Pathway to zero-carbon homes

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Abstract
This paper looks at what is needed in technical and policy terms to reduce long-term carbon emissions from newbuild housing to acceptable levels.

The paper starts with an assessment of potential carbon emissions from newbuild housing to 2050, the date for which the UK Government has set a goal of a 60 % reduction in national carbon emissions.[1] This assessment shows that the contribution of newbuild emissions will be significant at current rates of build levels of performance.

The paper moves on to look at the need for a long-term vision, with a strategy, for moving to low-carbon newbuild housing as a requirement under Building Regulations. This strategy includes committing to the vision; initiating a co-ordinated research programme; and creating demand. Energy ratings, introduced under the European Directive on the Energy Performance of Buildings, are one of the tools required in this strategy.

A further key feature of the strategy is that it needs cross-Government and multi-disciplinary buy-in, covering potentially competing priorities, for instance: securing energy efficiency vs market transformation in microgeneration.

Introduction
New houses are being built in the United Kingdom on an ongoing basis. Far more houses are being built than are being destroyed, because of a range of demographic issues, including: an expanding population, the reducing size of family units, and the increasing desire by people to own their own, individual home.

The minimum energy performance of new homes is governed by the Building Regulations. Housing policy, including the Building Regulations, is devolved to varying degrees to the individual countries of the United Kingdom. However, the Building Regulations for Scotland and for Northern Ireland tend to be broadly in line with those for England and Wales. This paper uses the English policy context as the basis for discussion.

In December 2006, the Government announced a public consultation on its intention to require all new homes built in England and Wales to be "zero-carbon" by 2015/16, i.e.: within the next two or three iterations of the Building Regulations (DCLG 2006A). However, the term "zero-carbon" has yet to be fully defined. This announcement was accompanied by the launch of the "Code for Sustainable Homes," a six-star sustainability rating scheme for new homes (DCLG 2006B). The Code includes mandatory energy performance levels at each star. The aim is to allow independent, credible recognition and promotion of "sustainable" homes to the public at large.

These are very positive developments in the newbuild policy arena. However, they are just the beginning. The real task is actually to deliver the homes, on a scale of hundreds of thousands, using proven methods and technologies that are guaranteed to provide a safe, secure, desirable, and sustainable environment

1. This paper refers to carbon emissions, which is standard practice in UK climate policy. To convert tonnes of carbon (tC) to tonnes of carbon dioxide (tCO_2), multiply by 44/12.

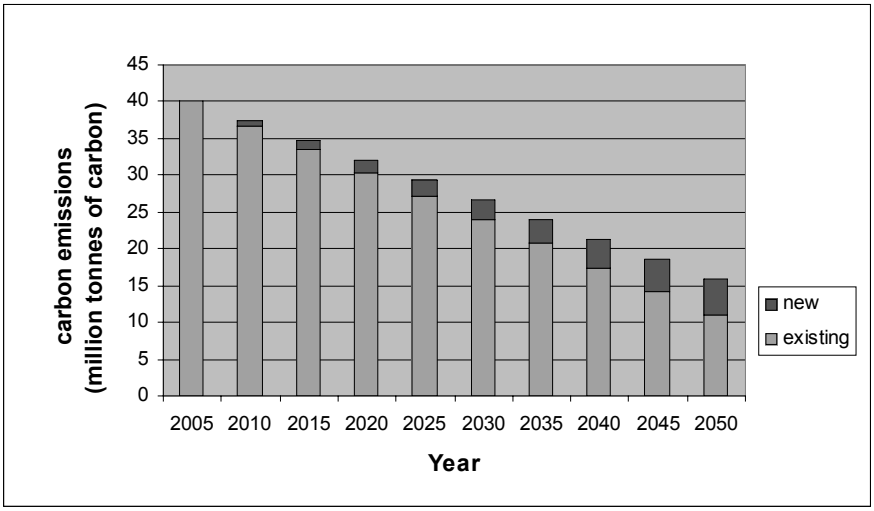


Figure 1: Reducing Carbon Emissions by 60 % from our Total Housing Stock

to the people living in them. This paper explores what is needed to ensure we are in a position to build these homes within the next ten years.

Newbuild Housing and Carbon Emissions

Newbuild housing is important for carbon emissions in the long term. In any one year, the number of new homes built accounts for less than 1 % of the UK's total housing stock. But by 2050, homes yet to be built – "newbuild housing" – will account for over one quarter of our total housing stock.[2]

Every new home built, although far more efficient than the average existing home, is still adding to our carbon emissions. This is at a time when the Government has committed to putting the UK on a path to reduce its carbon emissions by 60 % by 2050, with real progress by 2020.[3]

Household energy use accounts for a large proportion of the UK's carbon emissions, at 27 % of the total. This means that significant emissions reductions will need to be secured from this sector. Although no sectoral targets have been set to 2050, this report assumes that the housing sector will play its equal share of carbon emissions reductions, i.e.: of the order of 60 %.[4] Within this framework, there is trade-off, i.e.: the more we reduce emissions from our new stock, the less we need to do on existing stock, and vice-versa. This is shown in figure 1.

This report does not set out to assess what can be achieved in the existing stock. The Energy Saving Trust believes this should be the subject of the Review of Existing Buildings.[5] However, it is obvious that a 60 % reduction in carbon emissions from our existing housing stock is already a challenging target, and to make it even more so by not seeking to mitigate the emissions from newbuild would seem unwise.

In fact, the relative benefits of improving the performance of existing stock as against that of newbuild need to be assessed on the basis that we have to reduce our emissions by around 60 %. So the costs of improving newbuild need to be compared with the costs of improving the existing stock beyond 60 %, including so-called "hard-to-treat" homes with solid walls and off the gas network. It is not appropriate to compare newbuild costs with those of the most cost-effective refurbishment measures, which are just the first step in a long-term strategy.[6]

➡ Newbuild and existing stock emissions need to be considered together on a long-term basis, and the costs and benefits of reductions in newbuild need to be compared with the costs and benefits of reducing emissions from the existing stock by beyond 60 %.

For newbuild, as for any area, it is difficult to forecast as far into the future as 2050. In order to assess the carbon contribution of homes we are yet to build, we need to make a number of assumptions. These cover both what we build – for example: the number of homes, the size of homes, the construction type of homes, demolition rates and strategies – and also the wider context in relation to energy, for example:

- the heating regimes in the homes we build
- appliance energy use
- the grid energy mix (i.e.: carbon content of electricity)
- changes in climate

The scenarios that follow are based on simple modelling. The modelling is not an academic piece of work, nor does it use cutting edge methodology; these are not needed to establish the overall direction of travel. Rather, it is a top-line overview of newbuild carbon emissions, and how these can be reduced in practice.

Although nobody any longer suggests that we should stop improving the performance of our newbuild housing stock altogether, figure 2 usefully illustrates the contribution that new-

2. ECI: "40 % House," Environmental Change Institute, 2005

3. DTI: "Energy White Paper: Our Energy Future – Creating a Low-Carbon Economy," 2003

4. The contribution from the household sector to emissions reductions could be less or could be more. – Given ongoing increases in emissions from the transport sector, there is an argument that other sectors such as housing will need to reduce their emissions by more than 60 %.

