock (pre-1991) and housing built between 2002 and 2004, using data from CLG's English House Condition Survey and Survey of English Housing. The review summarises the results and statistics from these surveys and provides a snapshot of households' views on their homes and neighbourhoods, including suggestions for potential improvements to future housing. Offering a powerful resource tool the review details information on topics as varied as satisfaction levels, demographics, spatial issues, safety and perceptions of neighbourhoods overall.

NF6, November 2007



A review of microgeneration and renewable energy technologies

The use of microgeneration and renewable energy technologies has been highlighted as one key approach in addressing the government's ambitious 2016 zero carbon homes target. With less than a decade within which to develop systems and processes to meet this target, and with strict definitions of zero carbon outlined in the Code for Sustainable Homes, the work needed cannot be underestimated. This review is, therefore, both timely and pertinent, assessing a variety of the current technologies for their likely capability, impact, payback periods and suitability for use in the domestic sector. In addition it reviews the legislative framework and the mechanisms local authorities are implementing to drive the uptake of these technologies.

NF7, January 2008

NHBC Foundation publications in preparation

- Hydraulic lime mortars
- Site waste management plans

NHBC FOUNDATION
Housing research & development in partnership with BRE Trust
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Zero carbon: what does it mean to homeowners and housebuilders?

This report presents the findings of a detailed survey of the views of homeowners and housebuilders on zero carbon homes, commissioned by the NHBC Foundation. It reveals the current awareness, understanding and attitudes of homeowners towards issues relating to climate change, the Code for Sustainable Homes, airtightness, water conservation and microgeneration. It also assesses where consumer priorities lie when purchasing a home and their views on energy saving mechanisms. The research also establishes the awareness, views and attitudes of housebuilders in relation to the zero carbon agenda, how this is being driven by the Code for Sustainable Homes, emerging technologies and strategies for carbon reduction.

NHBC Foundation
Housing research & development in partnership with BRE Trust

The NHBC Foundation has been established by NHBC in partnership with the BRE Trust. It facilitates research and development, technology and knowledge sharing, and the capture of industry best practice. The NHBC Foundation promotes best practice to help builders, developers and the industry as it responds to the country's wider housing needs. The NHBC Foundation carries out practical, high quality research where it is needed most, particularly in areas such as building standards and processes. It also supports house builders in developing strong relationships with their customers.

NF9
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