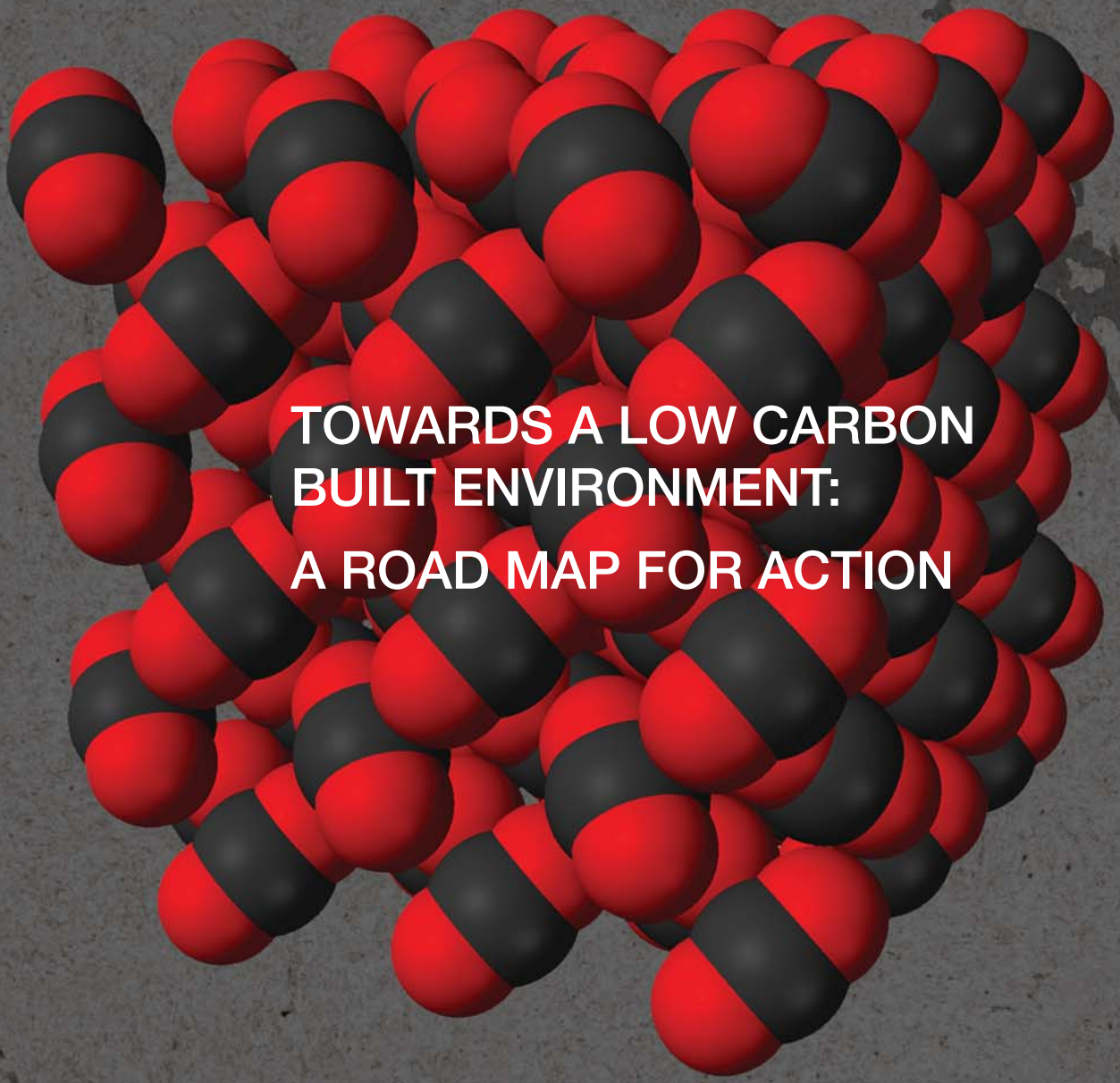
EXECUTIVE SUMMARY

NOVEMBER 2008

RICS REPORT



TOWARDS A LOW CARBON BUILT ENVIRONMENT:

A ROAD MAP FOR ACTION

RICS

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Research

Carbon dioxide

The image on the front cover depicts molecules of carbon dioxide its solid state, generally known as dry ice.

Carbon dioxide is a chemical compound composed of two oxygen atoms covalently bonded to a single carbon atom. It is a gas at standard temperature and pressure and exists in Earth's atmosphere in this state. It is currently at a globally averaged concentration of approximately 387 parts per million by volume in the Earth's atmosphere. Atmospheric concentrations of carbon dioxide fluctuate slightly with the change of the seasons, driven primarily by seasonal plant growth in the northern hemisphere. Concentrations of carbon dioxide fall during the northern spring and summer as plants consume the gas, and rise during the northern autumn and winter as plants go dormant, die and decay. Carbon dioxide is a greenhouse gas, as it transmits visible light but absorbs strongly in the infrared and near-infrared wavelengths.