5. The Review of Existing Buildings was announced by Government in autumn 2005.

6. Suggestions of new "carbon neutral developments" by trading off with existing housing lend no additionality, because that existing housing will still need to be refurbished until it is 60 % better.

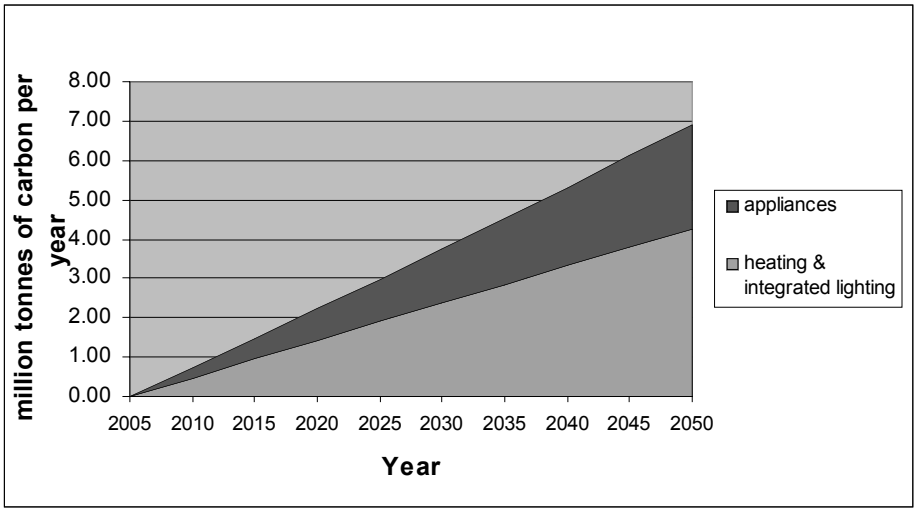


*Figure 2: Cumulative Emissions from Newbuild Housing: "No Further Improvements"**
** Note the split between measures integral to the building and those covered by Building Regulations – space heating, water heating, ventilation, integrated lighting – and those that are currently not, i.e.: appliances.*

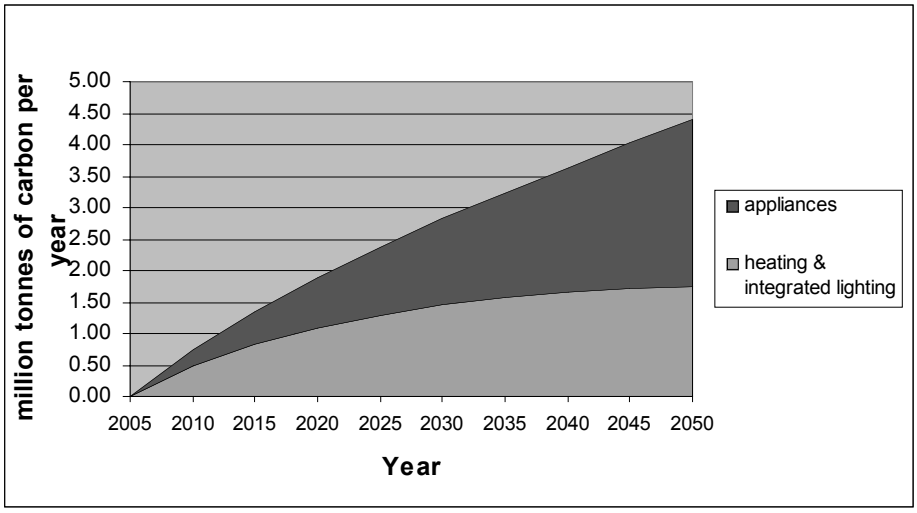


Figure 3: Cumulative Emissions from Newbuild Housing: "Business as Usual"

build would make to our total carbon emissions if we continued at current rates of build and levels of energy performance.[7]

The figure shows that, were we to build as we do now, emissions from newbuild would contribute some 7 MtC, or well over one third of the 16 MtC emissions we can allow ourselves from our total housing stock by 2050 (as shown in figure 1).

Were we to pursue such a course, we would need to reduce emissions from the existing stock not by 60 % but by 71 %. Clearly, it is undesirable to increase our target unnecessarily, and it is more sensible to complement improvements to the existing stock by improving newbuild performance in parallel.

A more realistic scenario – what some might call "Business as Usual" – is a continuous, consistent tightening of the Building Regulations, at rates already being spoken of.[8] The Building Regulations cover what are generally long-lasting features, integral to the home, i.e.: the fabric, the heating system, ventilation mechanisms, integrated lighting. The last Government publication referring to the long-term future of Building Regulations suggested a further 25 % tightening under the next review in England and Wales in 2010,[9] with similar levels expected in the Devolved Administrations.

The Energy Saving Trust strongly supports the Government in implementing a 25 % improvement to the Building Regulations, although we believe there is a need for yet more concerted action thereafter. The effect on carbon emissions of a repeated 25 % improvement in the Building Regulations is illustrated in figure 3.

The figure shows the following:

- improving the thermal and lighting performance of the home consistently by 25 % every five years would reduce overall emissions from newbuild from 7 MtC to 4.5 MtC

7. Demolition rates are assumed to remain constant at current levels in this and further figures.

8. Strictly speaking it is difficult to define "Business as Usual" because each amendment of the Building Regulations has been developed on a seemingly ad hoc basis. Our "BAU" is based on the levels of improvement achieved in recent years.

9. ODPM: "Proposals for Amending Part L of the Building Regulations and Implementing the Energy Performance of Buildings Directive: A Consultation Document. Section 6," July 2004.

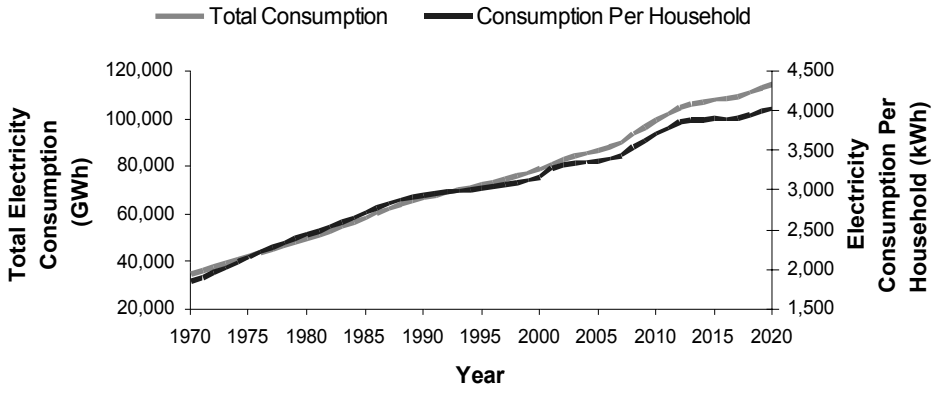


Figure 4: Trend in Annual Domestic Electricity Consumption from Appliances and Lighting

