HM Government

Low Carbon Construction

Innovation & Growth Team

Emerging Findings

Spring 2010

Contents

1. Executive Summary

1. These are the emerging findings of an Innovation & Growth Team (IGT), drawn from the construction industry and from Government, charged by the Secretary of State for Business Innovation and Skills with considering how the UK construction industry can rise to the challenge of the low carbon agenda, and with making recommendations to Government and to industry.

2. The United Kingdom's commitment to reduce carbon and other greenhouse gas emissions is now a matter of legal obligation. The broad strategy by which this might be achieved, as set out in the UK Low Carbon Transition Plan, makes clear that the implications of a low carbon economy reach deep into every aspect of the construction industry, and the plan depends for its delivery upon the industry working at its best. Over the next 40 years, the Low Carbon Transition Plan is virtually a business plan for construction.

3. For companies in the wider construction industry, the task is three-fold:
   - to de-carbonise their own business, wherever they may be in the supply chain;
   - to provide the owners and occupiers of both new and existing stock with buildings that enable them to lead more energy efficient lives;
   - to provide the infrastructure which enables the supply of clean energy and sustainable practices in other areas of the economy, such as transport and agriculture.

4. This pivotal role creates the opportunity for the construction industry to take up a position of leadership. This will require new ways of working and the acquisition of knowledge and skills that will provide competitive advantage at home and internationally.

5. Carbon reduction is not the only critical issue for the industry, nor the only measure of sustainability, but a concentration on carbon brings simplicity and rigour, and provides a new focus for action and a sense of priority.

6. There is a general awareness of this new focus, but few businesses have an accurate understanding of the sheer scale of the undertaking ahead; and there is a level of disbelief about whether or when the tough decisions that will lead to the necessary changes in customer behaviour will be made.

7. Nonetheless, the construction industry has engaged positively with the issue of sustainability, and stands ready to play its part in responding to the more focused challenge of carbon reduction. There are already many examples of good practice, but there needs to be a quantum change in the industry's response to that challenge if the commitments of the Climate Change Act are to be met.

8. This calls for active engagement with the process of identifying the main barriers to transformation, and the means of overcoming them – probably the biggest change management programme that the industry has faced since Victorian times.

9. If the industry can, with its clients, overcome those barriers, then it stands on the threshold of four great opportunities:
   - to carry out a huge programme of work, stretching out over at least the next 40 years;
   - to make use of that workload to reform the structure and practice of the industry;
   - to export the products, knowledge and skills of a modernised industry;
   - and to excite future generations of potential recruits into an industry with a noble cause.

10. Also, if the industry and its clients working together can make the cost savings of 10-30% mooted as the rewards of integration and modernisation, then that holds out the prospect of delivering net zero carbon buildings for the same price or less than buildings conforming only to current Building Regulations, meeting the critical need to render the transition to low carbon affordable.

11. The principal barriers to progress identified by the IGT are:
   - the plethora of policies, reports and initiatives, undertaken by a variety of Government Departments, or by NGOs or other special interest groups, which are incapable of absorption by businesses who need to focus on the more immediate interests of their clients and shareholders;
   - the structure of the industry, particularly in the lack of collaborative integration of the supply chain, and in the silo-based habits of the industry's institutions;
   - a growing need for a general up-skilling of people in all parts of the supply chain to address the design, construction and operation of low carbon, energy efficient buildings;
   - the evidential gap between the design criteria of buildings in use and their performance on completion, and the invisibility of energy consumption;
   - a continuing preoccupation, on the part of many public and private clients, with initial capital cost, instead of appraising projects on a whole life basis;
   - a related need for workable methodologies and tools for carbon accounting, including a settled policy towards discount rates that will create an attractive market for private finance;
   - the lack of drivers for a change in customer demand, without which the supply side lacks the confidence to invest in new products and services for which there may be no market at a profitable price.

12. In addition, specific issues affecting the separate sectors of the industry, each of which is represented by a separate IGT Working Group, are, first for housing:
    - building on the progress being made towards the sector meeting its regulatory target in 2016, whilst addressing real issues of affordability, coupled with the technical constraints associated with smaller sites;
    - stimulating demand for the domestic retrofit programme in particular;
    - assembling an accredited supply chain for that programme, with the necessary skills and practices;
    - striking the balance between whole house measures and centralised and distributed energy policy, so that carbon is reduced in the most cost-effective way;
    - the need for a central knowledge hub which can collect and disseminate the learning gained from around the country, and provide leadership for the industry to start planning for delivery.

13. For non-domestic buildings:
    - the specific challenges of addressing the existing stock, and particularly the problem of frequently separate ownership and occupation;
    - as for housing, the need to stimulate market demand for products and works (new build and retrofit) designed for carbon reduction;
    - a linked need for innovative means of financing the transition to low carbon;
    - the invariable adoption of project level decision-making on the basis of appraisals founded on a whole life approach.

14. For infrastructure:
    - the stress placed on our ageing infrastructure by a growing population, compounded by the demands imposed by the transition to a low carbon economy;
    - the ability of users and/or tax revenues to service the funding of infrastructure projects – the most significant constraint on development;
    - the need for a shift in the regulatory regime that makes initial use of utilities easy and affordable and increasing use more prohibitive, and to a regime that plays a more integrated enabling role in the transition to low carbon;
    - a new approach to the development of best practice, codes and standards, which should move away from a prescriptive to an output-led basis – and which given the lead-in time for major infrastructure projects, need to be turned around faster;
    - the adoption of evaluation models for infrastructure solutions that reflect the inclusion of carbon as a primary design constraint.

15. And for major projects: participation in an effective knowledge network for the capture and exchange of lessons learned.

16. Finally, to be "fit for purpose" the industry first has to be fit, and it has been weakened by the fall in its workload since 2007, and by the consequent loss of capacity. Innovation, the development of skills, and investment in business and industry improvement all feed off workload, and this calls for policies that allow and encourage the industry and its customers to be an engine for economic growth.

Propositions to address these issues and the barriers to change are set out in the report, and summarised in Annexe B. Fundamental to them, though, is the need to stimulate demand; and if the industry is to lead the transformation of its product, it must first be confident of the transformation of the market. The evidence is that the clearest signal of this will be taken from well-designed regulatory standards, underpinned by the presumption of a stable and realistic price of carbon.

In addition there is just one key recommendation to Government: to commission a suitably qualified Program Manager to prepare a detailed execution plan for the physical work assumed in the UK Low Carbon Transition Plan, steered by the IGT, and with adequate access to all Government stakeholders.

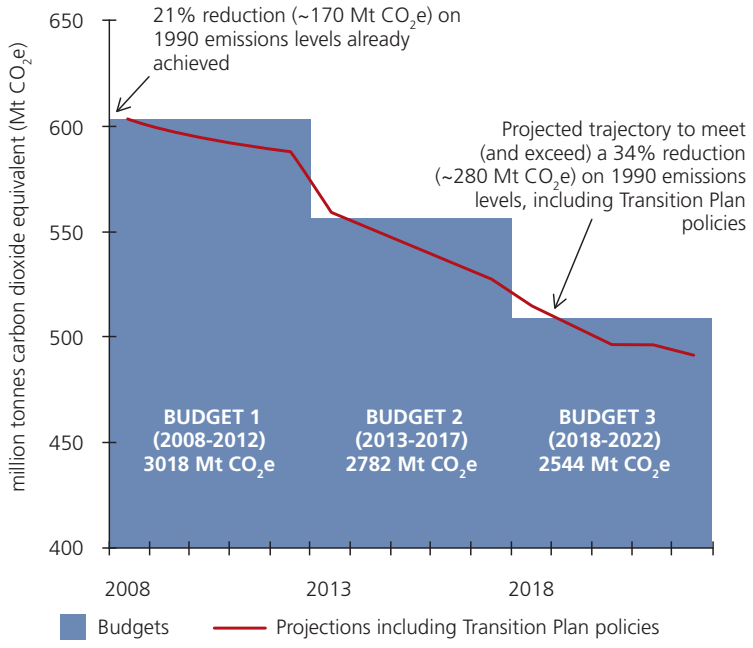
2. Introduction

2.1 Policy and Strategy

The United Kingdom's commitment to reduce carbon and other greenhouse gas emissions is now a matter of legal obligation. Under the Climate Change Act 2008, emissions are targeted to fall by 26% by 2020 (by comparison with a 1990 baseline) and by no less than 80% to 2050.

The Climate Change Act also requires the Government to establish a carbon budgeting system which caps emissions over five year periods, with three budgets set at a time, to set out a trajectory to 2050. The first three carbon budgets will run from 2008-2012, 2013-2017 and 2018-2022, and are set out in the UK Low Carbon Transition Plan published by the Department of Energy and Climate Change.

Figure 1: carbon budgets 2008 – 2022;
Source: UK Low Carbon Transition Plan, DECC, July 2009



The broad strategy by which this might be achieved is also set out in the Low Carbon Transition Plan, and this makes clear that the implications of a low carbon economy reach deep into every aspect of the construction industry, and the plan depends upon the industry for delivery.

Headlines of UK Low Carbon Transition Plan as it relates to construction

Residential

- Increased energy efficiency in all homes to reduce heating emissions by 29% by 2020 (from 2008 levels).
- All new homes to be zero carbon from 2016.
- Smart displays to be fitted to existing meters in two to three million households; and smart meters to be fitted to all homes by 2020.
- Major retrofit programme to increase the energy efficiency of existing stock.

Non-Domestic Buildings

- Increase in efficiency to reduce emissions by 13% by 2020 (from 2008 levels).
- All new public sector buildings to be zero carbon from 2018, and private sector buildings from 2019.

Infrastructure

- A larger, more flexible, smarter grid.
- New nuclear power stations to provide additional 16GW of power between 2018 and 2025
- Major programme of wind power and marine energy to increase electricity from renewable sources to around 30% by 2020.
- Programme of carbon capture from coal-fired power stations.
- New green communities.
- Infrastructure to support a more sustainable transport system, to reduce transport emissions by 14% by 2020 (vs 2008 levels), including sourcing 10% of UK transport energy from sustainable renewable sources by 2020.

It is scarcely an exaggeration to say that, over the next 40 years, the Low Carbon Transition Plan is a plan for construction.

So for companies in construction, the task is three-fold:

- to de-carbonise their own business, and to encourage the same habits throughout their supply chain;
- to provide the owners and occupiers of both new and existing stock with buildings that emit less carbon in their construction, operation and decommissioning – saving them money in the process;
- to provide the infrastructure by which the means of supplying clean energy and sustainable practices in other areas of the economy, such as transport and agriculture, are enabled.

Representing close to 9% of the UK's gross domestic product (approximately £114 billion of gross value added in 2008), and then employing some 2.6 million people, the construction industry has always been of major importance to the economy. In the words of the House of Commons Business and Enterprise Committee report of 2008, "construction matters". There can scarcely be a time in its history, however, when the strategic importance of the industry has been greater – not just to renew the country's building stock, but to do so in a way that meets the needs of a new low carbon economy, and at a time of economic restraint.

This pivotal role creates the opportunity, and almost the obligation, for the construction industry to take up a position of leadership, going beyond the execution of the work to act as advocates in preparing the broader public sector, business and public opinion for what lies ahead. This will require new thinking, new ways of doing familiar things, and the acquisition of skills that will provide competitive advantage at home and internationally.

Delivering a low-carbon economy is vital to our future prosperity and we welcome the IGT's contribution to how this can be achieved. Given the major role that construction can play in helping to reduce carbon emissions, the industry is ready to play its full part and sees this as a real opportunity for leadership, innovation, development and growth

John McDonough, Chairman, CBI Construction Council

2.2. Low Carbon Study by Innovation & Growth Team

In recognition of both the challenge of innovation and the opportunity for growth implicit in the move to a low carbon economy, the Rt Hon Lord Mandelson, Secretary of State for Business Innovation and Skills has commissioned a strategic review of the construction sector, to be conducted by an Innovation & Growth Team, with its membership drawn from the industry and from Government. It has a specific remit to:- (*inter alia*, and all in the context of carbon reduction)

- assess the strengths, weaknesses, opportunities and threats to the UK construction industry;
- identify the barriers to improved performance by the industry, and to make recommendations to overcome them;
- consider how the industry can rise to the challenge of the low carbon agenda and make recommendations accordingly;
- produce a report which makes recommendations to Government which are capable of being taken into account in policy making, and to industry to produce an action plan for the transition to low carbon.

The question which urgently needs answering is: how can the construction industry most effectively deliver a low carbon future?

Lord Mandelson, Secretary of State for Business Innovation and Skills

The work of the team is principally being conducted through six Working Groups, under the oversight of a Steering Group.

The first three of the Working Groups are addressing different sectors of the industry:

- residential buildings, new and existing;
- non-domestic buildings, new and existing; and
- infrastructure.

In addition there is a Cross-Cutting Working Group, looking at issues common to all work streams; a Major Projects Group which is looking in particular at how lessons learned on large scale works can be transferred to other projects, both large and small; and a young professionals group (the 2050 Group) looking at the position beyond 2022 through to 2050.

The final report of the IGT will be issued at the end of the year, but these interim findings are intended to engage the industry on as a broad a front as possible, by publishing a number of tentative findings (generally expressed as propositions rather than recommendations) for consultation during the year, and to set out the scope and programme of the work through to the issue of the final report. This will also enable others already engaged in similar or parallel exercises to come forward.

