495: Driving change in the UK built environment: A review of the impacts of zero carbon buildings policy in the UK

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Abstract

This paper gives an overview of UK zero carbon buildings policy, in the context of world and EU drivers. The currently employed definition of zero carbon is examined and important lessons are drawn out. The paper concludes by attempting to give some advice to UK and others regarding the type of policy likely to succeed in driving change in the built environment to dramatically reduce greenhouse gas emissions.

Keywords: zero carbon, policy, code for sustainable homes, sustainable development, sustainable construction, low and zero carbon construction

1 Introduction

1.1 The importance of the built environment

The impacts associated with construction and the built environment are far from trivial, with the industry accounting for around 8% of the UK's Gross Domestic Product (GDP). The buildings produced by the industry continue to have significant impacts throughout their operational lives and as a result of their demolition/deconstruction. Operational energy consumption in buildings is estimated to be responsible for anywhere from 25% to 50% of the UK's recorded greenhouse gas (GHG) emissions [1,2] (see figure 1).

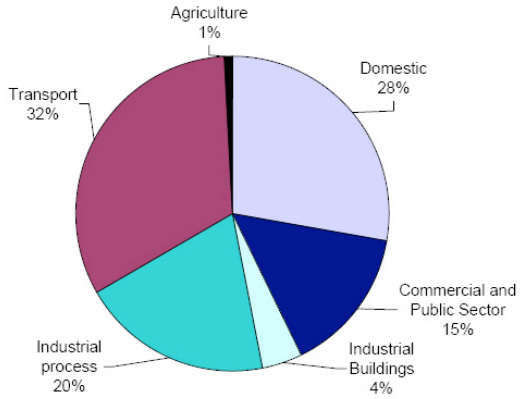

Fig 1: Total UK carbon emissions by sector for 2000

Alarming statistics and a wider acceptance of the need to reduce man-made greenhouse gas emissions, combined with issues of energy security in an increasingly competitive global market have lead many to start paying significantly more attention to the impact of the built environment.

1.2 The complexity of the built environment

Traditionally buildings were constructed primarily to provide shelter and therefore tend to be thought of, in the simplest terms, as inert 'weather screens' within which we choose to perform various tasks. However; with the advent of decentralised production and distribution of gas and electricity, as well as the rapidly increasing ubiquity of energy consuming products, buildings have become complex systems with many interdependent variables.

The complexity of the built environment is further compounded by the intrinsic fragmentation of the construction industry with different stakeholders traditionally seeing themselves as very separate, with separate institutions and little communication between groups

2 Top down or bottom up?

This increased focus on the built environment has been felt in countries around the world resulting in increased pressure to improve standards and reduce the negative impacts associated with the built environment. Some of the pressure for change has come from 'bottom-up' industry-based initiatives, such as the US Green Building Council (USGBC), growing out of thought-leaders within the industry uniting to call for change. Other pressures have been external; as anthropogenic climate change becomes an unavoidable political issue many Governments have stated some commitment to reducing greenhouse gas emissions.

In the US, the Energy Security and Independence Act was signed into law on December 19th 2007 outlining plans for *'zero-net-energy commercial buildings'* starting with a goal of all new buildings by 2030 and stretching to include all of the existing commercial stock by 2050 [3].

In Europe the Energy Performance of Buildings Directive (EU EPBD) requires Member States to implement a series of initiatives aimed at improving the energy performance of buildings [4]. The EU EPBD has four main components outlining: a common methodology for calculating the energy performance of all buildings; minimum energy performance standards; energy performance certificates; and boiler and air conditioning inspections. All Member States must implement the EPBD by January 9th 2009 [5]

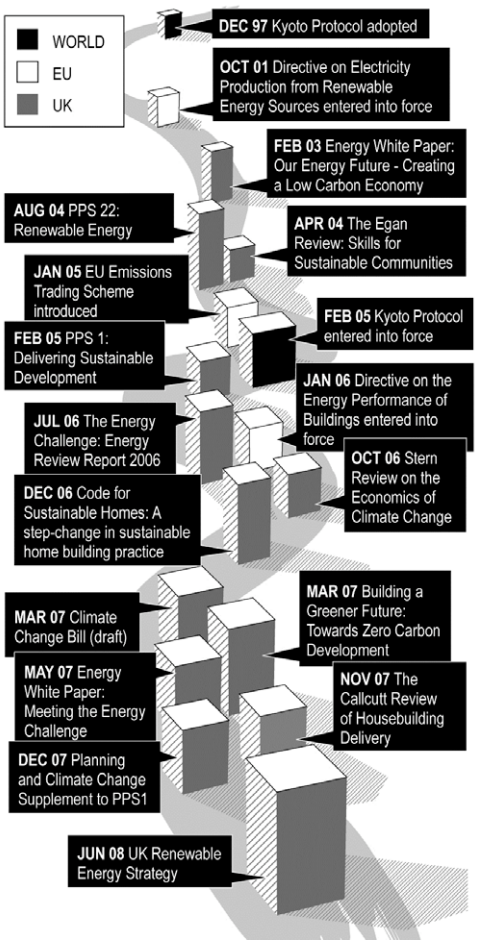

Fig 2: Timeline of selected key policies relevant to sustainable development in the construction industry.