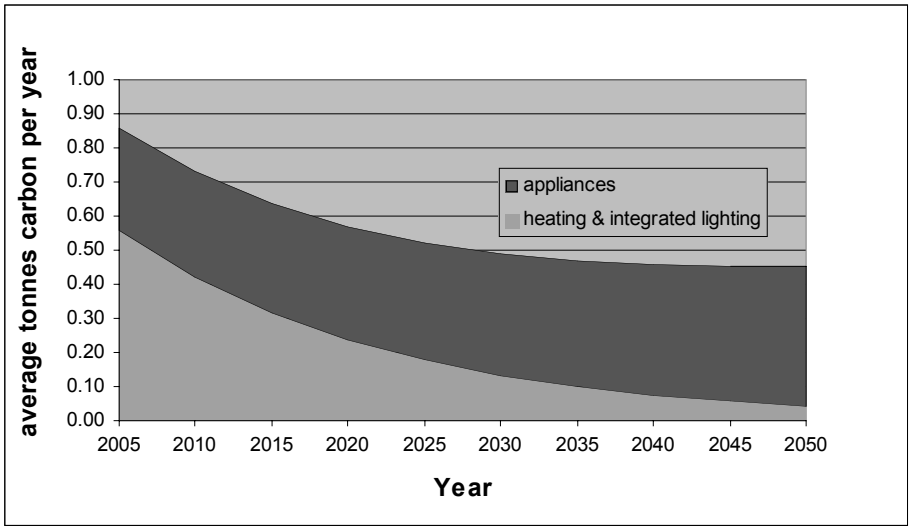


Figure 5: Allowable Emissions from a Newbuild Home: "Business as Usual"

- heating, ventilation, and integrated lighting would contribute just over one third of the emissions from newbuild, with the rest accounted for by electrical appliance use

Clearly, continuation of "Business as Usual" of the Building Regulations has its carbon benefits. However, at each increment, the 25 % reduction has a lower absolute impact. Furthermore, it leaves appliance use unchecked, apart from the impact of general product policy. Indeed, in a typical home, the carbon emissions associated with appliance use are widely forecast to grow by 1 % p.a., because of a trend for additional, energy-intensive lighting, and an ongoing demand for evermore innovative consumer electronics.[10] [11]

The eventual dominance of appliance related emissions from a typical newbuild home under the "Business as Usual" scenario is shown in figure 5.

➡ It is insufficient simply to tighten up on emissions from heating, ventilation, and integrated lighting; we need to bring appliance emissions into the newbuild equation.

How then, should appliance emissions from newbuild be curbed? It might be argued that this is a matter for appliance policy, not newbuild policy – with appliance minimum standards set for Europe as a whole under the European Directives on Labelling and Eco-Design. However, table 1 assesses some more holistic solutions.

It is worth noting that the Building Regulations already require minimum performance standards ("backstops") for boilers and for fabric elements, so there would seem to be scope to require the same of built-in appliances (washing machines, fridges, cookers, etc.). If we were able to achieve a 25 % reduction in total appliance related carbon emissions on a five-yearly basis, this would look as in Figure 6.

Even here, however, with a 25 % tightening of the whole-house performance of newbuild home every five years, the newbuild sector would in 2050 still be adding significantly to carbon emissions from the total housing stock, at some 2.7 MtC out of a total allowable 16 MtC. Yet, as set out at the beginning, we are trying to reduce overall emissions by 60 %.

▪ Incremental toughening of whole-house emissions requirements from newbuild are insufficient to prevent an ongoing, long-term addition to emissions from the housing sector.

The Energy Saving Trust believes we need to be far more aspirational in our thinking.

10. See Energy Saving Trust: "The Rise of the Machines," June 2006 for a review of energy using products in the home from the 1970s to today.

11. Figure 4: See Energy Saving Trust: "The Rise of the Machines," June 2006 for a review of energy using products in the home from the 1970s to today.

Table 1: Pros and Cons of Including Appliance Criteria within Newbuild Performance Requirements

Pros	Cons	Realistic Approach
Appliances account for an increasing proportion of newbuild carbon emissions	Appliances can be removed and should not be traded against building fabric	Minimum banding requirement for all built-in appliances; no trade-off
Building Regulations offer an opportunity to regulate overall carbon emissions of a home	Appliance standards are set in Europe, to cover all appliance markets	Use newbuild as leader in market transformation for appliances
Appliance usage can link with microgeneration within home, which is covered by Building Regulations	Developers should not be deviated from their "core" task of improving the fabric	Overall carbon emissions cap caters for appliances by allowing trade-off with microgeneration

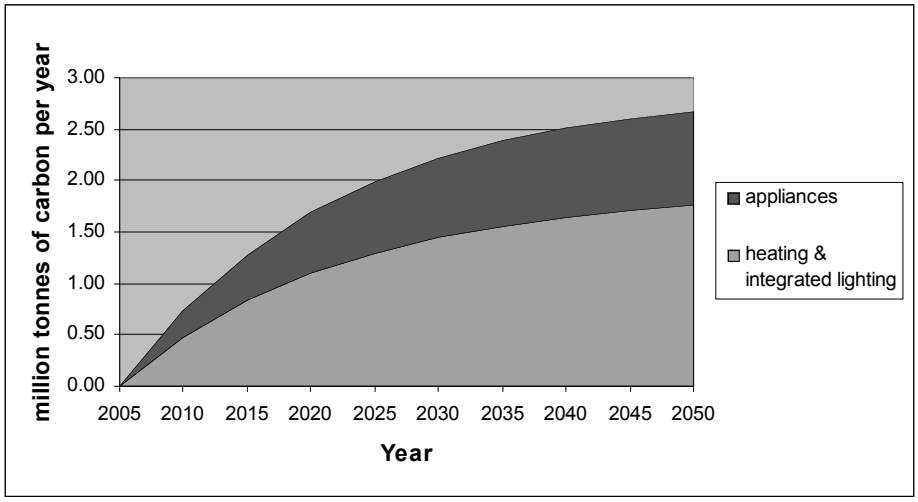


Figure 6: Cumulative Emissions from Newbuild Housing: 25 % Whole-House Reductions

A Long-Term Vision for Newbuild Housing

Imagine that, by the middle of this century, the new homes we build no longer draw the bulk of their electricity from the grid. They no longer use gas from underground pipes. Their running costs are no longer subject to the vagaries of energy markets. Over the course of a year, they are no longer net emitters of climate damaging carbon dioxide. Instead, the homes we build are net generators of energy. They feed into the grid. They are not a carbon emissions liability, but a carbon displacement asset.

An ambitious vision? Yes.

An achievable vision? Yes.

There are already a number of homes in existence with net zero-carbon heating arrangements. Possibly the most challenging feature is the provision of domestic hot water at appropriately high temperatures throughout the year. Examples of zero-carbon heating homes include:

- a very well-insulated home that needs virtually no additional space heating beyond ambient solar and the heat given off by appliances, with solar water heating for hot water and a PV array to offset off-peak electricity for winter hot water
- a well-insulated home using biomass (such as wood chips) for both space and water heating, with perhaps a micro-wind turbine or PV array to offset the carbon emissions arising from fuel transportation
- a well-insulated home using ground source heat pump for space and water heating, perhaps with a community wind turbine to offset the electricity used by the heat pump
- a very well-insulated home connected to a community heating system (most appropriate for blocks) to provide hot water, powered by biomass CHP

Given that the above homes already exist, using proven technologies, it would seem that it is only a matter of will and vision to make these the norm over the course of the coming decade. For this reason, the Energy Saving Trust believes that newbuild policy should set a goal of a net zero-carbon space and water heating regime in all newbuild by the next but one review of the Building Regulations (2015/16 in England and Wales, and similar timescales in the Devolved Administrations).