2.3 Adaptation

The importance of adaptation is fully recognised by the IGT, both as a necessary response to unavoidable climate change and as a source of opportunity for the construction industry. However, the focus of this study is mitigation through carbon reduction, and adaptation (which is the subject of a separate report commissioned by DEFRA) is therefore outside its scope.

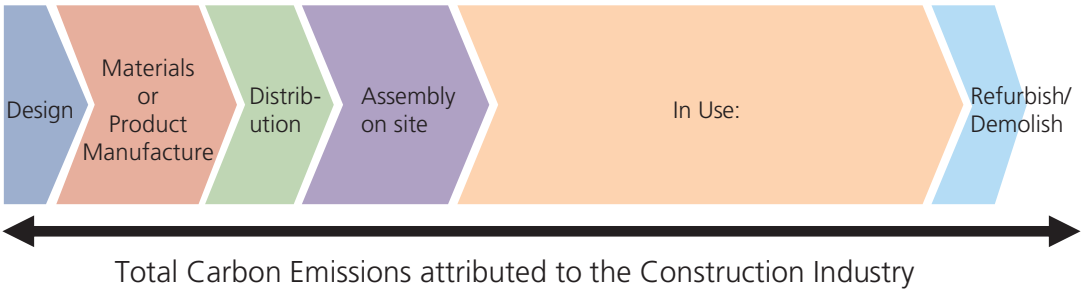
2.4 Carbon in the Built Environment

It is said that buildings are responsible for between 40% and 50% of UK energy consumption. In reality, this is too simplistic a statement to be helpful. The figure is derived from operational energy – that is, where energy is consumed, and it would therefore be truer to say that this is the amount of energy consumed by *people* in buildings. The distinction is more than pedantic, because it demonstrates that behaviour is going to be as important, or more important, than technology in reducing emissions. For the industry, the question is how can it develop a built environment that supports and encourages a life lived at dramatically lower levels of energy consumption.

Furthermore, the 40-50% figure, being based on buildings in use, excludes embodied energy – that is, the energy consumed in the extraction or manufacture of the materials and products required for construction work, or in the process of transporting and assembling them. This is counted in Low Carbon Transition Plan as the operational energy of the industrial and transport sectors.

However, the IGT regards its scope as being necessarily concerned with emissions from the whole life cycle of the process of design and construction, including this embodied energy; and also with emissions resulting from the use of the building *to the extent that the industry can feasibly influence them*. This is illustrated in figure 2.

Figure 2: The carbon footprint from the construction and use of a building



Concentrating on operational energy clearly avoids the risk of double-counting (given that all embodied energy was once operational energy somewhere in the construction process), but the IGT feels that practical ways of addressing a reduction of carbon in the industry demands attention be paid to embodied energy, in order to engage the full supply chain.

This is not instead of paying due attention to operational energy, but rather in addition – so that "whole life carbon" becomes as important a means of appraisal as whole life cost and value should be.

Appraising in this way also avoids a number of unintended consequences of not doing so, including:-

- that it would otherwise be possible to count as a good thing an "energy saving" product which consumes more energy in its manufacture than it can save over its working lifetime;
- that imported materials would effectively arrive at the site "carbon free" in accounting terms, creating the risk that emissions are effectively exported rather than reduced ("carbon leakage"), and that UK manufacturers seeking to reduce their emissions, or paying to offset them, are disadvantaged; and
- that unnecessary increases in carbon emissions may be created by demolishing and replacing a building, where the carbon benefit of recycling existing structures is not taken into account.

The way that the rules of the carbon marketplace are framed will also influence basic objectives in product design. If, for example, operational efficiency is rewarded, but resource efficiency is not, then manufacturers may be expected to develop products that perform well over their life, but for which the design life will be relatively short – leading to the embodied carbon penalty of having to replace them more frequently.

These effects could be avoided by operating a "net carbon added" calculation throughout the supply chain, as a mirror of valued added accounting. One way or another, though, they must be avoided if CO_2 emissions are to be minimised.

Proposition 1: that, as soon as a sufficiently rigorous assessment system is in place, the Treasury should introduce into the Green Book a requirement to conduct a whole life carbon appraisal, and that this is factored into feasibility studies on the basis of a realistic price for carbon; and becomes a matter of confirmation through the OGC Gateway process.

Further work: IGT to establish stretching but achievable targets for embodied carbon for different building types, considering each part of the project life cycle, in order to encourage innovation by design teams and input from the supply chain.

Following the project life cycle shown in figure 2, this further work would follow the consideration of the carbon that could be taken out of the process through:

- design and material selection;
- improved product design, and de-carbonising extraction/manufacturing processes;

- better logistics between factory and site, including use of consolidation centres, low carbon vehicles etc;
- better logistics on site, including reduction of double handling, just-in-time deliveries, reduced waste for disposal off site etc;
- low carbon construction operations.

As a preliminary indication, Figure 3 shows the IGT's preliminary estimate of the carbon footprint (measured in terms of CO_2 equivalence) that construction can influence. The total footprint figure of 306 $MtCO_2e$ represents 48% of the UK total CO_2e emissions[1] in 2007. The figure for 'in-use' includes emissions from unregulated energy use in homes and process emissions in industry, in other words it represents emissions from peoples' activity in buildings.

Figure 3: Estimate of the carbon footprint of UK construction 2007[2]

Sub-Sector	Greenhouse Gas Emissions Mt CO_2e	% of total, Carbon Footprint
Design	**<0.1**	<1%
Manufacture	**39.8**	13%
Distribution	**6.1**	2%
Operations on-site	**4.5**	1%
In Use[3]	**255.9**	84%
Carbon Footprint Total	**306.3**	100%

2.5 The focus of carbon reduction

Carbon reduction is not the only key issue for the industry, and all of the other items on the business improvement agenda (increased productivity through process improvement, the elimination of waste, respect for people, properly negotiated terms of employment and rates of pay, higher levels of training, full regard to health and safety etc) remain undiminished.

Nor is energy efficiency the only measure of sustainability. Nonetheless, measures of sustainability have become so broad and varied that it is possible to claim that almost any new building is "green" on the grounds that it ticks a few of the boxes. A concentration on carbon (as shorthand for carbon dioxide or its equivalent) therefore brings both simplicity and rigour to the subject, providing focus and a sense of priority.

1 UK end user emissions as 636.2 Mt CO_2e, National Communication, February 2010
2 Full detail of this calculation (which is preliminary and subject to further evidence) is available: http://www.bis.gov.uk/constructionigt
3 Excludes estimates of non-CO_2 GHG's for Non-Domestic buildings

Attending to carbon reduction also draws in many other desiderata, including air quality, water conservation (water being carbon heavy in its treatment and distribution), resource efficiency (all waste arising from the construction process representing embodied energy that has also been wasted) – and, indeed, the efficient use of money. Taken to its logical conclusion, carbon will become another means of exchange, requiring the same management and accounting processes as money itself.

The one qualification to this is that, given that a key objective must be energy reduction, rather than just switching to energy from cleaner sources (which may still be used wastefully) or to carbon trading, energy should be measured first when assessing the performance of a building, and then be converted to its CO_2 equivalent. This is considered further in section 3.1.4 below, in the context of Display Energy Certificates.

2.6 Construction industry response to carbon reduction policies to date

The construction industry has engaged positively with the issue of sustainability since the word first came into common currency, and stands ready to play its part in responding to the more focused challenge of carbon reduction.

We live in uncertain times but there are two things we can take as a given – the continuing impact of climate change and the fact that we are running out of resources. We all have a responsibility to do something about this. The construction industry is already designing and building low carbon buildings. This provides tremendous business opportunities and creates new skills. We are up for the challenge. **James Wates, Chairman, UK Contractors Group**

There are already many examples of good practice, including:

- construction clients who are prioritising carbon reduction in the design of buildings commissioned for their own use, or for sale or letting – for example in the retail sector, with Marks and Spencer's "Plan A" and projects such as Sainsbury's low energy store at Greenwich Peninsula and Tesco's zero carbon store at Ramsey;

With our Ramsey store, we got to zero carbon a decade before the Government's target date – a step on the road to becoming a zero carbon business by 2050. Some of the measures that make a store zero carbon will pay for themselves quickly through the energy they save; but even where the

benefits take a little longer to materialise, we have made this investment because we see advantages in being ahead of legislation and preparing for a future of higher energy prices. We owe it to our customers, who want us to show leadership. Sir Terry Leahy, Chief Executive, Tesco

- other clients who work with their supply chain to establish new standards for low carbon products – such as the Olympic Delivery Authority's work on low carbon concrete and the use of recycled aggregates in concrete blockwork;
- house builders who are developing designs at the various levels of the Code for Sustainable Homes – such as the Innovation Park at the Building Research Establishment, and Miller Homes "Miller Zero" Pinnacle pilot project, near Basingstoke;
- many architects and engineers who have developed a strong track record in the design of energy efficient buildings, earning the United Kingdom a reputation as world leaders in sustainable design;
- contractors who have made real efforts to de-carbonise their own operations, and to spread good practice down through their supply chain;
- product manufacturers who have introduced innovative designs in response to the demand for increased energy efficiency; and manufacturers who are working together in innovative new ways, to develop products that depend upon the skills of more than one company – such as the joint venture announced between Kingspan and Romag for the incorporation of photovoltaic cells in insulated roof and wall panels.

However, although the number of examples of good practice and innovation is increasing, progress remains patchy, and there needs to be a quantum change in the industry's response to the carbon reduction imperative if the commitments of the Climate Change Act are to be met, and met in the prescribed timescale.

The following sections of this report therefore consider, first on an industry-wide basis, and then for each of the IGT workstreams, the status of each sector and the main barriers to the necessary transformation of construction-related businesses – probably the biggest change management programme that the industry has faced since Victorian times.

The context for this is that, if the industry can, with its clients, overcome those barriers, then it stands on the threshold of four great opportunities:

1. To carry out a quite spectacular programme of work, stretched out over at least the next 40 years. (The programme announced for wind power alone has been estimated at £70bn.)
2. To make use of that workload to reform the structure and practice of the industry in the way espoused in many Government and industry reports.
3. To export the products knowledge and skills of a modernised industry to countries following the UK's lead in reducing emissions from the built environment
4. To excite future generations of potential recruits into an industry with a noble cause – at the very core of addressing probably the greatest challenge of our time.

All of these opportunities need to be seized, failing which they become threats, if others move faster and further.

Proposition 2: That, to support this process, the Government should, in the short and medium term, consider the potential for the procurement of publicly funded construction programmes to be used as test beds for transformation of the industry and its product towards a low carbon outcome.

3. Industry-Wide Issues

3.1 Supply side barriers

3.1.1 Complexity and lack of awareness

As part of its background work, the IGT has conducted a search of recent and current work relevant to carbon reduction. The current count of reports and initiatives, undertaken either by the Government or by NGOs or other special interest groups, currently stands at 200 and rising.

Standing below the over-arching strategies of the Low Carbon Transition Plan, there is a host of initiatives, research projects, pilot programmes etc, produced or sponsored by many different Government departments or agencies. To take just the case of energy efficiency in existing homes, recent or current initiatives include:-

- existing or developing strategies for Zero Carbon new homes;
- Kirklees Council's *Warm Zone* programme for increased energy efficiency in housing;
- the *Retrofit for the Future* programme being run by the Technology Strategy Board;
- The Energy Technologies Institute's research project into *Optimising Thermal Efficiency of Domestic Housing;*
- The *Delivering Neighbourhood Retrofit* project being run by the Sustainable Development Commission;
- The development of the Zero Carbon Hub's Energy Efficiency Standard;
- and many others.

Doubtless all of these initiatives represent progress and are a necessary part of the whole picture, but what is harder to find is the picture itself – that is, a timed (and funded) plan by which construction and its product will be moved from the status quo to a series of actions and behaviours that will meet the commitments in the Climate Change Act. Nor, given the lack of incentives, will such a plan emerge from the construction industry acting alone, and its development therefore needs to be moved by Government.

The sheer quantity of this activity is also just one measure of the complexity of the subject, and of the enormous amount of reading that is required by businesses to stay abreast of it – whilst all the while serving the more immediate interests of their clients and shareholders. Whilst, therefore, there is a good general awareness of the new focus on carbon reduction (and, on the evidence of the IGT's work to date, a very low level of cynicism about the science of climate change), few businesses have an accurate understanding of the sheer scale of the undertaking ahead; and there is a level of disbelief about whether (or at least when) the tough decisions that will lead to the necessary changes in the built environment and in the behaviour of those who occupy it will be made.

On the Government's side there is also perhaps an incomplete understanding of the detailed processes by which the enormous construction workload envisaged in the Low Carbon Transition Plan needs to be planned and executed.

The IGT therefore believes that the first task is to take each tranche of work assumed in the Transition Plan, and prepare a detailed plan, scheduling out all of the lead-in operations, and the necessary timing of any new regulations, incentives etc. if the necessary actions are to be taken in good time to meet the trajectory of the carbon budgets set out in the Transition Plan. This will also call for an assessment to be made of the rate at which low carbon practices will be taken up by Government, business and the public in each workstream, in response to whatever regulation, incentives or penalties may be designed to stimulate change.

Recommendation: Government to commission a Program Manager to prepare a detailed execution plan for the physical work assumed in the Low Carbon Transition Plan, steered by the IGT, and with adequate access to all Government departments and agencies having a relevant stake in each tranche of work. This programme will then become part of the IGT's final report at the end of the year.