3 The UK Policy Context

The current UK Government has taken a strong public stance on climate change and made a number of commitments to reduce emissions.
The built environment has seen a flurry of activity (see figure 2) on the policy scene over the last few years driven in part by European legislation.

3.1 Building Regulations

Building Regulations in England and Wales outline the legal minimum standards for construction. Historically, percentage improvements to the Building Regulation requirements have been used to drive increases in building energy performance. In 2006 the Building Regulations methodology was updated to test compliance based on a calculation of the predicted carbon emissions.

3.2 Local Authority Policies

In October 2003 the London Borough of Merton introduced policy PE13 which required all new non-residential developments above 1,000m^2 to incorporate renewable energy production equipment to provide at least 10% of predicted energy requirements. This became known as 'the Merton Rule' and many local authorities began to implement similar policies.
In 2004 the Mayor of London published 'The London Plan' the spatial development strategy for Greater London. In it, policy 4A.9 called on the individual boroughs to require major developments to generate a proportion of their energy needs from renewable technologies. Policy 4A.8 outlined the Mayor's energy hierarchy which established the order in which interventions should be applied in order to meet the energy needs [6]. In practice though, this hierarchy made little sense and was applied differently and later corrected [7]. At the same time, the Mayor's energy strategy was published [8]. Proposal 13 of the Mayor's energy strategy stated that *'the Mayor will expect applications referable to him to generate at least ten percent of the site's energy needs (power and heat) from renewable energy on site where feasible.'* This was also later amended to refer to 10% of the total energy demand of the site measured in terms of carbon.
In August 2004 the Office of the Deputy Prime Minister published Planning Policy Statement 22: Renewable Energy which states that local planning authorities may include policies in their local development documents that require a percentage of energy to be met by on-site renewable sources, but warned that such policies *'should not be framed in such a way as to place an undue burden on developers, for example, by specifying that all energy to be used in a development should come from on-site renewable generation.'* [9]

3.3 The Code for Sustainable Homes

The Code for Sustainable Homes (CSH) was officially launched in December 2006, and replaced Ecohomes as the environmental assessment method for all residential development in England on April 10th 2007 (Scotland still uses EcoHomes, and Wales is about to switch to the CSH from EcoHomes).
The CSH rates the sustainability of a development by assessing it against nine key criteria, one element of which is CO_2 emissions. The scores from each category are weighted, and then combined to give an overall rating on a 1 to 6 star scale, 1 being the lowest, and 6 intending to denote an 'exemplar development in sustainability terms' [10]. As this was the first major attempt by Government to define 'sustainability in the built environment' comprehensively various elements of it are often invoked by planners and funding organizations such as the Housing Corporation even in areas not covered by the CSH itself. As such, throughout this paper issues found in the CSH may appear to be referenced in relation to areas not directly covered by the CSH such as non-domestic buildings and the existing stock.

3.4 The 2016 commitment

In December 2006, the Department for Communities and Local Government (CLG) published the consultation paper 'Building a Greener Future: Towards Zero Carbon Development' which outlined plans to increase the requirements of the Building Regulations in a series of step-changes towards 'zero carbon'. In July 2007 a policy statement was published confirming the steps as shown in table 1 below [11].

Table 1: Proposed changes to Building Regulations, taken from *'Building a greener future: policy statement'*

Date	2010	2013	2016
Carbon Improvement as compared to Part L 2006	25%	44%	'True zero carbon'
Equivalent energy/carbon standard in the Code	Code Level 3	Code Level 4	Code Level 6

3.5 Stamp Duty Land Tax Relief Scheme

During the 2007 pre-budget report, Government announced plans to provide a time-limited relief from Stamp Duty Land Tax (SDLT) for 'the vast majority of new zero carbon homes in the UK', running from October 1st 2007 through till September 30th 2012 [12].