It is important to note that the suggestion is for net zero-carbon heating. This is in recognition of the fact that, whilst it is possible to super-insulate and to provide 100 % carbon-free heat, an element of tradability and flexibility would make it easier to deliver this vision. "Net zero-carbon heating" essentially means that, once tough fabric standards have been achieved, microgeneration and additional appliance efficiency measures can be used to compensate for any carbon emissions arising from space and water heating.

But the work does not stop there. After 2015/16, the remaining contributor to carbon emissions, namely appliance use, would need to continue to be addressed. This requires still further efficiency improvements in appliances, coupled with ad-

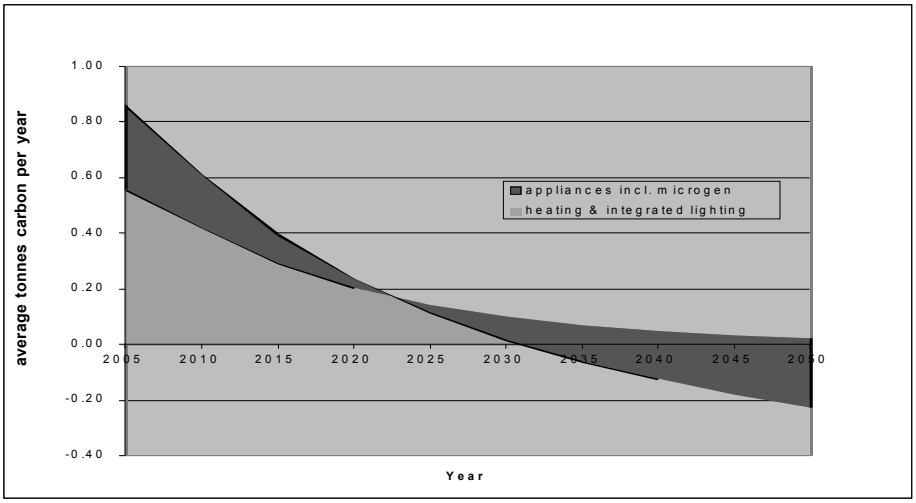


Figure 7: Allowable Emissions from a Newbuild Home: To Zero-Carbon and Beyond

ditional microgeneration capacity. In addition, the carbon content of grid electricity needs to be taken into account. – With a number of large-scale renewable plant (in particular wind farms) under consideration, as well as smaller-scale community renewables projects, the carbon content of grid electricity is assumed to reduce by some 1.5 % over the course of each 5-yearly iteration of the Building Regulations.[12] This actually makes it easier to address the appliance issue.

Taking all of the above into account, the Energy Saving Trust believes that we should aim for a requirement of zero-carbon newbuild housing by 2030, and for the vision of newbuild homes becoming net generators of energy beyond then. Figure 7 illustrates the proposed allowable emissions from newbuild homes built between now and 2050, bundling emissions from appliances together with emissions displaced by microgeneration.

Key policy points to note about this scenario are:

- a 25 % improvement in carbon emissions from newbuild heating, ventilation and integrated lighting by 2010/11, with a further 30 % toughening every five years thereafter
- incorporation of tough fabric "backstops" within these requirements, to ensure the best fabric performance possible and avoid too early trade-off with building systems efficiencies
- a requirement by 2010/11 for carbon emissions from appliances in newbuild homes to be 25 % lower than currently, through a combination of energy efficiency and usage reduction measures, with a further 25 % tightening of appliance emissions every five years thereafter
- a requirement for a further reduction in total carbon emissions from the home, corresponding to the carbon that can be displaced by an incremental, five-yearly rise in the electricity generated by the home
- the scope for trade-off between microgeneration and appliance emissions, and also between microgeneration and heating once the tough fabric backstops have been realised

And the results, in terms of carbon emissions, are:

- at 2015, net zero-carbon space heating, with any residual heating requirement compensated for by the export to the grid of clean electricity[13]
- by 2030, the absolute carbon emissions arising from a new home will be zero
- after 2030, the new home will be a net exporter of electricity over the course of the year

Figure 8 shows the overall effect of this scenario on carbon emissions from newbuild.

It is worth noting from figure 8 that:

- cumulative carbon emissions from newbuild housing would peak in 2030 at 1.9 MtC
- as of 2030, net carbon emissions from newbuild housing will be reducing
- by 2050, cumulative carbon emissions from newbuild housing will be 1.6 MtC and falling

The results can be compared with the "Business as Usual" scenario under which carbon emissions to 2050 would amount to some 2.8 MtC, i.e.: they have been cut by almost one third.

But the benefits of this approach go further than the immediate carbon savings from the new stock. They include:

- offering the country some slack for dealing with "hard-to-treat homes," that may be difficult to refurbish to a 60 % improvement in carbon performance

12. Consistent with DTI projections to 2020, after which it becomes very difficult to predict.

13. The emissions from appliances would have been 0.32 tC under BAU (see figure 5); instead, they are here 0.10 tC (with a contribution from microgeneration). This reduction of 0.22 tC compensates broadly for heating related emissions, hence "net" zero-carbon. Another way of looking at this from figure 7 is that, by 2025 (at the cross-over), microgeneration will be providing carbon-free energy for all appliance use – and more after that.

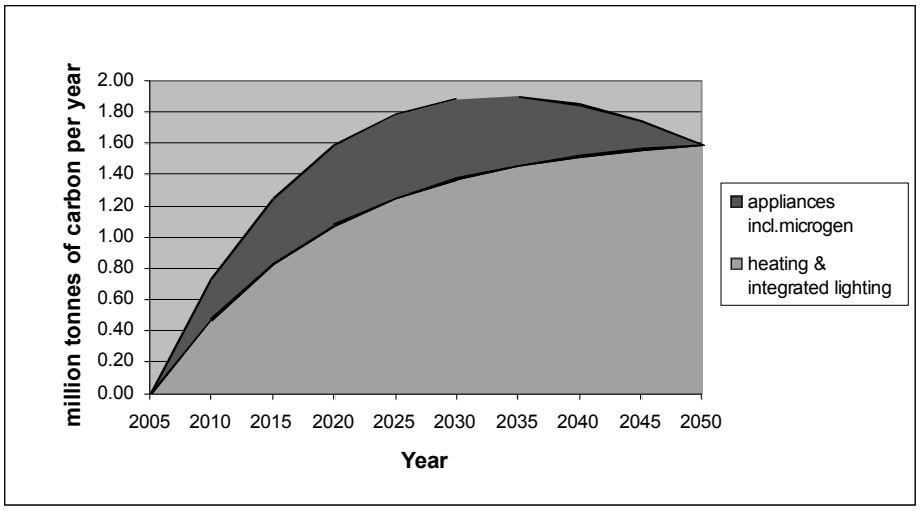


*Figure 8: Cumulative Emissions from Newbuild Housing: To Zero-Carbon and Beyond**
**Note that, for illustrative purposes, microgeneration has been shown to displace appliance emissions first.*

- effecting market transformation in energy efficiency and microgeneration technologies, that can then be adopted in existing housing, including to address fuel poverty
- accelerating market transformation in appliances, in particular consumer electronics, a sector in which carbon emissions are currently increasing
- setting a visible model for householders for "future" sustainable living, and raising awareness of what they can and should expect from the existing stock
- reducing the need for energy infrastructure for new developments – such as laying of gas pipes, reinforcement of the distribution network, new generation plant, etc.
- overall, taking forward technologies, techniques, and skills for driving a low-carbon economy in the UK and in the rest of the world

The Way Forward: Policy, Research, and Support

What needs to happen in order to ensure we make swift progress to achieve the zero-carbon vision set out above? This section looks at the policies, research, industry action, and support that are required.