Carbon dioxide is used by plants during photosynthesis to make sugars which may either be consumed again in respiration or used as the raw material to produce polysaccharides such as starch and cellulose, proteins and the wide variety of other organic compounds required for plant growth and development. It is produced during respiration by plants, and by all animals, fungi and microorganisms that depend on living and decaying plants for food, either directly or indirectly. It is, therefore, a major component of the carbon cycle. Carbon dioxide is generated as a by-product of the combustion of fossil fuels or the burning of vegetable matter, among other chemical processes. Large amounts of carbon dioxide are emitted from volcanoes and other geothermal processes such as hot springs and geysers and by the dissolution of carbonates in crustal rocks.

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This report was prepared to suggest to RICS ways in which we can map out a route towards a low carbon built environment. As such, its aim is to provide a basis of evidence of where we are now and what that means for how we might move forward.

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Your descendants shall gather your fruits.

Virgil (October 15, 70 BCE – September 21, 19 BCE)
Classical Roman poet

Executive Summary

Background

It would have been difficult over the last months and years to have avoided becoming aware of the concern that is being expressed about climate change. "Something must be done" seems to be the message but what and by who is less clear. In reality, we all need to play our role, and we also all need to ensure that our actions are pulling in the same direction.

To explore how the chartered surveying profession could best play its part in this, the Royal Institution of Chartered Surveyors (RICS) commissioned this study to establish the current state of knowledge and practice in this area, and to describe a possible framework to support moves towards a low carbon built environment.

Our primary objective is to try to suggest how a developed country might go about reducing carbon emissions from the built environment, and how that could fit within a wider national programme.

Setting the scene

This study is based on three assumptions:

- **Firstly, an acknowledgement that human induced climate change is happening and presents serious future risks,**
- **Secondly, that by acting now it is possible that 'dangerous climate change' can be avoided,**
- **But a firm belief that the benefits of acting now outweigh the costs.**

A low carbon built environment is integral to meeting climate stabilisation targets. And the following corresponding 'principles for a low carbon built environment' underpin the discussions throughout the report:

- **Action focused on the most cost-effective carbon abatement measures should be a priority. Existing buildings present the main opportunities for cost effective carbon abatement through energy conservation and efficiency,**
- **The prospect of early and sustained emissions reductions can justify the implementation of relatively costly carbon abatement options. New buildings offer a unique opportunity to implement relatively costly carbon saving measures that are more expensive or impractical to retrofit in existing buildings – like certain low and zero carbon technologies.**

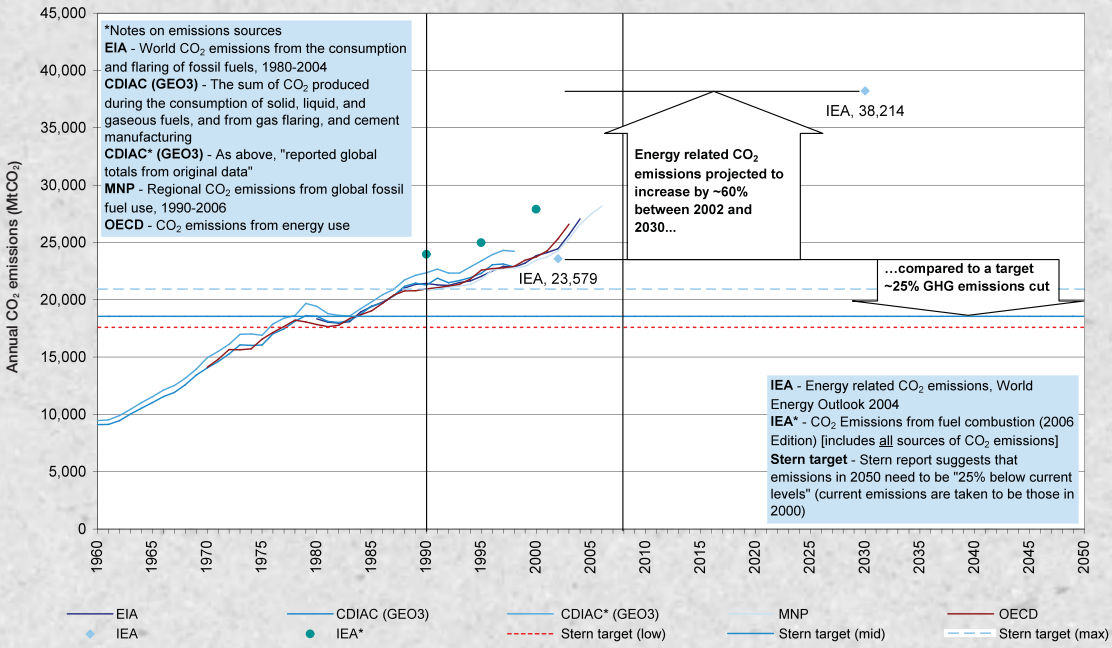
Policies, implementation of carbon saving measures, and assessment of progress must focus on absolute emissions reductions rather than relative efficiency improvements. There are many underlying trends that are tending to increase emissions and which must be counteracted. This is why it is essential to reduce emissions from currently existing buildings; policy and spending on carbon saving must evolve to reflect this.