3.1.2 Construction industry fitness for purpose

There have been many reports into the structure, conduct and performance of the construction industry – most recently those led by Sir Michael Latham (*Trust and Money* 1993 and *Constructing the Team* 1994), Sir John Egan (*Rethinking Construction* 1998 and *Accelerating Change* 2002) and Andrew Wolstenholme (*Never Waste a Good Crisis* 2009).

There is no need for any great new thinking to supplement these reports. There is, in fact, a fairly harmonised view of the developments needed to enable the industry to operate consistently at its best. These principally comprise:

- greater integration of the supply chain, from design through product manufacture and construction to operation, with a shared customer focus;
- committed client leadership and engagement in the process;
- greater collaboration between clients and the supply chain, based on long-term relationships, utilising procurement routes and contractual arrangements designed for that purpose, and tested by performance measurement;
- making design, product and construction choices on the basis of whole life value for money;
- clear definition of best practice regarding briefing, project management, parity of tendering, use of coordinated project documentation, timely payment through the supply chain etc;
- increased and better coordinated research leading to greater technical and process innovation;
- commitment to people – addressing culture, working conditions, training and skills;
- improved product development, including offsite fabrication, and the intelligent use of standardisation or mass customisation, and other modern methods of construction;
- and the more widespread adoption of Building Information Modelling (BIM) and other IT applications that have the capacity to improve resource efficiency right through the project life cycle.

There are good examples of *some* clients and *some* contractors working on *some* projects in accordance with these principles, and benefits have followed – with the Strategic Forum for Construction estimating, on the basis of demonstration projects, that integration and related best practice lead to improvements of between 25% and 40% in the speed of project delivery, whilst requiring between 11% and 30% less capital. However, as the Wolstenholme report shows, the adoption of new ways of working has been slow, and penetration has been low.

So whilst these principles do not need re-thinking, they do need to be looked at again in the context of a carbon reduction programme – in respect of which they become both more important and more urgent. In particular, a lack of integration between design, product development, construction and building operation represents a serious barrier to the development of innovative and cost-effective proposals for the reduction of carbon emissions associated with the built environment.

This does, of course, call for an adjustment on the part of both clients and their design and construction teams, and it leads to the following propositions.

Propositions:

3. That the industry, working through a collaborative forum such as Constructing Excellence or the Strategic Forum for Construction, should produce a tighter definition of precisely how an integrated supply chain should come together, what the gains would be, and how the client's position could be protected against cost increases resulting from a lack of competitive tension.
4. That, as an extension of this, a number of integrated teams should develop a delivery proposal for a suitable building type (such as one or more of the thirty six eco-schools which have been announced), with a view to showing how, given the right procurement and contractual arrangements, a zero or close to zero carbon building could be constructed for the same price as a building built only to current Building Regulations.
5. That the Chief Construction Adviser and the OGC should work with a public sector department or delivery agency responsible for a rolling building programme to seek to agree a procurement and contractual arrangement within which the above proposition can be tested.

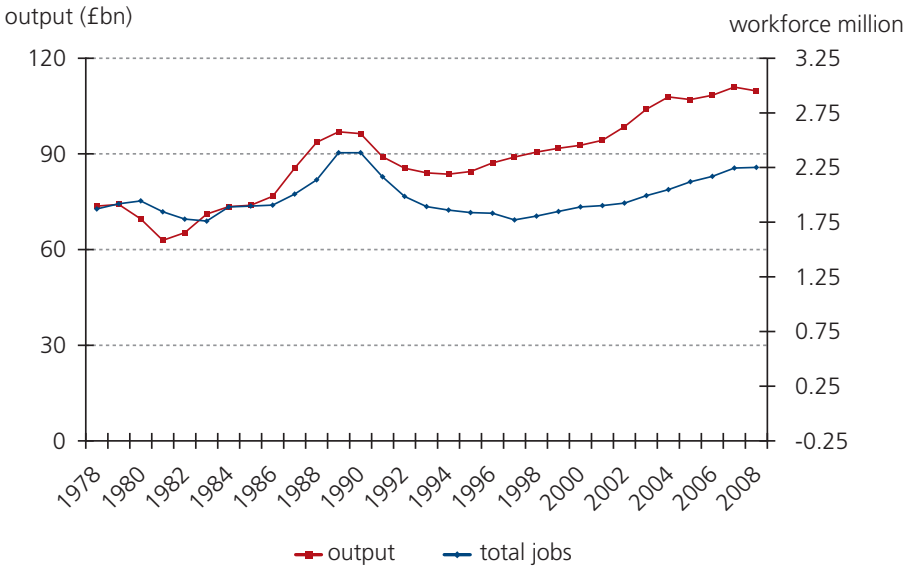
In addition, it has to be acknowledged that the industry has been weakened by the fall in its workload since 2007, and by the consequent loss of capacity. Innovation, the development of skills and investment in business and industry improvement all feed off workload,

and to be "fit for purpose" the industry first has to be fit. This calls for policies that allow and encourage the industry and its customers to be both the engine and the beneficiaries of economic growth.

3.1.3 Skills and resources

Although the anticipation of skills gaps and shortages have been a constant concern of the industry, growth in construction output has rarely been constrained by a shortage of human resources, and the relationship between output and employment is, unsurprisingly, closely correlated.

Figure 4: Construction output and workforce annual data graph



However, this fluctuation in workload and employment does have consequences:

- growth in output above the level of growth in the economy as a whole creates inflationary pressure;
- skills shortages are frequently filled by drawing in labour from overseas, which creates pressure on social costs lying outside construction output, and means that there isn't a constant up-skilling of the domestic workforce;
- inadequately skilled labour is drawn into the market;
- and as a consequence of the above, there is a risk of a loss of quality in the industry's output.

The last point is critical in the context of compliance and enforcement. This is considered below, but clearly enforcement is less of a problem where it is preceded by the skilful installation of products designed for compliance.

What is clear, though, is that there will be a growing and enduring need for a general up-skilling of all parts of the construction and property supply chains to address the location, design, construction and operation of low carbon highly energy efficient buildings, and of the way that they fit into the larger scale of neighbourhoods, towns and regions. The issue, which addresses skills gaps more than shortages, stretches along the whole delivery cycle – before, during and after the execution of work on site; and the move to more efficient buildings will require action on a number of fronts, including:

- Mandating low carbon practice as an element of all construction-related further and higher education programmes. University courses are already producing graduates with considerably enhanced awareness skills in sustainability; and this needs to be further encouraged and visibly portrayed as part of UK's future as a world leader in low carbon design and manufacture.
- Strengthening further the construction education infrastructure, to meet the need for specialist engineering skills in certain areas – e.g. transmission and distribution, smart grids, low carbon construction; and to increase the numbers of graduates in engineering compared to other subjects. There may be lessons from other countries on how this could be done – such as the German "Fraunhofer" approach to linking construction and training/education providers.
- Recognising the importance of leadership, and of changing the mindset of business leaders towards longer term planning – so that, for example, construction-related companies see leadership courses along the lines of the Cambridge Programme for Sustainable Leadership as a necessary and worthwhile investment for their best people.
- Up-skilling existing practitioners to transform their knowledge and practices in the application of low-carbon solutions. Alongside this, continuing professional development courses need to be developed and rolled out across the sector, addressing the use of design tools and methods to minimise embedded and whole life carbon.
- Establishing a network of practitioners to improve industry practice by sharing experience and ideas.
- Raising the awareness of SMEs to the opportunities available to them in the transition to low carbon (and the domestic retrofit in particular); and developing accessible programmes for gaining the skills necessary to take advantage both of the potential workload and of the opportunity to use that workload as a springboard for growth and development.
- Exploring ways to educate end users as to how buildings should be operated so that they perform to their fullest potential.

There is also a real need for the many institutions which operate in the sphere of construction to come together to co-ordinate their work (and not just on skills, but on all issues relating to sustainability), to avoid the duplication and confusion evident in their separate but parallel programmes.

The industry needs to get closer to research institutes, academia and government to inform research and development programmes on low carbon infrastructure with a view to large scale deployment, with R&D efforts undertaken by both industry and the research community acting together. This will need a major shift in attitudes to where responsibility for R&D currently lies and

how strategy is developed. This may involve the Technology Strategy Board (TSB), Modern Built Environment Knowledge Transfer Network (MBE-KTN) and/or the National Platform for the Built Environment, but a new, integrated approach will be necessary.

A number of initiatives designed to address the low carbon skills challenges facing construction are planned or in progress, including:

- the Built Environment Skills Alliance Future Skills Group has workstreams to identify skills gaps across a range of built environment sectors, looking at their impact on occupational standards and qualifications;
- ConstructionSkills, the Sector Skills Council for construction, is planning a 'Cut the Carbon' awareness campaign to launch shortly, under the banner 'What's in it for me';
- the Government will shortly publish a Low Carbon Skills Consultation document covering a number of industries, seeking views on the barriers and priorities identified and how the skills systems should deliver on those priorities.

The IGT will engage closely with this last exercise in particular, focusing on the needs of the construction industry.

Further work: working with interested parties (including the combined BIS/DECC team looking at low carbon skills generally, the Skills Councils, CIC and the institutions, etc), the IGT will map the landscape of skills development (who is doing what, and for whom – given the plethora of Government initiatives in place), to establish the status quo re skilled resources working in the industry; to identify the new or enhanced skills that will be required; to analyse the gaps; and to make recommendations to address them.

This will also build on work done by others, such as the mapping exercise conducted by the Zero Carbon Hub. It will also look at the influence of industry structure (and a business model whereby main contractors have generally moved away from direct employment) on continuity of employment, the development of trade skills, the application of terms and conditions that attract good people into the industry, the adoption of safe and progressive practices, and the engagement of the full depth of the workforce in an agenda for change.

3.1.4 Non-compliance and the invisibility of consumption

Notwithstanding the benefits of the simplicity of a focus on carbon reduction, carbon remains the effect of inefficiency rather than its cause. The first duty must therefore be to reduce energy consumption, and the starting point for that, as far as the existing stock is concerned, is to get the building systems running as they should. Studies repeatedly show that buildings do not achieve their design criteria, in energy efficiency terms, when tested post-completion. This may be the result of shortcomings in the original design, or in its execution, or in the way that the building is run, but given this fact and the size of the problem (with energy consumption having been measured at three or even four times the predicted level), it is extraordinary that so little priority is attached to seeing how buildings perform in practice.

There are two ready responses to this:

- to adopt as standard practice the post-completion energy audit of buildings to establish whether they are meeting their design standards;
- to make visible the consumption of energy through the introduction of smart meters, and/or the posting of Display Energy Certificates (DECs) which, on the basis of energy measured by type and source, should demonstrate whether a building is efficient in terms of its electricity use, thermal energy use and carbon emissions – all benchmarked on an A to G scale.

Propositions:

6. That the possibility of re-introducing a programme of independently conducted, properly funded published audits of buildings' energy performance by comparison with their design criteria, should be explored. These would be along the lines of the PROBE studies conducted by the Usable Buildings Trust a decade or so ago, and consistent with the principle of the Soft Landings Initiative.

7. That the scope for major companies in the construction industry to subscribe to a voluntary scheme for the posting of DECs in their own buildings, following the practice now mandated for public sector buildings, should also be explored. This could perhaps be an extension of the voluntary programme proposed by the Strategic Forum for Construction for on-site energy conservation.

For new buildings, there must also be a new stress on ensuring compliance in meeting design and regulatory standards in construction. The problem of non-compliance has long been recognised within the industry, but it is going to take on a critical importance as design is increasingly directed towards energy efficiency. Unless the standards of workmanship necessary to deliver high levels of air-tightness, insulation etc are achieved, then the risk is that enormous sums of money could be expended without a commensurate reduction in emissions. Countering this risk is a matter of designing for ease of accurate installation, product development founded on the same principle, training of the workforce, testing for compliance, and finally enforcement.

Further work: The IGT will consider possible mechanisms to ensure higher levels of compliance – such as linking Building Regulations approval to the quality of installation in practice as well as specification, and applying more widely performance testing requirements such as those in the Code for Sustainable Homes.

3.1.5 Competitiveness

Whilst contractors are judged principally on a lowest price basis, even where other factors are taken into account, they will understandably exclude from their offer any proposals that add to cost without adding to competitiveness. They will also exclude proposals that *may* produce a competitive benefit (in the form of increased productivity or reduced waste, for example) where there is insufficient confidence to factor this into the bid.

There are two responses to this:

- to demonstrate through measured case studies where competitive benefits have accrued through good practice implemented to reduce emissions;
- in the interim, to investigate where voluntary or locally enforced codes may address the externalities of contractors' costs in the interests of reducing emissions.

As an example of the latter, a soon-to-be-published report by Arup for the Strategic Forum for Construction will propose the formation of an industry task force to explore the scope for driving quick innovation to reduce on-site emissions by using LED temporary lighting on all sites; introducing bio-fuel for generators and major plant; enabling all mobile plant to turn off automatically when not in use; introducing timers on all 110v transformers so they automatically turn off at night and weekends; and prioritising power connections from utility companies to construction sites, to avoid the need for inefficient temporary generators. It is estimated that these actions alone would cut carbon emissions during construction by up to 15% – a valuable contribution to the reduction of embodied carbon.