POLICY RECOMMENDATIONS

A Long-Term Plan for Tightening of Building Regulations

Experience to date has shown that many developers see Building Regulations as the target to aim for. The Energy Saving Trust is hopeful that new Government policies will help to create market differentiation in newbuild housing whereby there will be a stronger incentive to aim higher. Nevertheless, we firmly believe that Building Regulations will continue to be important as a benchmark and a minimum legal requirement.

What the construction industry and others have asked for is a clear indication of the pace at which improvements will be required of newbuild. Such a long-term assessment is important not only to secure a defined contribution towards the country's climate change goals, but also because the industry has a long lead-in time when it comes to manufacturing capacity for new products.

➡ We need a clear vision of the future direction and pace of change of Building Regulations.

The Energy Saving Trust has shown what we believe to be the right pace:

➡ We need a 25 % improvement in carbon emissions from newbuild heating, ventilation, and integrated lighting by 2010/11, with a further 30 % toughening every five years thereafter.

➡ We need tough fabric "backstops," within these requirements, to ensure the best fabric performance possible and avoid too early trade-off with building systems efficiencies.

➡ We need to incorporate a requirement on appliance emissions within newbuild. This requirement would entail a 25 % efficiency improvement on built-in appliances by 2010/11 and every five years thereafter, in conjunction with an overall carbon cap for the home and wider policies to address non-integrated appliances.

➡ We need a further carbon reduction as of 2010, corresponding to the carbon that can be displaced by an incremental, five-yearly rise in the electricity generated by the home.

To make this practicable, there needs to be scope for trade-off between microgeneration and appliance emissions, and also between microgeneration and heating once the tough fabric backstops have been realised

The above should lead us to net zero-carbon space and water heating by 2015/16, and overall zero-carbon housing by 2030.

The proposed trend in the toughening of what is currently covered by the Building Regulations, i.e.: space heating, water heating, ventilation, integrated lighting, is shown in Figure 9.

The Energy Saving Trust is proposing that the above is retained, but is also incorporated into a total carbon cap for a new home, that is itself reduced. Figure 10 summarises the actual emissions allowed from a new home as a consequence.

Is this rate of change achievable? We believe it is. Historic evidence attests to this – in particular:

- The last review of Building Regulations Part L (2006) toughened up on carbon performance by 20 % over a four-year period. This happened without industry having years of

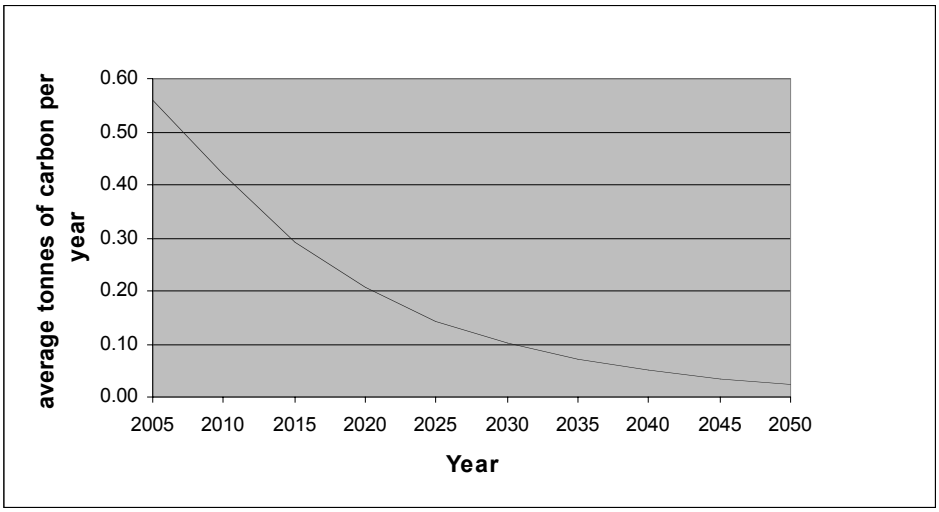


*Figure 9: Allowable Emissions from a Newbuild Home: Building Regulations Evolution**
**This covers space heating, water heating, ventilation, and integrated lighting.*

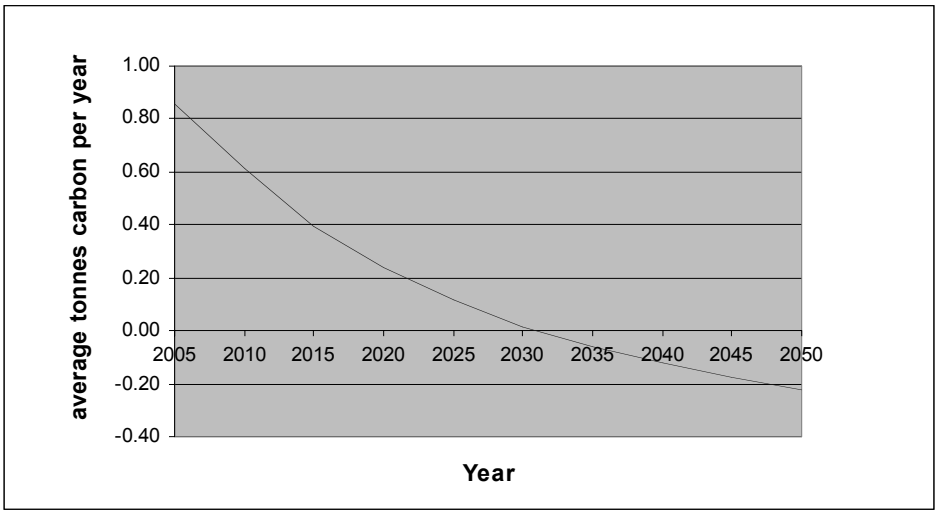


*Figure 10: Allowable Emissions from a Newbuild Home: Total Cap**
**I.e.: covers all energy use, including appliances.*

preparation time, without a long-term strategy setting the course, without a range of support policies such as the Code, and without a coherent research and evaluation mechanism in place. To achieve 25 % and then 30 % over five-year periods, with all of these factors now in place, should in theory be easier.

- On appliances, the overall trend in built-in labelled units is an improvement in efficiency, (although this is set back by increasing size and usage). A top-of-the-range appliance in general emits around 30 % less carbon than the average appliance sold. Therefore a 25 % improvement in the efficiency of built-in appliances is already achievable; it just needs to be made a requirement in newbuild policy. Non-integrated appliances need further consideration – for instance, they could link in with the development of Personal Carbon Plans.
- Over 56 % of new local authority development plans submitted since 2004 that have the potential to do so require a percentage of the energy of new developments in their area to come from microgeneration.[14] In London the percentage requirement looks set to rise to 20 %, within a time period of only a few years. The rise of 10 % every five years that we suggest nationally is of this order.