New and more effective mechanisms are needed to ensure appropriate spending on carbon abatement measures in the built environment. In principle given the value of and ongoing yields from property assets, measures to reduce emissions can be afforded. Still, costs and benefits of mitigating climate change should be shared equitably across the economy, and policymakers need to consider how this can be achieved.

Global emissions

Global CO_2 emissions are rising. Not only that, but there are signs that increases in recent years have been particularly sharp. One IEA projection is that emissions in 2030 will be over 60% higher than emissions in 2002. By comparison the Stern Review suggests that global emissions in 2050 should be "5% below current levels" to meet the climate goals adopted as the basis of the Review. So, not only are we not on track, we are actually going in the wrong direction.

Figure 1. Global CO_2 emissions



First, a few definitions

In spirit, 'carbon' in the study title can be read as 'CO_2 equivalent' – the intention is to move towards a built environment that gives rise to less of all the greenhouse gases that cause climate change. In practice, it is important to be able to engage with the policy agenda as it exists now, so this report focuses on CO_2 emissions.

The majority of built environment carbon emissions arise from energy use to meet three broad categories of demand:

- **Heat,**
- **Electricity, and**
- **Transport.**

Reducing carbon is a means to an end – avoiding 'dangerous climate change' at least cost – rather than an end in itself. So the meaning of 'low carbon' depends on how much emissions need to be reduced by to achieve the ultimate climate goals. The built environment is just one area where carbon emissions can be reduced.

The objective for 'a low carbon built environment' is to emit a quantity of carbon that is consistent with meeting agreed global climate goals. Implicit in that objective is that this is enabled by the energy supply sector, that other sectors are working to complementary objectives, and that the goals and objectives apply globally.

Where we are now

Before we think about out journey, we have to know where we are starting. This study considers where we are now on the road to a low carbon built environment in the areas of legislation and regulation, low carbon technology, business and financial processes and social attitudes. In reviewing the current status in each area, it is easy to draw up often quite lengthy lists of actions taken. But many separate instances of carbon savings in relation to specific end uses and activities do not necessarily add up to an overall reduction in emissions. Reporting of impressive efficiency improvements often obscures underlying trends going in the wrong direction and static or rising total carbon emissions. Increase in service demand more than outstrips the improvements in end use efficiency and carbon intensity of energy supply. One of the messages of this report is that improved energy efficiency is not enough in itself to deliver a low carbon built environment.

The bottom line in terms of progress is that global CO_2 emissions are rising. There are signs that increases in recent years have been particularly sharp. One IEA central projection is that emissions in 2030 will be over 60% higher than emissions in 2002.

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The role of government

Internationally the UN and the EU have been particularly important to date in establishing policy and mechanisms for reducing greenhouse gas emissions.

The United Nations Framework Convention on Climate Change (UNFCCC or Convention) is arguably the single most important UN institution in relation to climate change and greenhouse gas emissions. 191 governments have ratified the Convention that sets "an overall framework for intergovernmental efforts to tackle the challenge posed by climate change" with an aim that developed countries stabilise greenhouse gas emissions. Within that framework the 1994 Kyoto Protocol goes further and aims to reduce greenhouse gas emissions. Overall, the parties to the Protocol are legally bound to reduce their average emissions over the "commitment period" of 2008-2012 by 5% below 1990 levels. The Kyoto Protocol is important because it demonstrates the possibility of international cooperation to reduce greenhouse gas emissions.

The EU has produced a substantial body of policy on climate change and sustainable development, including specific targets for reducing carbon emissions. The EU Emissions Trading Scheme (ETS) and the Energy Performance of Buildings Directive are particularly important EU policy instruments in relation to buildings. Participation in the EU ETS is mandatory for "11,500 energy-intensive installations" across Europe, including electricity generators and refineries accounting for around 50% of CO_2 emissions in the EU. The EU ETS is materially important to the built environment because it acts as an indirect mechanism for 'internalising' the cost of carbon emissions in the supply chain for energy intensive construction commodities such as "steel…cement, glass, lime, brick, [and] ceramics". More critically it does the same in relation to electricity and transport fuels.

Nationally, the main mechanisms governments have traditionally used to influence business and individual behaviour and could use in future to bring about a low carbon built environment include:

- **Compliance based legislation/regulation,**
- **Environmental taxation,**
- **Tax incentives e.g. for low carbon R&D,**
- **Direct funding of R&D for 'market acceleration',**
- **Advocacy, sponsorship and support for voluntary mechanisms,**
- **Price support, e.g. grant for new low carbon technologies,**
- **Direct spending on carbon saving measures, e.g. in public buildings.**

There are also relatively new approaches that have emerged specifically to address carbon emissions:

- **Mandatory carbon emissions trading schemes, and**
- **Supplier obligations.**

These last two mechanisms are expected to deliver a significant quantity of emissions savings under the UK Climate Change Programme.