Further work: as part of targeting carbon reductions right through the supply chain, the IGT will consider how a case can be made for the widespread adoption of low carbon measures for which there is no obvious business case – such as consolidation centres in city centre locations (the construction equivalent of "park and ride"), where the immediate benefits go to hauliers and suppliers, rather than be captured by clients.

3.2 Demand side barriers

For the construction industry, though, there is little doubt that the most impenetrable barriers are on the demand side. Much has been written about the "circle of blame" – which could more accurately be called a circle of inertia: because we cannot demonstrate the value of carbon efficient buildings, clients do not demand them. Because they do not demand them, new technologies are not developed and built – so there is no evidence.

This circle needs to be broken, and although the most effective way to do so is to create a business case for increased demand, this is not within the control of the construction industry – and in the meantime, the clock started by the Climate Change Act ticks on.

Clearly the levers available are any of the following, either singly or in combination:

- campaigns designed to convince the public that they should reduce their energy consumption, reinforced by public sector example;
- regulation that effectively rations the carbon emissions attributable to a consumer;
- regulation that prescribes standards that are designed to bring about a reduction in energy consumption;
- fiscal penalties for consumption;
- fiscal incentives for investment in measures designed to reduce consumption.

Put another way, there has to be a presumption that consumers will be converted to energy efficiency on the basis of peer pressure or conviction; or that they will be priced or regulated out of energy consumption; or that

they will be incentivised (most obviously by payment, subsidy or relief) to adopt products or practices that have the same effect.

From the point of view of the construction industry, and whatever levers are used, there is a need for clear signals that there is going to be a wholesale take-up of low carbon solutions if companies are to have the confidence to invest in new products, methodologies and skills. Also, to meet the timetable of the Climate Change Act, those signals need to be in place very soon – and on the evidence of new build housing, and the operation of Part L and the introduction of the Code for Sustainable Homes, the surest signal is regulation, announced in advance, with clear dates for implementation.

As just one example of this, prior to the introduction in 2002 of higher standards within Part L, the market take-up of condensing gas boilers was 40%. With the implementation of Part L, this has now risen to more than 90% – close to the practical maximum; and because of product development, the cost of condensing boilers is now below that of conventional boilers.

This is the beneficial consequence of industry innovating around a new standard, and re-tooling to deliver it competitively. A similar thing happened with the programme to introduce double-glazing – so that single glazing is now generally more expensive than double.

So the evidence is that the industry will take well-designed and effectively enforced regulation as a clear signal that demand will grow, stimulating investment and innovation.

The second clear signal would be the promise of a stable or rising price of carbon, with a protected floor, so that investment in new low carbon products can be committed in the certain knowledge that they will have a value related to their capacity to reduce a purchaser's exposure to that price.

Other means of changing behaviour will work, of course, but the timescale over which they take effect, and thus the size of the market at any particular time, will inevitably be unpredictable; and in those circumstances it can be expected that the industry will follow, rather than lead, the change – and the trajectory of carbon reductions assumed in the Low Carbon Transition plan will not be achieved.

The particular challenge that this sets for the existing housing stock is recognised. However, the application of an escalating standard for new housing, in the form of successive levels of the Code for Sustainable Homes, without any commensurate pressure to raise the energy efficiency of existing homes, clearly has the potential to act as a disincentive to develop new build homes.

CIBSE believes that changing our buildings and communities is the first and fastest step to a less carbon intensive world. Engineers, architects, facilities managers and all those involved need to be united in their vision and in their approach to delivering that vision, while building users must demand change, and show their desire for more energy efficient workplaces. We must speed up the process and make real headway now in order to have a fighting chance of reaching future targets.

Mike Simpson FCIBSE President, Chartered Institution of Building Services Engineers

3.3 Methodologies, tools and data

The means of achieving purposeful progress is also conditional upon the development of methodologies and tools which can be adopted as industry standards, backed by authoritative data so that they are trusted to produce the right outcome. Although there is much work in progress, there are gaps, and the need to develop workable solutions is critical if the mandated trajectory of carbon reductions is to be followed. Examples that have arisen in the work of the IGT to date include:

- carbon accounting systems, specifically in respect of "whole life" accounting, and the related need for an incentivising policy re discount rates;
- more specific standards for carbon footprinting and labelling;
- data on materials and product footprints, life cycle etc, on a rolling basis, keeping pace with the introduction of new products (which will involve addressing issues of intellectual property and disclosure);
- methodologies for testing the anticipated performance of design propositions.

Taking just the last of these, the work on developing the Standard Assessment Procedure (SAP) and Simplified Building Energy Model (SBEM) programs for modelling the energy/carbon performance of domestic and non-domestic building designs is vital.

Further work: to map the requirement for methodologies, tools and data specific to the transition to low carbon construction; and to make recommendations for adoption or further development work.

4. Major Projects

The Major Projects Group also has a cross-cutting aspect to its work: to consider how lessons learnt from major projects can be taken up within the industry more generally. The main themes set for the Group are: scalability (including how to scale down successful practice to render it accessible to smaller projects), knowledge capture and transfer, and the effective mechanisms to achieve that.

"Major projects" have been taken as those which have both the size and duration to create their own standards in the industry – projects that are sufficiently significant and structured in such a way that the usual market constraints can be influenced or changed.

Major projects might be defined by scale and duration (such as Crossrail), but what might be taken as a large housing project, in terms of value or duration, might not count as major in the case of an infrastructure project, or a programme of projects. So major projects should perhaps be defined not by size, budget, physicality, location or building type but rather by the scale and importance of their impact (environmentally, socially or economically); and by what can be learned and transferred.

Such projects are generally (though not exclusively) led, sponsored, and procured within the public sector; and this gives both local and national Government the opportunity to take a lead in knowledge capture and dissemination, and setting standards for a number of criteria, including carbon reduction.

Major clients have the opportunity to introduce new concepts or to trial them over a series of projects. Through their size and capability they can create their own rules, dedicate more resource to experimentation, and make clear their expectations of suppliers.

Central and local Government may also be able to leverage greater improvements in the future by looking for ways to exploit the benefits of scale, particularly through the initiation of rolling programmes for repeat building types.

In brief summary, major projects provide the opportunity for knowledge transfer in areas such as:

- integrated planning, design and engineering;
- collaborative procurement and contractual arrangements, including the use of framework agreements and working with all tiers of the supply chain;
- governance and management functions, including resourcing specialist roles such as Carbon Manager, Logistics Manager etc
- championing innovative products and processes, including setting new standards and piloting new ways of working;
- advanced HR policies, including labour engagement, industrial relations agreements, and specialist training and development for professionals, craftsmen and operatives;
- and economies of scale, including the opportunity to apply neighbourhood level systems for heat and power.

Taken together, these characteristics provide a unique opportunity to address the low carbon agenda, allowing specifiers, designers, clients, planners and contractors to test ideas and learn lessons – which can then be captured and communicated more widely.

In its deliberations, the Working Group has addressed four main questions:

- barriers – and what inhibits the effective transfer of knowledge and experience;
- levers – and the opportunities for improvement;
- potential quick wins to improve performance on knowledge transfer, especially in respect of carbon reduction;
- and ideas for future work.

In addition, the Group is considering what might be done to pull new products (such as low carbon concrete) routinely into the supply chain; and the scope for major projects, particularly mixed use developments, to take advantage of low carbon community heating and power projects.

Emerging ideas have been brigaded into main themes and prioritised for further development. The first priority, though, is the identification of a suitable platform for knowledge capture and transfer.

Proposition 8: That the industry should develop a means of capturing and more widely disseminating best practice gathered from major projects. Good practices are quickly dissipated in the construction industry, the "not invented here" syndrome is a particular challenge, and the project-based nature of the industry is a weakness. This will include identifying a suitable platform for knowledge exchange.

Further work: Three strands in particular have been identified for further investigation by the Working Group, building on similar or related work completed or in progress elsewhere, and reaching out to other organisations engaged in major projects:

1. Acknowledging the potential positive impact of major projects on industry practice, and identifying mechanisms for more effective use of current and future major projects to raise the bar of achievement in terms of low carbon practice. Considering, in particular appropriate public sector major projects, the scope for devising criteria that might be used to set higher standards in terms of carbon footprints.
2. Action on communications and publicity to promote effective knowledge capture, retention, and communication of lessons derived from major projects to other smaller scale projects.
3. Establishing a common industry database that would assist the adoption of good practice.

5. Housing

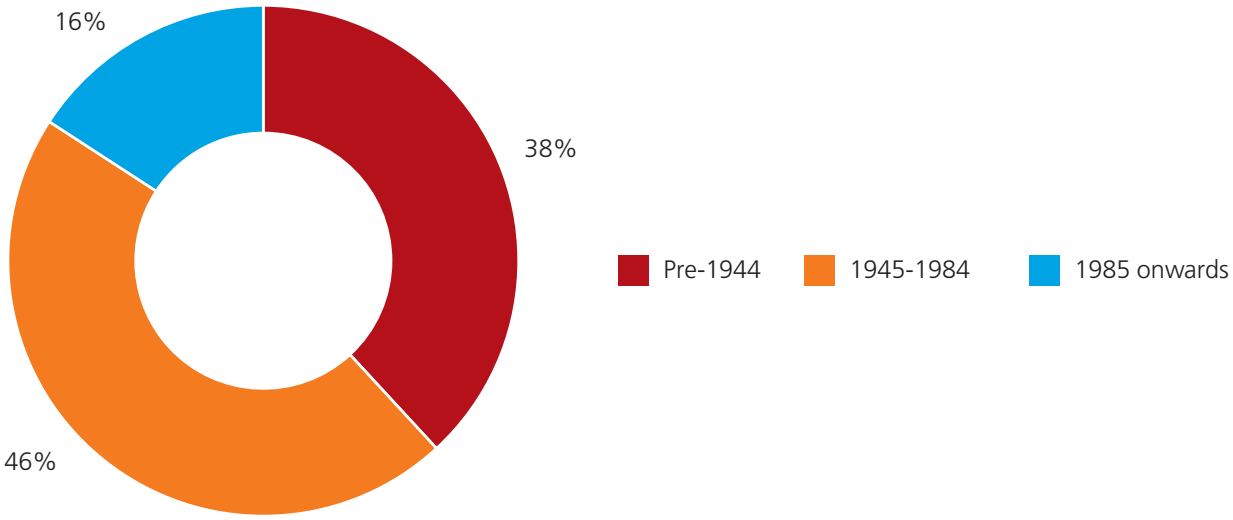
5.1 Summary of key initial findings

- New build housing is making progress towards its 2016 regulatory target but cost, coupled with technical constraints associated with smaller sites, is currently viewed as the major barrier to economic delivery, especially for smaller house-builders.
- While there could be a significant retrofit market for existing homes the industry has not yet engaged at scale, and is unlikely to do so until there is evidence that demand will grow.
- Significant action (grant, fiscal and regulatory) needs to be taken to ensure demand is triggered by consumers.
- The construction industry could then face significant skills and re-training issues as the market takes off.
- Technology (including process) and scale will be critical to bringing down cost in future
- Energy policy needs to be clearer, so that de-carbonisation is cost effective and delivers to the whole built environment including existing homes.

5.2 The characteristics of the sector

- As at 31 March 2007 there were 26,652,000 dwellings in the UK (70% owner occupied, 12% privately rented and 18% social rented).
- 700,000 homes are vacant.
- Britain has the oldest housing stock in the developed world – 8.5 million properties over 60 years old.

Figure 5: Age of housing stock in England:
Source: CLG Live tables, table 110: Year built by region



- One in four homes in the UK is of solid wall construction, reducing the scope for quick and affordable insulation.
- The energy used to heat, light and run our homes accounts for 27% of all of the UK's carbon emissions – around 40 million tonnes.
- House builders generally follow a "current trader" business model: land acquisition, development and sale of the new home, retaining no long term interest in the property.
- In 2006 the top 10 homebuilders built 44% of all new homes, the 75 largest supplied 63% of output, and 25% are built by 5,000 small or micro firms.
- The bulk of new homes are delivered by traditional techniques, but the use of offsite production and other modern methods of construction is growing, offering advantages in energy efficiency and improved product quality.
- The sector is subject to extensive regulation, and the availability of suitable development land is controlled by the planning regime.
- The market is highly cyclical, and is characterised by long term under-supply.
- The Government has set a target of 240,000 new homes per year in England by 2016, delivering 3 million homes by 2020.
- This is challenging in view of the recent downturn, with UK house building rates the lowest amongst the major economies.
- In 2009, spending on new build homes amounted to £14.2bn; and repair, maintenance and improvements, public and private, accounted for £21.5bn.

5.3 The challenge to the industry

Government has committed to reducing the UK's CO_2 emissions by 80% from 1990 levels by 2050. This applies equally to housing, which also has the shorter-term target of a 29% reduction in non-traded emissions by 2020[4].

From 2016 it has prescribed that **new** homes will be built to ensure they have net zero carbon emissions over the year[5]. There are substantial challenges to overcome to achieve these 'new build' targets, which are picked up later, but already momentum is building in the industry to gear up for delivery.

For existing homes there are programmes running to increase insulation levels, primarily to cavity walls and lofts, funded directly by Government or as an obligation on energy companies funded through electricity and gas bills.

However, to bring existing homes up to the standard required to meet the overall carbon reduction targets, a much more intrusive programme of whole house retrofit will be required for a large number of the 26 million dwellings that exist today.

4 Warm Homes, Greener Homes: A Strategy for Household Energy Management, HMG, March 2010.
5 Building A Greener Future: Policy Statement, HMG, July 2007

5.4 The opportunity for the industry

The opportunities that present themselves to the construction industry are three-fold.