Methodological Issues around Building Regulations

In addition to simply setting out a programme for tightening the Building Regulations, and widening the scope of newbuild policy to include requirements on appliances, a number of methodological issues need to be addressed. These are set out below.

1. Process for Decision Making and Updating of Methodology. Whilst a long-term plan for the tightening of Building Regulations will help with long-term investment, technical decisions will still need to be made as the detail of future Building Regulations are drawn up. For instance: how should the

14. DCLG: "Review of Planning Policy Statement 22: Renewable Energy Policies in Emerging Development Plans," 2006

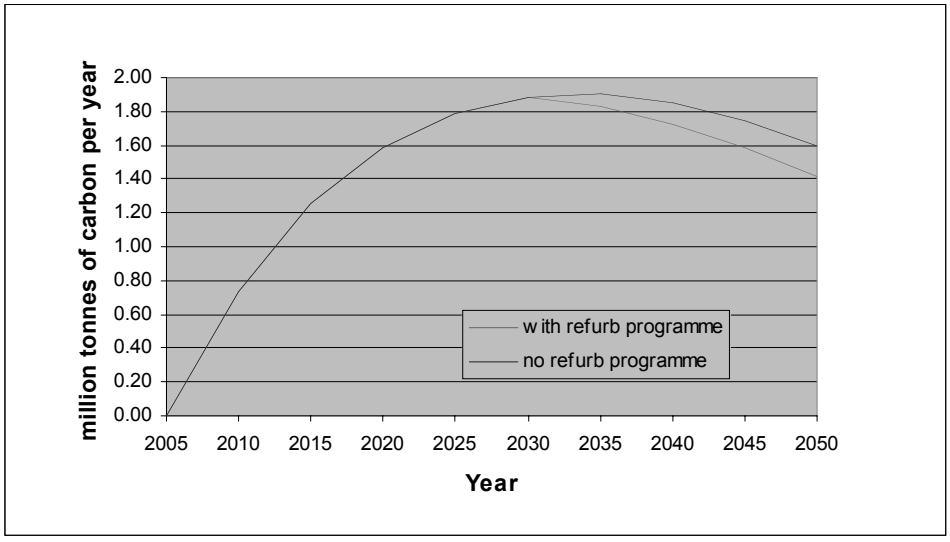


Figure 11: Impact of a Refurbishment Programme on Cumulative Newbuild Emissions

combination of thermal mass, solar gain, and ventilation be accommodated? How should the carbon benefits of microgeneration be accounted for?

The answers to these questions need to be based on evidence. The most transparent process for this is if questions for the next review are set out well in advance, and stakeholders are made aware of the need to answer them. This will motivate all involved to collate appropriate evidence, as well as giving industry an indication of how decisions on detail will be made. By establishing a common protocol for relevant technical monitoring, Government would maximise the robustness and cross-comparability of the evidence gained.

➡ There is a need for a clear process and protocol for commissioning and collating evidence that will feed into the detail of future Building Regulations. The Energy Saving Trust is helping to develop this, but ultimately it needs buy-in from all stakeholders.

2. Integration of Further Measures. Whilst in-use energy performance will for a long time account for the majority of carbon emissions from a new home, embodied energy, and indeed other non-energy related sustainability issues, will with time become proportionately more important. These need to be taken into account without confusing the core message to the industry that there is a long-term commitment to reducing in-use carbon emissions. The principle of a separate points system, such as that proposed by Government in the Code for Sustainable Homes, seems a sensible way to proceed.

In addition, it has been shown that there is a need to cap carbon total carbon emissions from a new home, including appliance usage. This is difficult in terms of regulatory practicability for several, interrelated reasons:

- There is a need to maintain an absolute downward pressure on fabric performance, and not allow trade-off with appliances.
- Even built-in appliances are replaceable, and are sometimes not supplied with the new home to begin with, in which case they are not the responsibility of the developer.
- The proportion of energy use and carbon emissions from non-integrated appliances is rising, from 17 % in 1970 to some 52 % by 2020.[15]

➡ There is a need to introduce a tightening requirement on built-in appliance efficiency within newbuild, and an overall carbon cap for the home, in parallel with imposing ever tougher fabric standards.

3. Contingency for Refurbishment. Over the period to 2050, some refurbishment of what is now "newbuild" will inevitably be required. For the longer term, newbuild policy therefore needs to consider the refurbishment potential of new homes, and to maximise the scope for energy efficient refurbishment, as well as minimising the need for energy consuming services as climate change takes hold. Ideas might include modularity (e.g.: to allow easy installation of solar collectors on roof), pre-installed fittings (e.g.: dedicated light fittings), shading (to avoid air conditioning), siting and spacing (e.g.: for future biomass supply, digging for groundsource heatpumps), etc.

The potential carbon savings arising from a refurbishment programme, where the energy performance of all new homes is improved by a further 10 % twenty-five years after they are built, is shown in Figure 11.

The figure shows that the scope for carbon savings from a refurbishment programme is not insignificant.

➡ The refurbishment potential of newbuild homes needs to be accommodated in the development of newbuild policy.

Labelling

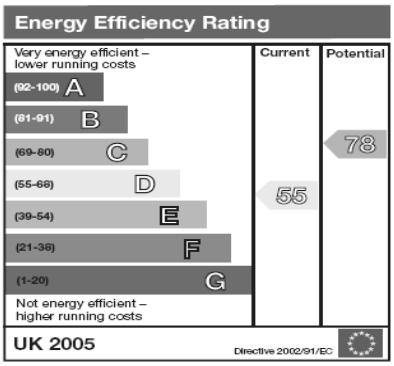
Labelling is the only way in which consumers will know that the product they are buying performs according to claims. The introduction of Energy Performance Certificates (A-G Label) for new homes is therefore in principle very welcome.

It is important to note, however, that the banding for the label will be set such that that homes meeting Building Regulations (i.e.: all new homes) will meet mainly A-B, with possibly some C. It therefore offers little consumer-friendly differentia-

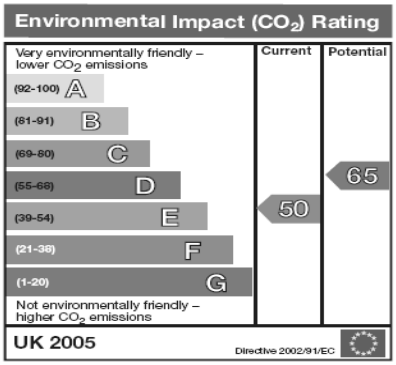
15. Market Transformation Programme

tion on the energy performance of new homes, as compared with differentiation within the existing stock. Much will need to be done to identify sub-bandings, or to use the Code for Sustainable Homes with its star ratings exclusive to new homes, as the primary consumer tool.

➡ It is essential that the consumer receives a clear and consistent message on the energy performance of their new home, whether through the Energy Performance Certificate, or the Code, or a clear combination of the two.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating, the more energy efficient the home is and the lower the fuel bills will be.



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide emissions. The higher the rating, the less impact it has.

None of these labels, of course, mean anything unless they are seen – by the local authority as specifier or planner, or by the consumer as purchaser, or by other relevant stakeholders.

➡ There is a need for high-profile Government endorsement of newbuild energy performance labels, together with a requirement to make these available or have them displayed at the most effective point in the decision making process.