The role of business

Businesses use energy directly in their own operations and can indirectly influence energy use by others through a wide range of decisions, from where they locate their offices to how they design products and offer services. There is often significant scope for action to reduce their direct emissions and influence indirect emissions. Corporate strategies on carbon emissions are likely to be influenced by environmental taxation and tax incentives, mandatory (for intensive energy users in Europe) or voluntary participation in emissions trading schemes, financial support for carbon savings and innovative low carbon technologies, and reputational risk in the context of Corporate Social Responsibility (CSR) and associated reporting.

CSR provides an ethical justification for managers of publicly owned companies to spend the company's money addressing environmental and social aspects of company operations on the basis that this is a fundamental part of a long term risk management. There is wide interest in improving the extent and quality of voluntary company CSR reporting on direct and indirect carbon emissions. Research carried out by the UK Environment Agency in 2006 found that climate change and energy use were mentioned by 61% of companies. 15 disclosed CO_2 emissions in absolute levels and 37 gave some figures for energy. However only six companies linked environmental issues to financial performance or shareholder value, suggesting most companies still struggle to understand and report the 'value at stake' in relation to their emissions.

Generally it seems fair to say that short term financial decision-making remains the norm in business. On that basis, any CO_2 saving measure that is associated with a quick return on investment should be highly attractive. In practice up front costs remain a barrier even when measures have quick returns. Company spending in general, and property costs in particular, are commonly subject to year-to-year comparison, or some form of benchmarking presenting additional barriers to sudden increases in spending on carbon savings. i.e. companies face the same problem as nations in terms of the effects of their decisions on their competitiveness.

For companies committed to reducing their carbon footprint, the barriers are hard financial constraints, organisational knowledge and skills, and the difficulties of managing organisational change. These factors constrain the rate and success at which carbon saving measures can be implemented across the organisation.

The role of people

In private life, in business and in government, choices and decisions are in the end made by individual people. The 'technical' challenge of reducing personal built environment carbon emissions – from household energy use and travel – ultimately depends on constructing a framework of policies that makes low carbon choices financially and socially preferable.

A report by IPSOS MORI[1] of research in the UK indicates that 88% of people believe that climate change is happening and 46% that it is caused mainly by human beings. But only 9% believe it "will have 'a great deal' of impact on them personally," and just over 20% "strongly agree" that "they personally can help reduce climate change" and "are prepared to change their behaviour". When asked what they were doing to address climate change, very small numbers – 3% or less – mentioned reducing their energy use, driving less, or taking specific measures to reduce their energy use at home.

1. Downing, P. and Ballantyne, J., July 2007. Tipping Point Or Turning Point? Social Marketing & Climate Change. IPSOS MORI http://www.ipsos-mori.com/publications/srireports/climatechange.shtml

So how are we going to get there?

Our actions need to be coordinated to achieve maximum effect. While individual actions have some impact, the ultimate goal will only be achieved if all actions take place within a framework. Then, we can be sure that all actions are properly thought out as to their effects, and the appropriateness of allocating resources to them. Some aspects of this framework are actually about putting in place carbon-saving measures, others are about defining what it is that we should be doing – between them, we believe that they will be capable of delivering the levels of carbon reductions that are required.

There is no first step and no last step – all have their part to play, but the more of these that are acted on, the greater will be their cumulative impact. However, some are likely to have a greater long-term impact than others and might be thought to be "mission-critical" to achieving the levels of carbon reductions that are being proposed, and the framework is presented in that order.

We need to have clear global climate goals to avoid 'dangerous climate change'

The greatest and most significant step that can be taken, which would support everything else in tackling climate change, should be a global agreement on the overall climate-related objectives that addresses the following related questions:

- **What would be considered 'dangerous climate change'?**
- **What increase in atmospheric greenhouse gas concentrations over time is consistent with avoiding 'dangerous climate change'?**
- **What are the limiting global emissions pathways that could be followed that would avoid 'dangerous climate change'?**

That allows us to have international agreement on the target global emissions pathway

Agreeing a target pathway from among the possible options will be a closely related but important and difficult challenge in itself.

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We can then have a comprehensive global agreement on allocation of national emissions allowances

If this was achieved, then it would enable global agreement to be reached, setting out how the total quantity of allowable global emissions in each defined period would be divided up between countries. This agreement needs to be comprehensive. It must cover developed nations, those with transition economies, and developing countries and it must cover all sources of greenhouse gas emissions. An equitable basis for allocation of future emissions will be important to obtaining the agreement of transition-economy and developing nations – particularly China and India. Ideally the agreement would adopt 'Contraction and Convergence' as the model for determining national emissions allocations.

That would enable us to establish a robust international emissions trading system

Once global agreement of allocations has been reached, we could then introduce international emissions trading, which would play an important role in any effective plan to cut global emissions because it is a mechanism that can enable a given target level of emissions reductions to be made at least cost.