Firstly, the scale of retrofit required is very substantial, assuming demand is forthcoming. Based on the work already done, refurbishing the fabric of existing buildings could cost between £2,500 and £15,000 per dwelling depending on the dwelling type (ranging from apartments to detached houses) and the level of improvement required[6]. Refurbishment of most of the existing stock at the simple mean of this range of cost would require an investment of more than £200 billion by 2050. In addition, depending on overall energy policy, it is likely that substantial investment will be required to deliver single building or distributed energy solutions as well.

If the industry focuses on just the refurbishment of the fabric of existing buildings, based on these initial costs, it could amount to a business opportunity approaching £5 billion per annum for the next 40 years.

Secondly, by leading the world in the production of new zero carbon homes and the refurbishment of existing ones, and given that much material is sourced locally – especially where transport costs are a significant factor, it is possible that suppliers may retain or base their factories in Great Britain rather than elsewhere, creating more employment opportunities and inward investment.

And thirdly, the experience gained in delivering such far-reaching programmes should give British consultants and construction companies real competitive advantage when bidding for work overseas.

5.5 The issues and potential solutions

Not surprisingly, delivering a programme of this size is not without its difficulties and there are a number of key barriers that will need to be overcome. Whilst not exhaustive, these are set out below.

5.5.1 Creating 'customer pull'

For new build, whilst there is a need to get customers engaged in wanting to buy a new low carbon home, there will effectively be no choice between new dwellings in future. The biggest challenge the 'new build' industry faces today is the cost of delivery. Progress is being made to deliver the fabric improvements required, but the cost of on-site energy solutions is currently prohibitive, especially on smaller sites. In reality, the premium that these new homes will attract will be limited by the energy savings available and the price of competing existing homes.

6 Sustainable Refurbishment of the Existing Housing Stock, Housing Forum, April 2009; Solid Wall Supply Chain Review, Purple Market Research for Energy Saving Trust and Energy Efficiency Partnership for Homes, May 2009

For existing owner-occupied dwellings, customers will need to 'opt in' to a refurbishment programme. A reasonable amount of thinking has been done on ways to encourage this engagement, but none has been demonstrated at scale yet.

These include:

- 'Pay as you Save' schemes where the initial capital cost may be funded by a mix of Government subsidy, long-term loan and savings made by the customer on future energy bills.
- Changes to the tax system that incentivise or penalise behaviour through the level of Stamp Duty or Council Tax paid.
- Regulation on the supply chain to allow the sale of only very highly rated appliances in the home including lighting, heating and electrical fittings.
- Innovative energy tariff structures such as feed-in tariffs and the renewable heat incentive that make it more attractive for developers and householders to invest.
- A strong campaign of communication to inform consumers' views and motivate them to engage with the programmes that become available.

It is felt that different solutions will be needed for private and social rented properties, given that these dwellings are controlled by landlords. The challenge will be to find a simple mechanism that turns 'up front' investment by the landlord into a higher rental stream from the tenants that reflects the savings they make on their energy bills.

5.5.2 Reducing the cost of delivery

Given the scale of the investment required an absolute priority is to establish how the cost of implementation can be reduced considerably for both new and existing buildings.

The deployment of skilled professionals is key to ensuring design and technology solutions are identified and implemented successfully. Once it is clear which solutions are the most appropriate, and the most cost-effective in terms of carbon reduction, we expect there to be considerable benefits as scale increases. This assumes co-ordination and sharing of best practice solutions as they emerge.

Product and process innovation should enable new and lower cost solutions in future, and this should be further encouraged through the various research, development and funding programmes that exist today.

For existing homes, the delivery mechanism will be key to reducing the cost of roll-out. A community approach for private dwellings would be preferable but will be more difficult to organise. Nevertheless, this is likely to bring considerable benefits if the approach includes energy, new build integration, retrofit and other community services.

For rented properties there is likely to be real benefit of programmes directed at landlords' complete portfolios; and one proposition that needs to be tested is that the retrofit programme could be kick-started by prioritising social housing, if funding can be secured, perhaps in a Low Carbon Economic Area such as Manchester.

One of the biggest costs to deliver very low carbon homes is around the provision of renewable energy. Energy policy needs to identify what could be delivered through the de-carbonisation of the grid and what could be delivered through distributed networks of heat and/or power. Where those networks are community rather than dwelling specific, existing experience suggests that these will be lower cost. There is clearly a link between new and existing communities and this does have wider implications across the whole of the construction sector.

5.5.3 Creating the supply chain

Assuming the demand for lower carbon homes is established and that the economics of delivery can be accommodated, then the final challenge is how to create the delivery and supply chain to make low carbon homes a reality.

In the new build sector, the industry is already tackling this with many lower carbon developments already in the course of construction. Once mainstream solutions emerge, it is expected that the supply chain will continue to innovate to deliver better and lower cost solutions to the development industry. In parallel, skills and re-training requirements will become clearer.

For existing homes, the situation is quite different, as today there are only a few companies with the capability to deliver a limited number of refurbishments. To deliver the volumes required will require a substantial expansion of the installer industry and a number of sizeable new entrants, and the skills required for a massive increase in the level of refurbishments will not be readily available without significant new recruitment and training.

To ensure that the opportunity is made visible to the wider industry, it is proposed that a value mapping analysis is undertaken.

Given the intrusive nature of refurbishing existing homes we should not under-estimate the need to ensure that any delivery capability is of the highest calibre, delivering high quality, accredited solutions. This too is likely to require an increase in specialist skills, not least surveying (to sign off what is required) and building control (to ensure that the work has been done properly).

To give some idea of the scale of this task, the average number of new dwellings created over the last 20 years has been about 187,000 per annum. To meet population growth and demographic change it is estimated that output needs to increase to an annual average of 240,000 dwellings over at least the next 20 years – and, in addition, an average of 700,000 dwellings per annum will need to be retrofitted to bring them up to acceptable levels of energy efficiency.

Whilst it is legitimate for a business to wait until it can have sufficient faith in the market before making any significant investment in serving it, the IGT believes that the industry should, as an act of leadership, engage actively with the various studies and trial projects currently planned or in progress in respect of the domestic retrofit, to show how a supply chain could come together to deliver a programme of work that is unprecedented in its scope and scale.

Because this involves work in peoples' homes, and frequently whilst they are still in occupation, this cannot be conducted on a "business as usual" basis. Instead, the industry needs to

produce an integrated proposition, that covers every step in the process including:

- Diagnostics and measured surveys;
- identification of necessary physical treatment;
- the development of products which will make the task more secure and less disruptive;
- the logistics of assembling labour and materials for the execution of the works;
- accreditation of those responsible for the work;
- customer care throughout the process;
- customer instruction in the operation of the building and its systems on completion;
- ensuring compliance;
- insurance and financing packages;
- the program management of all of the above.

In addition, the industry needs to advise on the best way for this work to be brought forward (whether on a "whole street" basis or otherwise) in order to secure the greatest possible value for money.

By showing how this work could be carried out in such a way that customers can feel confident about its execution and finished quality, and by bringing down its cost, the industry can play a positive part in promoting consumer acceptance of the work that is required.

To ensure that the industry moves as quickly as it can to prepare itself for market growth when it comes, an independent body should be put in place to plan for delivery. This would be modelled on the highly successful Zero Carbon Hub that exists for 'new build', and could be handled as an extension of the Zero Carbon Hub's current remit, or by a separate organisation with the same independence, breadth of stakeholders, commitment to open access, the capacity to reach into the regions, and the knowledge, skills and resources to command respect.

In addition, work should be initiated with potential warranty providers to ensure that the consumer can have the peace of mind that the job will be carried out properly and achieve the desired result. Only work carried out under such schemes would be eligible to financing and grant programmes put in place (such as PAYS). Again, lessons can be taken from the new build market from providers like the NHBC.

Proposition 9: An *'Existing Homes Low Carbon Hub'* should be put in place to provide the leadership for the industry to start planning for delivery. This could link naturally to CLG/BIS tentative proposals for a Retrofit Consortium.

Further work

- Estimating the size of the business opportunity and agreeing the timescales for delivery
- Reviewing the solutions for delivering 'customer pull'
- Identifying the benefit of technology and innovation on delivery
- Considering the various delivery mechanisms that exist, including social housing and community solutions
- Extracting the lessons from the new build Zero Carbon Hub
- Creating the supply chain for delivery
- Understanding the right solution for cost effective energy supply.

6. Non-Domestic Buildings

6.1 The characteristics of the sector

The non-domestic buildings sector has certain characteristics:

- there are multiple building types – offices, factories, shops, schools, hospitals etc;
- there is frequently a separation between developer, owner and occupier;
- owners and occupiers are from both the public and private sectors;
- there is often multiple occupancy;
- design and construction are usually bespoke;
- typically there is a large supply chain, with SMEs featuring at the tail end;
- there is often a high degree of sophistication in the design and engineering of the building, which in turn requires a degree of sophistication on behalf of the building occupier to ensure it is operated in an optimum fashion;
- as in housing, there is major challenge in dealing with the existing stock, and although replacement cycles are generally shorter than for housing, much of the stock is old.

The Working Group leading on non-domestic buildings is considering both new and existing buildings, although members have agreed that the emphasis needs to be on measures to address the existing stock: whilst recognising that by 2050 the majority of emissions from non-domestic buildings may come from those constructed after 2020, the existing stock has far greater potential than new build for reducing its carbon footprint in the short to medium term. Moreover, issues surrounding improvement of the existing stock are more intractable than those associated with new build.

Whilst steps are being taken to improve the efficiency of new non-domestic buildings, given that at least 60% of the UK's non-domestic buildings in 2050 will be ones that are in use today, it is clear that we need to embark on a massive refurbishment programme if we are to have any hope of meeting our climate change targets.

As recognised in the Intergovernmental Panel on Climate Change Fourth Assessment Report, buildings offer some of the most cost effective and expedient ways to reduce emissions and tackle climate change; and recent research published by the Carbon Trust demonstrates that non-domestic buildings present a significant opportunity to reduce the UK's carbon footprint economically. They estimate that:

- 35% CO_2 reduction can be achieved by 2020 (from 2005 levels) with a net benefit to the UK of at least £4 billion;
- a reduction of 70-75% can be achieved by 2050 at no net cost, using options which exist today.

Many of the measures needed to improve the energy efficiency of the existing non-domestic building stock are already cost effective. Yet a mainstream market demand for energy efficiency refurbishment does not yet exist, even though there are overall financial, comfort and productivity benefits. This suggests that intervention is required to correct a market failure.

The scale of the challenge is demonstrated by data compiled by the Carbon Trust. There are around 1.8 million non-domestic buildings in the UK, which are currently responsible for 17% of the UK's total CO_2 emissions – equivalent to the entire primary energy use of Switzerland.

These emissions have only fallen slightly since 1990, yet going forward they will need to reduce by at least 80% by 2050 if the Government is to achieve its ambition for emissions from all buildings to be 'approaching zero carbon' by 2050.

Furthermore, nearly one third of our buildings are over 70 years old; and over 75% are more than 25 years old.