Metering

There is much evidence to suggest that "smart metering" can lead to savings of 5-15 %.[16] National field trials are currently being initiated to quantify these savings more precisely. Whilst the savings may be less in newbuild homes that are already efficient, we can assume intuitively that smart meters will have some benefit, as at minimum they will raise householder awareness of their energy consumption.

The European Directive on Energy End-Use Efficiency and Energy Services requires smart meters to be installed in all new build properties where technically and financially feasible.[17]

Clearly it is both technically and financially feasible to install smart meters in a newbuild home that already needs a new meter.

➡ Smart meters, with a minimum functionality, need to be prescribed for all newbuild homes, through a combination of new Building Regulations and regulatory instruments.

Monitoring and Enforcement

The compliance regime for Building Regulations has recently been much improved in England and Wales, under Part L (2006). There is scope for many more detailed improvements to the system,[18] but the Energy Saving Trust believes there are two fundamental mechanisms that need serious attention.

First, whilst building control officers have now been offered training on compliance with energy performance regulation, and compliance is somewhat easier to check (for example, with pressure testing certificates), there is still nobody to verify the building control sign-off. This is a problem in cases where it is not in the building control officer's interest to fail their client.

➡ There is a need for independent, nationally consistent quality assurance of building control checks, involving sample monitoring of sign-offs, with serious and high-profile consequences for inappropriate sign-offs.

Second, compliance monitoring aside, there is currently very little technical monitoring in place to ensure that homes that legally comply with the Building Regulations and other policy requirements (such as the Code) also do so in terms of technical performance.

➡ There is a need for a survey of the designs and energy performance of new homes, to inform the development of newbuild support activities, future Building Regulations and other newbuild policies, and our wider climate change strategy.

Planning

Planning policy has recently been recognised as an extremely important tool in the fight against climate change. Planning Policy Statement 1 for England requires regional and local planning bodies to "ensure that development plans contribute to global sustainability by addressing the causes and potential impacts of climate change," and explicitly requires the promotion of energy efficient buildings.[19]

Yet some local authorities still seem cautious about adopting more progressive policies. Of some help has been PPS 22 on Renewable Energy, clearly requiring the promotion and encouragement, rather than the restriction, of the development of renewable energy resources. Unfortunately, there is no specific PPS on other aspects of sustainable energy – leading to many local authorities setting targets for renewables without ensuring that the fundamentals, i.e.: energy efficiency are first in place. The Government's development of a Planning Policy

16. ECI: "The Effectiveness of Feedback on Energy Consumption," 2006

17. Article 13

18. Energy Efficiency Partnership for Homes: "Compliance with Part L1 of the 2002 Building Regulations," 2006

19. "Planning Policy Statement 1: Delivering Sustainable Development," ODPM, 2005

Statement on Climate Change, if it addresses these issues, is therefore very welcome.

➡ The upcoming Planning Policy Statement (PPS 26) on Climate Change should require local authorities to adopt climate change mitigation policies.

➡ PPS 26 should also make it clear that local authorities can require energy efficient, low-carbon homes, and that these can be specified as homes meeting certain levels of the Code for Sustainable Homes.

➡ Given the general lack of understanding of the energy hierarchy, all relevant planning guidance should highlight the need to secure tough energy efficiency standards before installing microgeneration.

The planning system in fact needs to go further, and complement consideration of the climate change impacts of individual housing with its wider context, to maximise the scope for the creation of genuinely low-carbon communities, including the surrounding businesses and transport links.

FISCAL INCENTIVES

Fiscal measures, if carefully used, can be used to encourage both householders and developers to invest in higher performance homes.

A reduction in stamp duty on low-carbon homes would act as an incentive for prospective buyers. Care is needed, however, not to encourage householders to choose a newbuild home over an old home, as clearly this has wider sustainability implications.

Similarly, a reduction in Planning Gain Supplement payable under a low-carbon development would encourage the developer to meet a specified level of carbon performance.[20]

Both of these options now have the potential to link in with the new A-G Energy Label and the Code for Sustainable Homes, enabling the development of a credible and robust fiscal mechanism.

➡ There is a need to re-examine the use of fiscal incentives for encouraging the development and purchase of low-carbon homes.

REGULATORY IMPACT ASSESSMENT (RIA)

Traditionally, the assessment of the impact of new newbuild policies, and new Building Regulations in particular, has been based simply on the cost of additional work, and the energy bill savings arising from improved efficiency. More recently, the social cost of carbon emissions has been incorporated. However, there are a number of other factors that come increasingly into play with higher energy performance. These include:

- reduced capital costs, e.g.: no further need to install a central heating system
- low-cost workmanship issues, e.g.: building airtight, reducing thermal bridging
- avoided infrastructure costs, e.g.: no need for gas pipes or grid reinforcement
- redesign, i.e.: designing out energy needs, rather than "slapping on more energy efficiency"

➡ There is a need for a comprehensive RIA to take account of wider avoided costs, both inside and outside the new home, in the interests of the best economic and environmental outcome for UK plc.

In addition, it should not be forgotten that additional emissions from newbuild need to be compensated for by reducing emissions further elsewhere – probably the existing housing stock – if we are to meet our overall 60 % carbon reduction target by 2050. This can sometimes be forgotten, when considering "carbon-neutral" projects that propose to trade off newbuild performance against the improvement of existing homes.

➡ The cost-effectiveness of tougher newbuild standards should be compared with the anticipated cost-effectiveness of improving the existing stock beyond the 60 % reduction target, and not with the most cost-effective measures that are just the first step towards this 60 % reduction.

It is worth noting that it may be particularly expensive to improve some "hard-to-treat," isolated, solid walled homes by over 60 %, and the same applies to heritage buildings. This would justify an even tougher push on newbuild. In fact, refurbishment and newbuild measures may be more closely linked still. – There is evidence that standards, methods and technologies adopted in newbuild very rapidly filter into the refurbishment market.[21] Clearly, the overall cost-effectiveness of newbuild standards would improve substantially if they were shown to drive far larger markets for improving energy performance in the refurbishment sector.

➡ The RIA of newbuild policies should incorporate their market transformation benefits, in terms of a) newbuild markets; b) refurbishment markets.

CROSS-DEPARTMENTAL LINKAGES

As well as the development and effective implementation of specific policies, it is crucial that cross-departmental linkages are forged and consolidated. This means that Government departments need to agree on their collective short and long-term priorities on issues relating to newbuild energy performance. Some of the most obvious issues that have arisen out of this report are set out below:

1. **The role of newbuild housing in reducing overall carbon emissions.** If Government does not set out the role of newbuild within a wider climate change strategy, it risks rehashing the debate every time a new policy on newbuild is being considered. This would lose momentum within the industry, prevent long-term investment in capacity, and lead to incremental and ad hoc change, rather than a step change in the pace of action.
2. **The carbon performance of newbuild that we are aiming for in the short and long term.** Without having a clear idea of short and long-term priorities, it is likely that initiatives will be established with inconsistent aims. For example, resources might go into publicising a demonstration to show

20. For a fuller discussion of fiscal incentives, see Energy Saving Trust: "Changing Climate, Changing Behaviour – Delivering Household Energy Saving through Fiscal Incentives," 2005.