It can be an effective and relatively equitable vehicle for technology and wealth transfers. While the Kyoto Mechanisms and the EU ETS have been important in establishing and demonstrating the principles of international systems for emissions trading, they have also illustrated some of the potential shortcomings that must be avoided if a robust global ETS is to be created in future.

Countries could then establish national strategies for 'low carbon infrastructure'

Once countries know their future target emissions profiles they can plan how to accommodate the aspirations of their citizens within that constraint. Developed nations in particular will need to make strategic decisions about fundamental elements of their energy and transport infrastructures.

So how are we going to get there?

Countries would then develop their own national segmented emissions reduction targets and capped trading

For countries to have a high chance of staying within their overall target emissions profiles, they will need a good understanding of how and where emissions arise, who is responsible and – given the structural factors discussed above – what their scope is to reduce emissions and at what costs. This report has discussed three broad groups that are directly responsible for emissions:

- **Individuals,**
- **Businesses, and**
- **Government.**

Looking at the intersection between the parties responsible for emissions and where and how emissions arise, gives the sort of list of 'sectors' or 'sources' used when looking at climate change policy, e.g:

- **Energy supply,**
- **Business,**
- **Transport,**
- **Domestic,**
- **Agriculture, forestry and land use management,**
- **Public sector, and**
- **Stimulating action by individuals.**

The carbon emissions attributable to the built environment consist of the emissions from buildings and some emissions from transport and industry.

In practice, it is only likely to be possible to identify a target emissions profile for the built environment in terms of the carbon emissions that arise from buildings, and primarily from energy use. A built environment emissions profile would be a useful tool for policy makers and for professionals in the construction and property sectors, which would be most involved in efforts to cut built environment emissions.

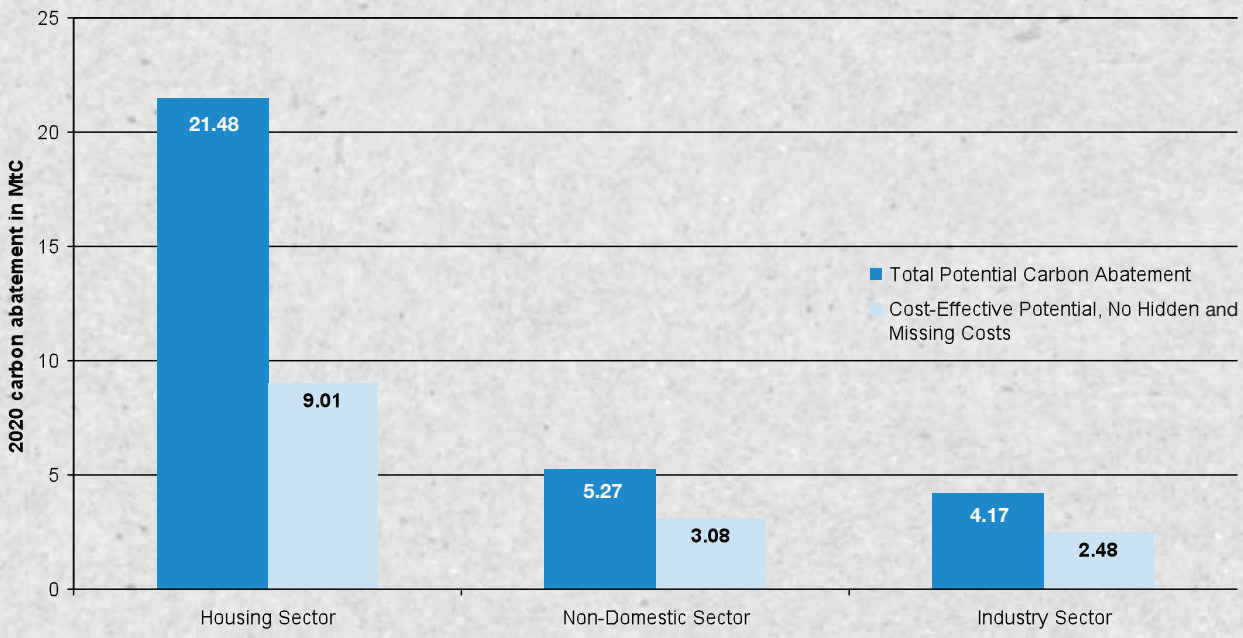
Once a target profile is set, the challenge for policy makers will be to identify and implement policies that deliver on the reduction targets. The traditional range of policy mechanisms – taxation, price support, regulation, performance standards, etc. – are sure to play a part in the policy mix. But a key conclusion of this study is that members of each part of society – individuals, businesses, and government – need a direct incentive to limit their emissions within an allowable amount. There should be an emissions trading system for each group. Emissions from buildings will be one portion of each group's carbon allowance.

But all the while that these are being put in place, we can also introduce practical support for implementation of low carbon measures

There is huge technical potential to reduce carbon emissions from buildings. Many studies in the UK suggest that a significant proportion of the technical potential is also 'cost effective' at current cost of implementation and energy prices (Figure 2).