Figure 6: The age of non-domestic building stock; Source: Carbon Trust, 2009

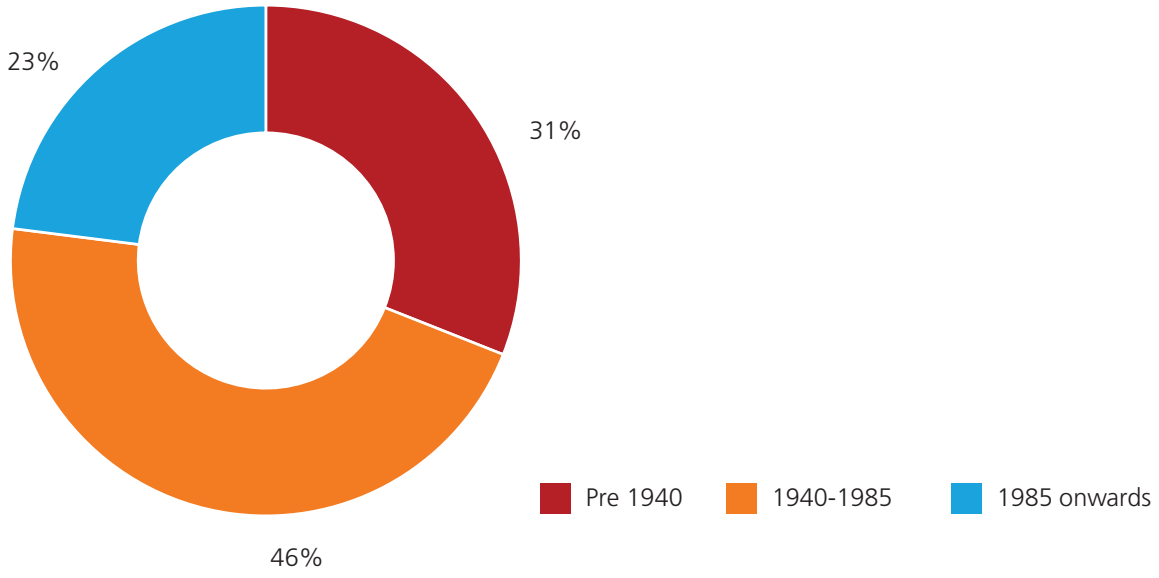
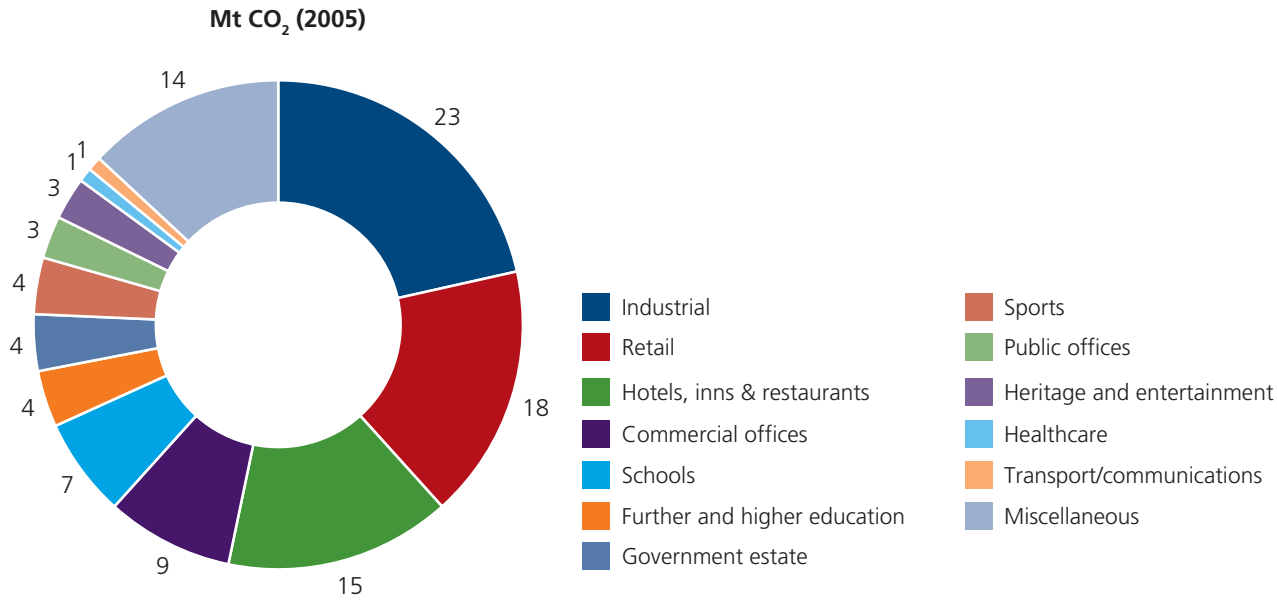


Figure 7: Emissions (%) by sector (2005); Source: Carbon Trust, 2009



The Interim Report reflects this emphasis on existing buildings.

6.2 Finance and business models

Central to driving change in the industry is the need to get the issues of improved efficiency and carbon onto the agendas of companies' Boards. The Non-Domestic Buildings Group will attempt to work up how to deliver possible solutions to this challenge. It is not about additional money: the emphasis should be on better use of existing money.

As a first step, the Group is considering developing a better understanding of finance in construction, to take advantage of tax relief for R&D, capital tax allowances and other financial incentives.

It will be important to explore novel ways of unlocking finance. For instance, third-party finance to pay for capital improvements, repaid from savings on revenue expenditure (e.g. savings in energy costs from insulation or heating efficiency measures) may well be a key measure. Proper use of whole life costing in PFI should also be explored.

The tenant/landlord issue warrants further investigation, including the possible removal of lease clauses that do not benefit tenants from installing low carbon measures, and the addition of mechanisms for amortised recovery of improvement costs on lease expiry.

Too often, Board project sign-offs are left to financial experts who don't have a full understanding of project processes. Project time, for example can skew cost and hence Return on Investment and Return on Total Assets extensively; and, as for the industry as a whole, there can be considerable positive impact on project out turn costs when using modern techniques like offsite manufacture, lean construction and Building Information Modelling (BIM).

6.3 Incentives and interventions

The level of change needed in the non-domestic sector is unlikely to be delivered without some Government intervention and incentives. Alongside the Group's other work to understand how businesses can respond to the low carbon challenge, it will also look at how targeted Government interventions and incentives can plug the gaps and ensure the industry delivers its share of emissions reductions.

There is a range of Government interventions that could be used to help drive down emissions from commercial buildings, and it is likely that different interventions and incentives will be appropriate to tackle different problems whether new buildings or existing, or whether emissions are controlled by occupiers, landlords or contractors. These include:

- Information – Unless we understand our emissions and energy use we are very unlikely to reduce them. Some form of information tool could help businesses understand and manage their energy use in buildings much more effectively. Information can also act as a reputational driver for improvements to be made where third parties can see or have access to the data. The use of Display Energy Certificates (DECs) needs to be explored further (see also section 3.1.4 above), especially as to how they can best be applied. This may help to overcome one aspect of the tenant/landlord issue.
- Regulation – For new buildings and major refurbishments, regulation may be the best way of improving the carbon footprint of the UK's building stock. Where regulations can link to overall targets for the sector to meet, this could also help give certainty to contractors, developers and their supply chains. The Group will investigate.
- Incentives – The affordability of physical energy efficiency measures, and the appropriate period of payback, will be major factors in the owner of a property deciding whether or not to carry out such work. In many cases, the numbers simply will not stack up since the cost of improvements will not be capable of being recouped either through the service charge or through higher rents. The answer to this may be to provide some form of fiscal incentive so that the cost to the property sector of retrofitting energy improvements is partially mitigated.

Some of the possible ways of incentivising building owners and occupiers to reduce their emissions include business rates, Stamp Duty Land Tax and Enhanced Capital Allowances. All of these need to be explored as future work.

6.4 Improved data collection, reporting and use

The reporting of data is as important as its collection and use, so a priority will be to explore ways of improving the use of DECs and Energy Performance Certificates, and investigating if common data standards are required.

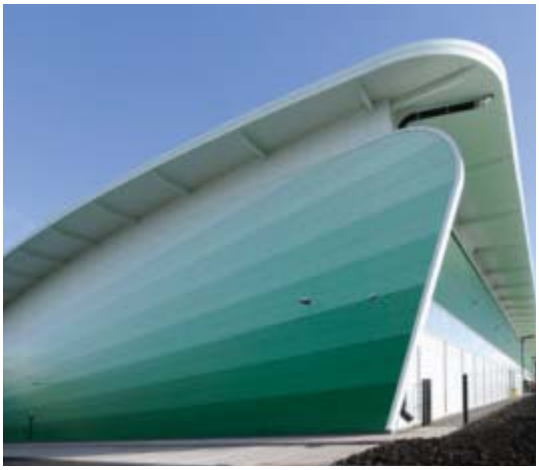
A long-term commitment to recovering building-specific data on performance through automated utility collection integrated with specific actions arising from DECs etc, is necessary to allow future new actions to be evidence based. The National Energy Education Development (NEED) project could form a basis for this.

Research is also required to compare actual performance with design data, to identify whether the building is delivering what it should do, and whether it is being run as it should be.

In order to help occupiers use buildings more efficiently, published data could be used to name, reward or shame, with clear presentation of all data in reception areas or the front door of all buildings and also in corporate reports. League tables and awards would also be part of the 'toolkit'.

However, in all of the above, data protection challenges exist and so they either need to be addressed or they may point towards looking for other approaches.

A review of the mechanisms to support the development of best practice information to be published and distributed through sector channels into mainstream business is required.



6.5 Client objectives and outputs

The industry needs a total focus on client objectives and outputs. These used simply to be expressed in terms of cost, time and quality. Today we can add safety to this, as well as the dimension of whole life cost and value, and the next step is to add the environmental measures of carbon and waste.

The Group will look at what lessons can be learnt from how safety came to be driven up the industry's agenda. Construction (Design and Management) regulations (CDM) were enacted, and an independent Government-backed body (the HSE) given the powers to police this, backed by strong legislation for Corporate Manslaughter. Clients and industry leaders then responded, driven also by growing pressures of social responsibility. So what are the equivalents for 'Energy Design and Management (EDM)'? The Carbon Reduction Commitment has enacted the powers, and there may be merit in exploring whether or not it would be appropriate to have an independent body, outside the industry, with the power to police compliance with 'EDM' and ultimately to withhold a license to trade to companies not meeting the grade.

The client – both public and private sector – is pre-eminent, and given the significant size of public sector purchasing in the non-domestic buildings market, it is considered that leadership by the public sector in the carbon agenda and in improved construction practices, is especially important.

A charter, code or accreditation scheme would provide a tangible means for leading clients to demonstrate their credentials and a corporate commitment. This could be patrolled by an independent body (such as Lloyds, or its equivalent), but it would need to be a meaningful globally-transferable scheme, comparable in that sense to other global industries such as nuclear, marine, aviation or computers and contracts would need to make the commitments binding on supply chains.

Although some PFI projects have improved the focus on whole life costs, much more could be done to standardise the assessment of whole life costs and then the selection of best value accordingly. A major challenge is to persuade Government to account for whole life costs rather than the current separation of capital and revenue expenditure and to enforce compliance with their 'Green Book supplement' on whole life accounting for capital projects.

A key strand of work will be to look at public sector procurement policy which, because public sector work represents close to 40% of the industry's new build output (including work procured through public/private partnerships) remains a powerful force for influence and change.

Further work:

During the coming months, the Non-Domestic Buildings Group will investigate the following themes and develop specific recommendations:

- financing the transition, including innovative business models,
- exploring incentives and interventions;
- identifying sector-specific skills requirements;
- improving data collection, reporting and use;
- focusing on client objectives and outputs.

The RIBA campaigns for a high quality built environment and sustainability is a prerequisite for that. Architects' education, training, tools and best practice equip them to meet the low carbon challenge head on and to grasp the emerging opportunities. We are committed to working closely with industry partners and the Government so that the built environment plays a major part in creating a low carbon future for us all.

Ruth Reed RIBA, President Royal Institute of British Architects

7. Distributed Energy

A substantial part of the challenge to produce zero carbon new buildings, and to reduce the carbon emissions of existing ones, will need to come from a programme of delivering renewable energy. It is currently envisaged that this will take the form of a number of distributed energy solutions, irrespective of the overall energy strategy for de-carbonising the grid.

There are likely to be substantial crossovers between new and existing, residential and non-residential properties. Indeed, if heat and power are taken together there are real benefits in looking at all sectors together.

What is needed is a policy framework that delivers across all sectors and at the lowest possible cost.

However, looking just at zero carbon new-build housing, the 'stand alone' cost of the energy component, delivered through microgeneration technology, is currently estimated at between £8,500 and £11,200 per dwelling[7] or at anything up to £20,000 per dwelling. Even at the lower range, and based on an annual new build programme of between 219,000 and 240,000 dwellings[8], the total investment could amount to say £2.5bn per annum to £2.75bn if individual dwelling solutions are deployed.

If this is extended to existing housing, and to non-domestic buildings, then the figure grows very considerably and makes it essential to explore more cost-effective solutions. This could be by

- systems that cover multiple buildings and building types (community solutions);
- economies of scale;
- product and process innovation providing more efficient and/or cheaper systems.

We need an overall energy policy that considers what should be generated locally and what should be delivered centrally via a de-carbonised grid.

Assuming distributed energy solutions are part of the mix and, given the cost and other benefits of community solutions, a different delivery model would be required.

A holistic approach to delivery of distributed renewable energy needs to be taken across the whole of our industry if the Government's agenda for carbon reduction in the built environment is to be realised by 2050.

Proposition 10: Each Local Authority should be tasked to produce a renewable energy strategy and stock audit that considers new developments together with existing buildings with a view to providing the opportunity to deliver energy and heat solutions for both.

7 Zero Carbon Homes Impact Assessment, Table 7, CLG, July 2009
8 Assumed supply of housing, as July 2009 Zero Carbon Homes Impact Assessment, CLG, July 2009.

8. Infrastructure

8.1 Introduction

Our quality of life depends upon existing and new infrastructure. There would be little economic activity without energy generation and distribution, water supply and disposal, transportation by rail, road, sea and air, waste reuse and disposal, and communications. High quality infrastructure is therefore essential for supporting economic growth and productivity, and for promoting social wellbeing. It is also necessary to attract foreign direct investment, as an increasingly mobile business community relies on infrastructure networks to function and compete in global markets.

However, many of the largest sources of carbon are currently associated with the construction, operation, maintenance and use of infrastructure, particularly in the energy, transport, water and waste sectors.

With extremely challenging and tightening carbon reduction targets, lengthy lead times, and unfavourable investment and delivery conditions for new and upgraded infrastructure, there is a critical, time-sensitive need for concerted action by industry and Government.

The challenge of achieving the complete transition to a low-carbon economy will be expensive: the cost of de-carbonising the UK energy sector has been estimated at £234bn[9]. However, the transition also represents a unique opportunity for the UK economy to improve its international competitiveness. The UK has competitive advantages relating to off-shore wind and coastal/estuarial power; it has a strong skills base and research and teaching capability related to infrastructure which can be harnessed; and because our economy depends so heavily on our infrastructure, the increase in efficiency and productivity that can be achieved through the driver of reducing carbon emissions will feed directly through to the rest of the economy.