21. BRE: "Reducing Carbon Emissions from the UK Housing Stock," 2005. See in particular figure 40 for the development of loft insulation standards.

how to achieve 10 % above Building Regulations, when in fact the industry needs information on achieving a 25 % performance standard within a few years.

3. **The relative priority of innovation as against mainstreaming of existing designs.** There is clearly a need both for mainstreaming "existing innovation," and for promoting "new innovation." There is the danger that highly innovative designs with new technologies are encouraged as part of a mainstream campaign, when it is in fact proven methods that need to be rolled out in the short term. Equally, innovation should be encouraged within a long-term framework. A large-scale training programme is needed to ensure all sectors of industry are able to deliver the quality and thoroughness of construction needed for high-performance buildings.
4. **The relative priority of energy efficiency and microgeneration measures.** There is a balance to be struck between on the one hand promoting the installation of microgeneration in order to accelerate market transformation in these technologies; and on the other hand encouraging the industry to build to robust fabric performance standards. There is the danger that we mainstream low-carbon homes that are reliant on microgeneration technologies for their superior energy performance, but are not optimally constructed.
5. **Integration of newbuild and appliance policies.** As carbon emissions arising from appliance use begin to dominate in a newbuild home, the strategy for newbuild must increasingly incorporate the strategy for appliances, and vice-versa. This needs careful thought, bearing in mind that much of appliance policy is set in Europe.
6. **The incorporation of criteria beyond in-use energy performance.** Whilst in-use energy performance will for a long time account for the majority of carbon emissions from a new home, embodied energy, and indeed other non-energy related sustainability issues, will with time become proportionately more important. These need to be taken into account without confusing the core message to the industry that there is a long-term commitment to reducing in-use carbon emissions.
7. **The incorporation of sustainable transport links.** Whilst keeping the pressure on reducing carbon emissions from the home, from a wider perspective there is little sense in this if the home is to be built away from any transport infrastructure. Consideration of the wider carbon emissions from new communities, including employment and flexible working trends, need to be incorporated into planning policy.

The above are obviously interrelated. Most of the issues need the involvement of appropriate divisions within DCLG, DEFRA, and DTI, but other Government departments, notably DfES, DfT, will sometimes need also to be involved. Whether it be new policies or support schemes or publicity or technical research, it is essential that these are co-ordinated to ensure the most efficient use of resources and the clearest message to stakeholders, particularly the industry. The Energy Saving Trust is already helping to bring together the various strands of thinking, but responsibility for policy of course rests with Ministers.

RESEARCH REQUIRED

Whilst we have a good understanding of the kinds of low-carbon homes that are successful, we do not have any statistically robust evidence on their on-the-ground performance, nor on the relative benefits of different house designs. Without such feedback and differentiation, it is a lot harder to push ahead with what works, and dispense with what is less effective.

➡ There is a need for quantitative and qualitative on-the-ground monitoring of the energy performance of low-carbon homes. Homes receiving support under the Low-Carbon Buildings Programme have the potential to provide this evidence.

In fact, we do not even know the true, on-the-ground energy performance of standard newbuild homes that simply comply with Building Regulations, as this has not been monitored, only modelled. Whilst the model for Building Regulations is highly refined, and the best there is, it is important to undertake on-the-ground monitoring for two reasons:

a) It will help assess the relative effectiveness of different solutions, allowing progress and market differentiation.

b) It will confirm the absolute contribution of newbuild to total housing emissions, enabling a comprehensive assessment of the role of newbuild within a national climate change strategy.

➡ There is a need for a large-scale, statistically robust programme for the monitoring of the energy performance of new homes. The Energy Saving Trust can contribute to this programme.

In addition, there is a range of technical research looking at specific technologies and combinations of technologies that will help inform the newbuild agenda. Such research tends to be commissioned by a variety of funders, leading to duplication and non-comparability.

➡ There is a need for technical research to be co-ordinated in order to maximise the use of limited resources, with a protocol for commissioning such research to allow robust cross-comparisons. The Energy Saving Trust can help to pull this together.

The Energy Saving Trust is keen to contribute its expertise in all of the above. However, such monitoring and development exercises do not come cheap. The Energy Saving Trust believes there is a severe lack of funding for RD&D into energy in buildings, and believes that this needs to be addressed.

RECOMMENDATIONS TO THE NEWBUILD SUPPLY CHAIN

Whilst Government policy and support are crucial to helping push forward towards zero-carbon homes, it should not be forgotten that it is ultimately the construction industry that will need to act and build homes with higher energy performance homes.

The Energy Saving Trust would like to see the industry follow some simple steps as set out below:

1. Developers and other members of the supply chain need to consider their training needs to ensure that they are able to utilise low-cost solutions associated with workmanship and skills for the production of low-carbon homes, before investing in capital-intensive technologies.

2. Developers need to develop their experience and their competitive edge by building to levels of the Code for Sustainable Homes and using this as a sales feature.
3. Where in doubt, members of the supply chain – developers, manufacturers, installers, architects, designers, and so on – should access the support offered by the Energy Saving Trust and other organisations, either individually or through their representative bodies, e.g.: RIBA, CIBSE, HVCA, etc.
4. Developers and product manufacturers need to think about what products they need to develop or gear up for in the long term, and show Government that these are realisable.
5. Developers and other members of the supply chain should contact the Energy Saving Trust with case studies for collation and possible evaluation, to help build up the evidence base that will place future policy on a firm footing.
6. When building high-performance housing, developers and others should consider whether there is scope to participate in the national monitoring effort, putting in place independent monitoring and ensuring robustness by talking it through with the Energy Saving Trust.

Next Steps

This report has shown the potential impact of newbuild housing on national carbon emissions. It sets out a vision for how this impact could not only be reduced, but begin to be reversed from around 2030. The report also suggests the policies and support that are needed to make this happen. Key among these are:

- setting out the long-term vision of net zero-carbon heating by 2015/16, and overall zero-carbon homes by 2030
- a large-scale programme for mainstreaming the low-carbon homes built today, including support for training and industry capacity building
- a technical monitoring programme to gain early and ongoing feedback both on the energy performance and on the liveability of the low-carbon homes being built
- a clear, transparent process and protocol for evidence from monitoring to feed into the technical development of future Building Regulations methodology
- a robust compliance and enforcement regime that ensures that newbuild homes meet the specification and contain the necessary design features to be truly low-carbon

The Energy Saving Trust offers this report to Government, to the construction industry, to all stakeholders involved in newbuild housing, to energy campaigners, as the basis for establishing a forward programme to set ourselves on a secure and predictable pathway to zero-carbon new homes.

References

DCLG 2006A: Building A Greener Future: Towards Zero Carbon Development, DCLG, December 2006

DCLG 2006B: Code for Sustainable Homes, DCLG, December 2006

Glossary

DCLG: Department for Communities and Local Government. The Government department responsible for housing policy, including Building Regulations energy performance standards for newbuild housing.

DEFRA: Department for Environment and Rural Affairs. The Government department responsible for energy efficiency.

DTI: Department for Trade and Industry. The Government department responsible for overall energy policy, including the promotion of microgeneration technologies.

LCBP: Low-Carbon Buildings Programme. The DTI-funded microgeneration grant programme run by the Energy Saving trust.

ODPM: Office of Deputy Prime Minister. Since renamed to DCLG (see above).