But the penetration and rate of implementation of carbon saving measures in buildings is low compared to the 'cost effective' potential. Many existing and proposed UK Government policies, such as the supplier obligation, are based on increasing the penetration of measures with robust carbon saving potential by overcoming recognised practical and financial barriers. Effective emissions trading would partly overcome financial barriers to the implementation of carbon saving measures by each group, but additional support would still be required to enable households, businesses and the public sector to identify and implement the most cost-effective carbon saving measures.

Figure 2. Carbon abatement potential in the UK building stock (from one Defra study)



Shape of a plan for the UK

Achieving global agreements on climate goals, national emissions allowances and a robust international trading systems will make it easier for countries to plan for and implement carbon reductions. But their absence has not prevented the UK from starting to take some important steps.

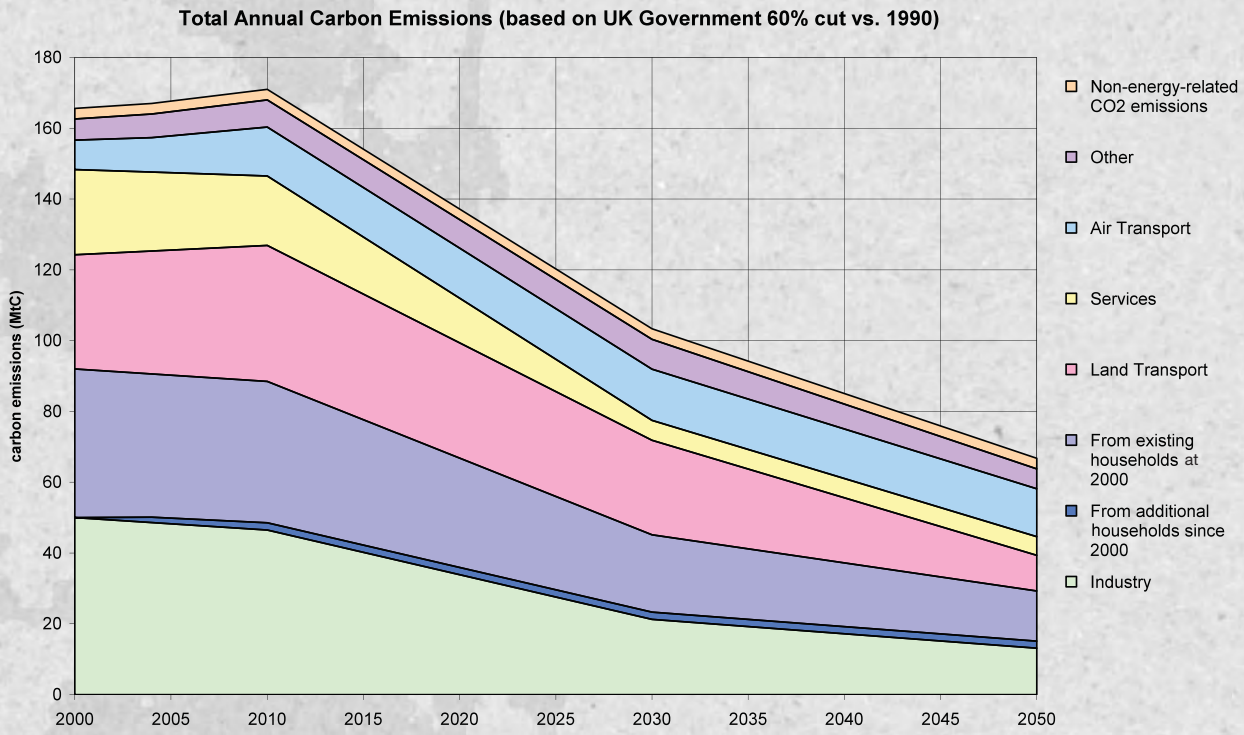
The UK has set national targets to cut CO_2 emissions by 80% by 2050, and has proposed binding 5-year national carbon budgets in the Climate Change Act. If such national carbon budgets become law, it is not far from there to the establishment of sectoral emissions targets.

If we assume that all sectors of the economy need to make their contribution to reducing emissions, then we can envisage an overall UK profile to meet the government's 2050 climate goals looking something like the shape shown in Figure 3 (p12).

This suggests the contribution that needs to be made by the built environment.