8.2 The characteristics of the sector

Many of the industry-wide issues outlined in this report apply equally to infrastructure, but the sector also has particular characteristics. In summary these are:

- The sector has a non-vertically integrated supply chain with a small number of very large players and a large number of smaller sub-contractors;
- There are relatively few clients in the UK, generally falling into one of four categories:
  - Government and Government agencies (such as the Highways Agency);

9 Ernst and Young report "securing UK energy futures – meeting the funding challenge" 2009.

  - Quasi-public bodies (such as Network Rail);
  - Regulated utilities (such as energy and water);
  - Privately owned facilities (such as ports and airports).

- The majority of clients are privatised and all are effectively regulated. Even where infrastructure is not technically subject to regulation (such as the highway network), its modus operandi for scheme evaluation and prioritisation etc, operated through a single agency, leads to practice comparable to the regulated industries.

- By its nature, infrastructure provides a support function, and is either implicitly or explicitly rationed in place either by price (peak hour tickets, for example) or by availability (e.g. by congestion), or both.

- Infrastructure projects have significant interface with wider social and economic policy and their performance is highly visible to the population, which is intolerant of failure.

- Ignoring short to medium term market issues, the rate of return on investment over the next ten years will determine where available private sector funding is placed. This is likely to mean either subsidising infrastructure or improving incentives to invest. So whilst a National Infrastructure Investment Bank should increase the availability of funding and reduce its cost, the significant constraint on development is going to be the ability of the user and/or tax revenues to service the funding.

- The UK population is projected to increase by 4.3 million by 2018 and if trends continue, will reach 71.6 million by 2033. With an increasing percentage of retirees, our ageing infrastructure is clearly going to come under growing pressure, even without the demands imposed by the transition to a low carbon economy.

- Given the historic lack of demand for innovation in infrastructure, a culture of risk aversion and no clear strategy for research and development, organisations develop competitive advantage via cost efficiency rather than low-carbon or other innovations.

8.3 Opportunities

Nuclear new build, offshore wind, and a smart grid alone will allow for significant growth of "green jobs" building upon the existing educational and institutional framework in the UK.

The repair and enhancement of existing infrastructure also has huge potential, but requires a significant shift in the regulatory regime that makes initial use of utilities easy and affordable and increasing use more prohibitive. Examples are the adoption of social tariffs in the water sector to complement metering and the introduction of feed-in tariffs for power generated on-site.

The de-carbonising of infrastructure (both embedded and whole life) is an exportable skill, enhancing the considerable export of professional skills already occurring.

The amount of investment gives the private sector both the challenge and the opportunity to make productivity and efficiency improvements of some 15-20%, in addition to other efficiencies that may be gained from (for example) quicker and more appropriate planning consents. This will require a comprehensive implementation plan to be developed and rolled out across the sector addressing procurement, interfaces within the industry and with third parties, standards and specifications, and streamlining the engineering process.

The drive to de-carbonise the construction, operation and renewal of infrastructure presents an exceptional opportunity to stimulate innovation, designing to outputs rather than accumulated standards developed by volunteer effort over many decades. Meeting the progressive DECC 5-year targets will require a new approach to the development of best practice, codes and standards, which can no longer take a decade or more to revise.

Adapting individual pieces of low carbon infrastructure is not enough. We need to understand the carbon implications of interactions between assets and how they will be used by people and machines. This will require greater knowledge-sharing and joint working between engineering and built environment professionals of all disciplines.

Engineers and other built environment professionals must develop a systems approach to managing carbon impact across the UK's interdependent energy, transport, waste and water networks. This means changing the way that engineers, clients and decision-makers think about designing and delivering infrastructure.

Institution of Civil Engineers, State of the Nation: Low carbon infrastructure, 2009

Propositions:

11. That the professional bodies should propose the necessary regimes and funding that would enable a much more rapid cycle time for best practice, codes and standards. A target of 48-months for the introduction of new standards would have major long term benefits, increasing flexibility and adaptability in the industry and stimulating innovation.

12. That Regulators should urgently be brought into the debate as to how we will move from the current highly specific regulatory regimes set out some years ago, to a more integrated regime that not only meets DECC's requirements but recognises that infrastructure is a primary facilitator of the transition to a low carbon economy.

13. The regulatory (or quasi regulatory) regimes should be mapped in detail, with gaps or inhibitors to efficiency and the transition to low carbon identified. BIS should lead on this.

14. The Government should convene a seminar later this year, chaired by a Minister or by the Chairman of Infrastructure UK, and attended by the Chairs of the regulated utilities and the Permanent Secretaries of the host agencies, DECC and the engineering profession, to review how those regimes obstruct or could aid the transition to low carbon.

This will affect areas beyond construction, but the IGT should prepare a brief covering issues relating to low carbon construction and participate in the meeting and its follow-up.

15. Infrastructure UK and the engineering institutions should collaborate with the relevant Government Departments and other professional disciplines to develop a workable system of carbon accounting, to the extent that infrastructure's requirements differ from other sectors. This is critical to inform the selection of solutions and through life performance requirements. Current tools are useful for comparative decisions but too inaccurate for absolute accounting. In keeping with the need to reduce cycle time for innovation, rapid deployment of a carbon model for infrastructure is vital, even if it subsequently needs to be updated on a pre-determined cycle.

16. Similarly there should be an early resolution of the question of the discount rate for whole life carbon and how this is to be deployed for infrastructure projects with their long time horizons, multiple interfaces with public and private consultees, dispersed social and economic benefits, and strong interdependence of carbon costs and benefits (in road, rail and air transport, for example). Moving beyond treating the carbon discount rate as a case by case variable is essential to creating an attractive market for private finance.

17. Evaluation models used to determine infrastructure solutions (such as time value models for roads etc) should be reviewed by host agencies, industry and relevant professions to reflect the inclusion of carbon as a primary design constraint, weighing this against established performance criteria.

18. The industry should collaborate with DECC to agree, for each element of infrastructure, its contribution to the UK's transition to a low carbon economy.

The points made in section 3.1.3 above on the issue of skills are equally critical to infrastructure development – particularly the inclusion of low carbon objectives in all infrastructure-related further and higher education programmes; the need for collaboration with research institutes, academia and Government to inform research and development on low carbon infrastructure, leading towards large scale deployment; the re-training of existing practitioners and a deepening of continuing professional development; and establishing a knowledge-sharing network of infrastructure professionals. This will call for a change of culture in the civil engineering profession to reflect the importance of training and to increase the capacity to take up new knowledge.

Improving our vital infrastructure, transport links, energy, utilities and residential and commercial buildings are key to reducing the UK's carbon dioxide emissions. As well as new construction, there is also much to be gained through enhancing existing assets and improving the way they are used. However, to do this requires a shift of mindset both by the clients that commission projects and by the industry that delivers them. The consultancy and engineering industry is ready to grasp the opportunities that the move toward a low carbon economy presents.

Michelle McDowell, Chair, Association for Consultancy and Engineering

9. 2050 Group

The IGT 2050 Group consists of young professionals from right across the spectrum of the built environment including: architects, an architectural technologist, building project manager, building services engineers, civil engineers, energy assessor, heating/plumbing engineer, housing professionals from both demand and supply side, interior designer, quantity surveyor, structural engineer, and a zero carbon consultant. They met in February to explore the vision for the industry from 2020-2050 against different future scenarios informed by the work of the Department for Energy and Climate Change on pathways to 2050.

The group identified different uncertainties and developed these into contrasting scenarios for 2050, considering:

- a well-informed population aware of the challenges and opportunities of the transition to a low carbon economy, versus a protectionist population, denying the threat of climate change;
- a collaborative, joined up industry addressing the transition to low carbon in an integrated way, versus a fragmented and highly segmented industry, with each specialism making its own way.

There was a strong view among those present that the most favourable scenario to them personally and to the industry, and the most beneficial in the long term, would be to work in a joined-up collaborating industry leading change on the low carbon agenda with a supportive population. However, no group members feel this is to be the scenario that is closest to the present day, nor that it is where current industry and government strategy is heading. They feel that, left unchecked, the industry is likely to be fragmented and to follow the transition rather than lead it.

Over the rest of the year, the 2050 Group plans to explore in more detail future industry trends to develop scenarios for a long term road map for the industry. They will aim to address what drivers can help the industry lead the agenda and be more integrated in its responses in the long term. They also wish to consider how they can engage the expertise of those not inside the group including clients, facility managers, contractors and end-users.

To be able to achieve the necessary carbon reduction in the future we need to be realistic about where we are now, accept that for what it is, and work together to set the path that means we achieve our targets to our mutual benefit.

Morwenna Wilson, Arup,
Member 2050 Group

10. Future Work

Subjects for further work by the IGT and its Working Groups are itemised in the body of this report. The intention is to replace these interim findings with a final report by the end of the year; and that report will draw on further work that will, in broad summary, address the following:

- testing and developing the propositions set out in this report, and working with the relevant stakeholders to develop these into firm recommendations to government and industry;
- a quantified assessment of CO_2 or equivalents emitted throughout the project life cycle, sector by sector, and targets for each;
- the scope for carbon reductions at each stage, and the possible means of securing them in a cost-effective way;
- the potential for new products and processes to contribute to those reductions, including an increased use of IT;
- the scale and nature of construction work that will be derived directly or indirectly from the transition to a low carbon economy, and its timeline;
- the changes that will be required in the structure and practices of the construction industry in order not just to deliver the programme of work necessary to make that transition, but also to lead it;
- Government or other public sector interventions that will be necessary to drive or underpin that change, including its own procurement policies;
- the barriers to change, on both the demand and supply sides, and measures to lower or remove them;
- the specific challenge of skills, addressing the gap between the status quo and the requirements of a very different future, and the influence of industry structure and employment practices on recruitment and skills development;
- the requirements for methodologies, tools and supporting data;
- perhaps above all, the means of creating a market in which suppliers of construction products and services designed to improve energy efficiency and reduce CO_2 emissions can find willing customers with the ability to pay for them.

The last of these is illustrated in the process diagram included in Annexe A, showing how the high level policy of the Climate Change Act needs to be developed into a clear plan of work, which customers then bring to the market for delivery by an improved and integrated supply chain – which is in turn motivated to de-carbonise its own processes.

On the basis of all of the above, and the program management work recommended in these interim findings, the final report will conclude with a route map to a low carbon future for construction – virtually a business plan for the industry through to 2050.

11. Industry Engagement

It is a primary purpose of the publication of these initial findings that the IGT engages the full breadth of the industry in addressing the challenges and opportunities of the transition to low carbon construction. Comments on these findings and on planned future work (or additional work that should be planned), or references to other work relevant to the IGT's terms of reference, will be welcome; and contact can be made with the IGT by emailing to constructionigt@bis.gov.uk

12. Acknowledgements

The membership of all of the IGT groups is listed in Annexe C to this report – almost 100 people, drawn from industry and Government, and the core IGT team acknowledges the work and assistance of all.

In addition, there have been regular meetings with a cross-Whitehall group drawn from all stakeholder Departments, and their co-operation and assistance is also acknowledged with thanks.

Finally, there have been many studies and reports that have informed these interim findings. Full sources will be detailed in the final report, but in addition to many reports produced by and for Government, the useful work of the following organisations is acknowledged in particular:

- The Aldersgate Group;
- The Building Research Establishment;
- The Carbon Trust;
- The Construction Industry Council;
- The Edge;
- The Existing Homes Alliance;
- The Institution of Civil Engineers;
- The Strategic Forum for Construction;
- The UK Green Building Council;
- The Zero Carbon Hub.

Photo credits

Front page

- Offshore wind turbine http://www.flickr.com/photos/pjh/185488411/
- Cavity Install – SIG plc, installing cavity wall insulation;
- Yorkon Bewdley School – low energy ventilation and biomass heating;
- Olympics Velodrome – London 2012. The design reduced the amount of steel required which significantly reduced the embodied carbon;
- PRI Home Energy Controller.

Major Projects, p25

- Olympic Park, Stratford: London 2012.

Housing Section, p30

- Barratt Homes, Toronto House, Maple Quays – Canada Water, Code 4 development, heating and hot water provided by 2 CHP/ Biomass boilers.

Buildings Section, p39

- Chatterley Valley Gazeleys 360,000 ft2 Blue Planet building, BREEAM Outstanding rating.

Infrastructure Section, p44

- Sizewell B, nuclear power station, Suffolk.

Photos in footers

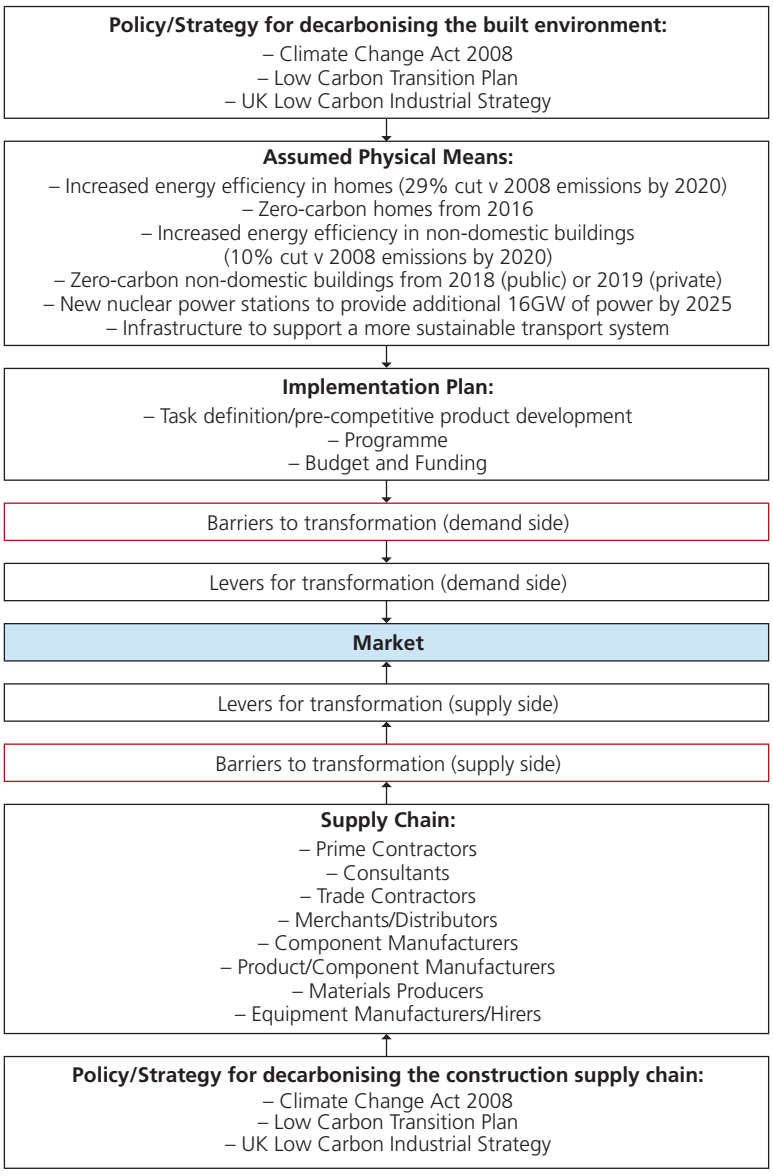
- p1, John Perryn School in Acton, London built for Ealing Borough Council.

- p5, 151 Tooley Street, Courtesy of Great Portland Estate.
- p14, Nature Pro – SIG plc, using natural insulation materials to improve thermal properties.
- p23, Corby Rail Station: Low carbon offsite construction that utilises solar energy and rainwater harvesting.
- p28, Great Bow Yard, Housing scheme, Photographer: Richard Mullane, Stride Treglown.
- p33, Manchester Civil Justice Centre, David Millington Photography Ltd, Denton Corker Marshall.
- p34, Installing cage and loops – Roger Bullivant ground source heat pump.
- p35, Tarmac Homes, Nottingham. Tarmac Ltd and Lovells to Levels 4 and 6 of the Code for Sustainable Homes.
- p46, M1 Roadworks 1mt tonnes of aggregate material reused or recycled.
- p49, 2050 Group of Young Professionals at Future Focus.

Annexe A: A Process Map for Market Transformation

This process diagram shows in much-simplified form how the high level policy of the Climate Change Act needs to be developed into a clear plan of work, which customers then bring to the market for delivery by an improved and integrated supply chain – which is in turn motivated to de-carbonise its own processes,

For the final report of the IGT, a more detailed version of the diagram will be populated for each sector (housing, non-domestic buildings, and infrastructure – new and existing). The focus will be on the barriers to progress, on both demand and supply sides, and the means of overcoming them to create a market.



Annexe B: Summary of Recommendations and Propositions

Recommendation

That Government commission a Program Manager to prepare a detailed execution plan for the physical work assumed in the UK Low Carbon Transition Plan, steered by the IGT, and with adequate access to all Government departments and agencies having a relevant stake in each tranche of work.

Propositions

1. That, as soon as a sufficiently rigorous assessment system is in place, the Treasury introduces into the Green Book a requirement to conduct a whole life carbon appraisal, and that this is factored into feasibility studies on the basis of a realistic price for carbon; and becomes a matter of confirmation through the OGC Gateway process.

2. That, to support this process, the Government should, in the short and medium term, consider the potential for the procurement of all publicly funded construction programmes to be used as test beds for transformation of the industry and its product towards a low carbon outcome.

3. That the industry, working through a collaborative forum such as Constructing Excellence or the Strategic Forum for Construction, should produce a tighter definition of precisely how an integrated supply chain should come together, what the gains would be, and how the client's position could be protected against cost increases resulting from a lack of competitive tension.

4. That, as an extension of this, a number of integrated teams should develop a proposal for a suitable building type (such as one or more of the thirty six eco-schools which have been announced), with a view to showing how, given the right procurement and contractual arrangements, a zero or close to zero carbon building could be constructed for the same price as a building built only to current Building Regulations.

5. That the Chief Construction Adviser and the OGC should work with a public sector department or delivery agency responsible for a rolling building programme to seek to agree a procurement and contractual arrangement within which the above proposition can be tested.

6. That the possibility of re-introducing a programme of independently conducted, properly funded published audits of buildings' energy performance by comparison with their design criteria should be explored.

7. That major companies in the construction industry should explore the scope for the voluntary posting of Display Energy Certificates in their own buildings, following the practice now mandated for public sector buildings.

8. That a means of capturing and more widely disseminating best practice from major projects should be developed.

9. That an *'Existing Homes Low Carbon Hub'* should be put in place to provide the leadership for the industry to start planning for delivery. This could link naturally to CLG/BIS proposals for a Retrofit Consortium.

10. That each Local Authority should be tasked to produce a renewable energy strategy and stock audit that considers new developments together with existing buildings, with a view to providing the opportunity to deliver energy and heat solutions for both.

11. That the professional bodies should propose the necessary regimes and funding that would enable a much more rapid cycle time for best practice, codes and standards.

12. That Regulators should urgently be brought into the debate as to how we will move from the current highly specific regulatory regimes set out some years ago, to a more integrated regime that not only meets DECC's requirements but recognises that infrastructure is a primary facilitator of the transition to a low carbon economy.

13. That, the regulatory (or quasi regulatory) regimes should be mapped in detail, with gaps or inhibitors to efficiency and the transition to low carbon identified.

14. That Government should convene a seminar later this year, chaired by a Minister or by the Chairman of Infrastructure UK, and attended by the Chairs of the regulated utilities, the Permanent Secretaries of the host agencies, DECC and the engineering profession, to review how those regimes obstruct or could aid the transition to low carbon.

15. That Infrastructure UK and the engineering institutions should collaborate with the relevant Government Departments and other professional disciplines to develop a workable system of carbon accounting, to the extent that the requirements for infrastructure differ from other sectors.

16. That there should be early resolution of the question of the discount rate for whole life carbon and how this is to be deployed, for infrastructure and other projects, moving beyond treating the carbon discount rate as a case by case variable.

17. That the evaluation models used to determine infrastructure solutions (such as time value models for roads etc) should be reviewed by host agencies, industry and relevant professions to reflect the inclusion of carbon as a primary design constraint.

18. That the industry should collaborate with DECC to agree, for each element of infrastructure, its contribution to the UK's transition to a low carbon economy.

Annexe C: Members of the IGT Steering Group and Working Groups

Steering Group

- Paul Morrell, Chief Construction Adviser, BIS (Chair)
- John Armitt, Chairman, Olympic Delivery Authority
- Bob Blackman, National Secretary, Unite
- Mark Clare, Chief Executive, Barratt Developments plc
- Keith Clarke, CEO, Atkins
- Dr Stewart Davies, Industry Commissioner, Sustainable Development Commission
- Tony Douglas
- Terry Hill, Chairman Global Transport, Arup; Chair, UKTI Export Group
- Janice Munday, Director, Low Carbon and Services, BIS
- Nick Pollard, CEO, Bovis Lend Lease UK
- Sunand Prasad, Senior Partner, Penoyre & Prasad
- Nick Raynsford MP, Chairman, Strategic Forum for Construction
- Richard Soper, Managing Director, Bosch Thermotechnology
- Phil Wynn-Owen, Director General for National Climate Change, DECC
- Annabella Coldrick, BIS (Secretary)

Housing Working Group

- Mark Clare, Chief Executive, Barratt Developments plc (Chair)
- Trevor Beattie, Corporate Director, Strategy, Policy, Performance and Research, Homes and Communities Agency
- Professor David Gann, Imperial College Business School; and Group Innovation Executive, Laing O'Rourke plc
- Neil Jefferson, Chief Executive, Zero Carbon Hub and General Manager, NHBC
- Gearóid Lane, Managing Director, Communities and New Energy, British Gas
- Gavin Purchas, DECC
- Dave Sheridan, Chief Operating Officer, Apollo Group
- Stephen Stone, Chief Executive, Crest Nicholson plc (GBC member)
- John Tebbit, Industry Affairs Director, Construction Products Association
- Professor Jeremy Watson, Chief Scientific Adviser, CLG and Director, Global Research, Arup
- Peter Whittington, BIS (Co-Secretary)
- Canda Smith, CLG (Co-Secretary)

Non-Domestic Buildings Working Group

- Tony Douglas (Chair)
- Andrew Eastwell, Chief Executive, BSRIA
- Stuart Farmer, Head of Buildings Strategy, Carbon Trust
- Mike Forster, Strategy Director, BAA
- Richard John, Sustainability Director, AECOM
- Paul King, CEO, UK Green Building Council
- Michelle McDowell, Chair, Civil & Structural Engineering, BDP
- Andrew Minson, Executive Director, The Concrete Centre
- Richard Ogden, Chairman, Buildoffsite
- Tom Paul, Director, Business Development, Kingspan
- Liz Peace, Chief Executive, British Property Federation
- John Rivett, Director of Design & Engineering, Wates Group
- Don Ward, Chief Executive, Constructing Excellence
- Emma Wild, Principal Policy Adviser, CBI
- John Newman, BIS (Co-Secretary)
- Dean Thomas, DECC (Co-Secretary)

Infrastructure Working Group

- Keith Clarke, CEO, Atkins (Chair)
- Chris Bolt, Rail Regulator and Arbiter, Tube Lines
- Humphrey Cadoux-Hudson, Managing Director, EDF Power and Nuclear
- Andrew Comer, Director of Infrastructure and Environment, Buro Happold
- Ian Marchant, Chief Executive, Scottish and Southern Energy
- Peter Mason, Chairman, Thames Water
- Scott Steedman, for the Royal Academy of Engineering
- James Stewart, Chief Executive, Infrastructure UK
- Barry Blackwell, BIS (Co-Secretary)
- Michael McDermott, BIS (Co-Secretary)

Institution of Civil Engineers Infrastructure Expert Panel

- Peter Hansford, Senior Vice President, ICE; Executive Director, The Nichols Group (Chair)
- Paul Buchanan, Director, Colin Buchanan
- Tim Chapman, Director, Arup (Deputy Chair)
- Barry Clarke, Professor of Engineering, University of Leeds
- Peter Guthrie OBE, Professor in Engineering for Sustainable Development, University of Cambridge
- Mike Napier, Strategy & Business Development Director, Costain
- Martin Pedley, Managing Director, Cementation Foundations Skanska Ltd
- Derek Salkeld, Chairman, DS+A Risk Analysis
- Neil Sandberg, Managing Partner, Sandberg
- Scott Steedman, for the Royal Academy of Engineering
- Simon Whalley, Senior Policy Executive, ICE (Support)

Major Projects Working Group

- John Armitt, Chairman, Olympic Delivery Authority (Chair)
- Murray Bean, Director Construction Solutions, Corus
- Rab Bennetts, Director, Bennetts Associates
- Professor Will Hughes, Reading University
- Andrew McNaughton, Chief Operating Officer, Balfour Beatty
- Roger Madelin, Joint Chief Executive, Argent
- Group PLC
- Dervilla Mitchell, Director, Arup
- Clive Young, BIS (Secretary)

Cross-Cutting Working Group

- Paul Morrell, Chief Construction Adviser, BIS (Chair)
- Michael Ankers, Chief Executive, Construction Products Association
- Cal Bailey, Marketing and Sustainability Director, NG Bailey
- Peter Bonfield, Chief Executive, Building Research Establishment
- Tim Clarke, Divisional Managing Director, Scottish Division, Balfour Beatty Construction Ltd
- Tony Iles, Associate Director, Atkins
- Henry Le Fleming, Partner, PricewaterhouseCoopers
- Sunand Prasad, Senior Partner, Penoyre & Prasad
- Nick Scott, BIS
- Tony Mulcahy, BIS (Secretary)

2050 Group

- Alan Shingler, Director of Sustainability, Sheppard Robson (for the RIBA)
- Robert Corbyn, Director, Low Carbon Energy Assessors Ltd (for the RICS)
- Gray Evans, CIPHE
- Crystal Fernandes, National Housing Federation
- Catherine Greig, Make:good (for the RIBA)
- Anastasia Kiochou, BIDA
- Robert MacDonald, Zero Carbon Hub (for the NHBC)
- Emma Nicholson, Stace LLP (for the CIOB)
- Kieran Owens, Queen's University Belfast (for the ICE)
- Antonio Pisanó, Sheppard Robson (for the RIBA, as nominated alternate for Alan Shingler)
- Mark Renshaw, Elliott Wood Partnership (for the IStructE)
- Andrew Stanford, INSIGHT (for the CIAT)
- Anna Whitehead, BIDA
- David Whysall, Turner & Townsend (for Constructing Excellence)
- Morwenna Wilson, Arup (for CIBSE)
- Hannah Collie, CIC (Secretary)

Contact BIS Email: constructionigt@bis.gov.uk
Phone: 020 7215 5000 Web: www.bis.gov.uk/constructionIGT

Department for Business, Innovation and Skills. www.bis.gov.uk
First published March 2010. Crown Copyright. BIS/17/03/10/NP. URN 10/671