Shape of a plan for the UK

Figure 3. UK profile for carbon emissions 2000-2050



The dramatic decreases from the expected trend to 2010 show how far off the required emissions path the UK is, despite being on track to meet its Kyoto targets. How will we be able to tell if the built environment is doing what is needed?:

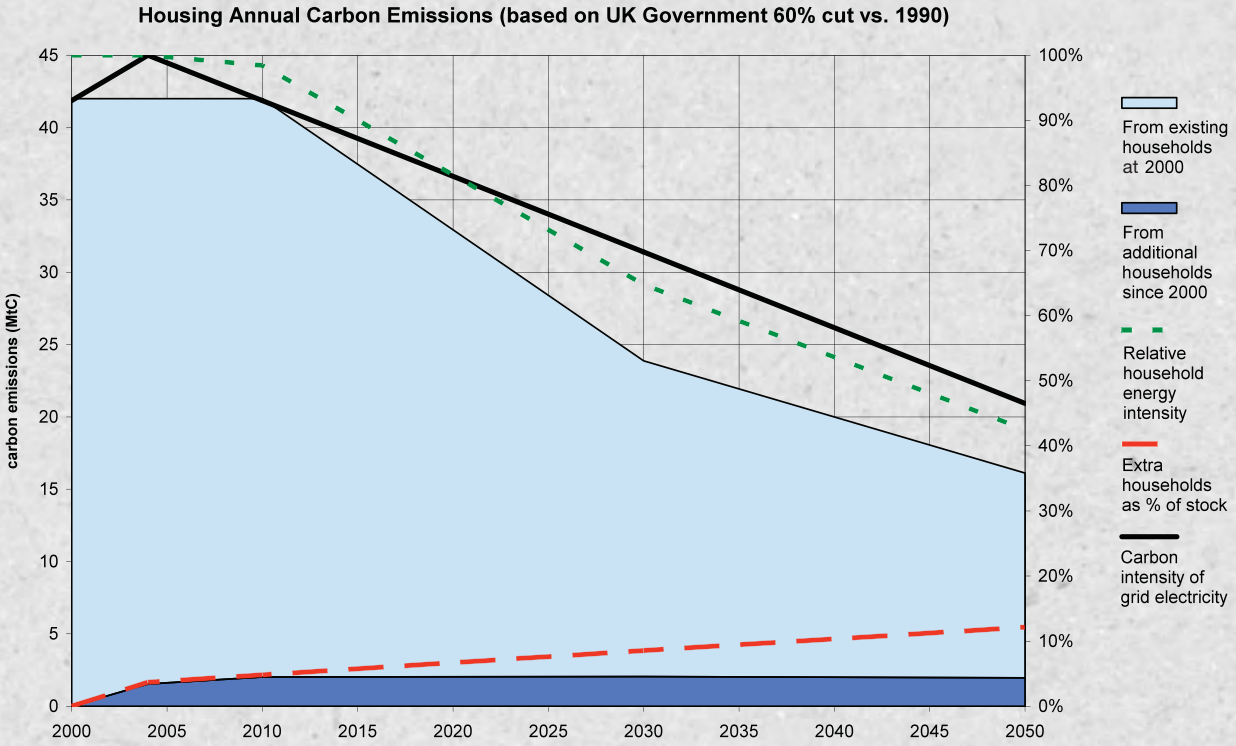
- **we will see a peak in emissions from housing, commercial and public buildings, and the total building stock, and subsequently a periodic rate of change on track to meet 2050 built environment sector target (which should be set),**
- **we will also see a peak in emissions from household appliances and consumer electronics,**
- **we will need to achieve the "40% house" conditions for the UK housing stock. Average UK house SAP score of 80 in 2050 compared to 51 in 2004 (Boardman et el, 2005).**

Of course, this merely tells is what we need to have achieved – what it doesn't tell us is how to achieve it. Amongst the things illustrated in Figures 3 and 4 is the critical importance of addressing emissions from the currently existing stock. The scenario used as the basis for this profile assumed that the carbon intensity of grid electricity falls to below 50% of its current level and that the Government meets its aim that all new housing from 2016 should be carbon neutral – both challenging assumptions. The overall point to underline is that switching from a rising emissions profile projected from now to 2010 to one that delivers already-announced UK climate goals in 2050 leads to some very dramatic assumptions.

A role for built environment professionals

Meeting climate goals that will avoid 'dangerous climate change' will involve carbon emissions reductions of 60% or more in developed countries. This will be a huge challenge and the built environmental will need to make a major contribution if this level of emissions reductions is to be achieved in the envisaged timescale. Specific practical roles for built environment professionals will become clearer as choices are made between key strategic options. At this stage, built environment professionals can play a positive role in this agenda as follows:

Figure 4. Example housing carbon emissions profile to 2050 consistent with current UK climate goals.



Strategic lobbying and support

Organisations like RICS have to lobby and support an effective policy framework of carbon targets. It is clear from the material set out in this report that the carbon targets that have to be achieved are known and the most cost effective measures for achieving the targets can be established. Therefore, the focus has to be on constructing the right policy to link the carbon targets and the cost effective measures in each sector. Currently, the Government is setting policies for zero carbon new housing. However, insufficient attention is being paid to the existing housing stock. This is largely because it is not clear who should pay for the improvement measures.

Costs and risks

The Stern Review suggested that the cost of action to mitigate climate change was likely to lie in the range 1 to 3.5% of GDP, whereas the cost of inaction was much higher. RICS has the expertise to assess the costs of action versus the risks of inaction for the property sector and is well placed to undertake this assessment. If the results of this assessment are in line with the findings of the Stern Review, then this work would be a way to demonstrate to RICS members that it is better to bear the cost of action now to avoid the far higher cost of adaptation.

Technical committee

Once the Climate Change Act has set a target and a trajectory set, then RICS should be involved with the anticipated technical committee with the aim of influencing planning on how the built environment should contribute towards the carbon reductions that are required. RICS can provide valuable advice to identify the most cost effective and technically robust measures for carbon abatement.

Awareness raising and skills

RICS can play a role in raising the level of awareness and promoting the development of skills relating to carbon savings in the property and construction sectors. This is particularly important for its own membership, but there is scope to work with related professions to improved training and skills, and also to develop common positions on the low carbon built environment agenda and bring this to bear to influence policy makers.

Shape of a plan for the UK

So, the choice is ours. What sort of world do we want to live in, and what sort of world do we want to hand down to our children and grandchildren?

This report provides us with clear guidance as to how to pick our way to the outcome that we want to achieve.

It's clear that we all have our part to play, as individuals within society, as members of an electorate, capable of holding a government to account for its actions, and as stakeholders and decision-makers within the complex web of relationships within the built environment.

Perhaps it might be best to end with a quote from Edmund Burke, (12 January 1729 – 9 July 1797), an Anglo-Irish statesman, author, orator, political theorist, and philosopher

"Nobody made a greater mistake than he who did nothing because he could do only a little."

Definitions

'Carbon' and other greenhouse gases

Carbon (C) is the 12th element in the periodic table. In its pure form it is a solid, with the majority occurring as amorphous carbon (e.g. coal and soot) and some in rarer crystalline forms including graphite and diamond. Emissions factors for fuels[2] and emissions over a period[3] are sometimes quoted in terms of carbon. This is somewhat misleading as the emissions of interest are in the form of carbon dioxide.

Carbon dioxide (CO_2) is a gaseous compound of carbon and oxygen and is produced in many energy conversion processes, including when hydrocarbon fuels are burned, and by respiration. CO_2 makes up a small proportion of gases in the atmosphere – currently around 0.0383%, which would more normally be quoted as 383 part per million (ppm). CO_2 in the atmosphere is a greenhouse gas (GHG) and plays a critical role in making the earth habitable through the greenhouse effect.

The current view of the IPCC is that human activity is primarily responsible for an increase in CO_2 concentrations in the atmosphere from a pre-industrial level of around 270ppm to the current level of 383ppm, which is increasing at a rate of 2-3ppm per year. Emissions figures in tonnes of carbon (tC) can be easily converted to their equivalent in tonnes of CO_2 ($t.CO_2$).[4]

CO_2 is one of a number of greenhouse gases arising from human activity and natural processes. Others include: water vapour; methane; oxides of nitrogen – NO and NO_2; and refrigerant gases including CFCs, HCFCs and HFCs. The warming effect of one tonne of each greenhouse gas is different and is referred to as its global warming potential (GWP), which is measured relative to the warming effect of one tonne of CO_2. Most greenhouse gases have a GWP greater than 1, e.g. methane has a GWP of 21 meaning that 1 tonne of methane causes the same amount of warming as, and is therefore equivalent to 21 tonnes of CO_2 emissions. In other words, the quantity of a greenhouse gas emitted can be converted to its CO_2 equivalent (CO_2e) quantity of emissions by multiplying by its GWP. Kyoto Protocol targets and reporting are based on a basket of six greenhouse gases with emissions quantities expressed in CO_2e.

Use of terms

The built environment gives rise to emissions of all six of the greenhouse gases covered by the Kyoto Protocol. It is assumed that the main aim of moving 'towards a low carbon built environment' is to contribute to addressing climate change. It follows that 'low carbon' should ideally be interpreted as meaning 'low CO_2e'. However, current UK climate policy generally uses 'carbon' to refer to CO_2 emissions. The UK domestic targets relate to CO_2 emissions.[5]

Therefore in spirit, 'carbon' in the study title can be readas 'CO_2e' – the intention is to move towards a built environment that gives rise to less of all the greenhouse gases that cause climate change. In practice, it is important to be able to engage with the policy agenda as it exists now, so this report focuses on CO_2 emissions. When reading this report, the safe assumption is that 'carbon' signifies 'CO_2.' But where 'carbon' has been used it will often be reasonable to read it as 'CO_2e' and an attempt has been made to use 'CO_2e,' 'CO_2,' and 'other greenhouse gases' in the text where the distinction is critical.

2. e.g. kilogrammes of carbon per kilowatt hour (kg.C/kWh)

3. Tonnes (t), thousands of tonnes (kilotonnes – kt), millions of tonnes (megatonnes – Mt), or thousands of millions of tonnes (gigatonnes – Gt) of carbon, written respectively as ktC, MtC, GtC

4. By multiplying by 0.273 (=12/44). I.e. one MtC is 0.273 $Mt.CO_2$ and one Mt.CO2 is 3.667 MtC

5. "Carbon budgeting" in the Climate Change Bill applies only to CO2 (and excludes emissions from some sources including aviation and shipping).

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