4 The effectiveness of policy

Despite increasing performance requirements for Building Regulations compliance there has been little improvement in overall energy consumption in the built environment. In fact, in general, overall energy demand has been increasing at over 2% a year despite stock dilution with newer, more efficient, buildings [13]. Figure 3 shows the trends in total energy consumption per household 1990-2004

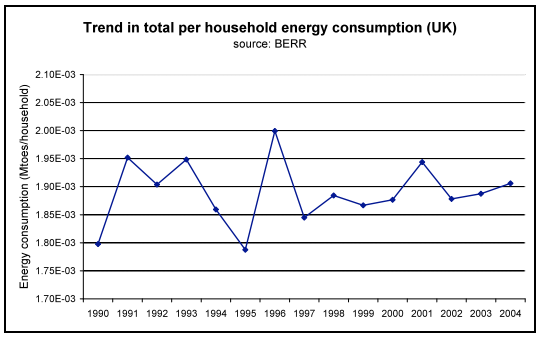

Fig 3: Total energy consumption per household 1990 - 2004

This suggests that, even if all new construction were to stop tomorrow, energy consumption in the built environment would continue to rise. It also highlights the difficulties of predicting energy consumption in buildings. The lack of empirical data for the built environment has proved to be a major stumbling block [14, 15] and will continue to prevent real progress being made without a strong commitment to support research in this area. This raises questions as to the effectiveness of policy in effecting real and lasting change in the performance of the built environment.

5 Towards a definition of 'zero carbon'

The UK Government first defined what it meant by 'zero carbon' in the Code for Sustainable Homes Technical Guidance. Put simply, the requirement was that: *'over a year, the net carbon emissions from all energy use in the home would be zero'*. For the energy uses covered under the Building Regulations, the Building Regulations methodology was adopted for continuity. Carbon emissions from energy uses not covered under the Building Regulations, such as cooking and appliances are estimated based on dwelling floor area.

The draft requirements to achieve SDLT relief were published in March 2007 and differed from the definition of 'zero carbon' contained in the CSH. The potential for confusion was obvious and Government quickly responded to calls for a single definition with an informal consultation in July 2007. In October 2007 the updated CSH technical guidance contained several changes to align the two definitions of 'zero carbon'. Box 1 contains a brief summary of the key requirements to achieve 'zero carbon' status as outlined in the Ene 1 credit of the CSH [16].

Box 1: Key requirements for 'zero carbon' as described by the Ene1 credit in the Code for Sustainable Homes.

- Dwelling CO_2 Emission Rate (predicted emissions from heating, hot water, lighting and ventilation energy requirements) = 0
- 'Occupant energy' (taking account of standard appliance and cooking consumption within the home) must be calculated using calculation sheets provided, and equivalent renewable energy generation capacity must be installed to reduce CO_2 emissions to zero.
- All renewable energy generation equipment must be located within the curtilage of the development, or directly connected.
  - In the case of electricity generating equipment this means a private wire connection
- Heat Loss Parameter (HLP) ≤ 0.8W/m^{2}K

The inclusion of the requirement for private wire connection produced a concerned response from many in the industry. The Renewables Advisory Board (RAB) (a non-departmental public body sponsored by the UK Department for Business, Enterprise and Regulatory Reform (BERR) in order to advise Government on renewable energy issues) published a report entitled *'The Role of Onsite Energy Generation in Delivering Zero carbon Homes'* [17]. The report used a computer model to predict the industry response to zero carbon policy and concluded that, even under favourable conditions, at least 11% of homes would be unable to generate sufficient electricity on-site due to physical restrictions alone, i.e. regardless of capital expenditure and economic viability. In early 2008 the UK Green Building Council (UK-GBC) used the same computer model to investigate the impact of different assumptions and concluded that any realistic changes to the assumptions made in the RAB report significantly increased the failure rate [18].

5.1 The import/export differential

The National Calculation Methodology uses different carbon factors for the import of grid electricity (0.422kgCO_2/kWh) and the export of electricity generated on-site (0.568kgCO_2/kWh). Essentially this means that, were an all electric dwelling to seek to supply all of its energy from photovoltaic (PV) panels, it would only need to supply 74% of its predicted demand in order to be considered 'zero carbon'. The UK-GBC work tested the impact of removing this differential,

establishing an equitable import/export relationship. The failure rate increased to nearly 80% of dwellings, again only considering physical restrictions such as lack of roof space for PV panels.
The UK-GBC report [18] outlined a number of key recommendations for Government in order to increase the effectiveness of the current policy in terms of total amount of GHG emissions avoided. These recommendations are expected to form the basis of a consultation although no date has been given for this yet.

6 Uncertainty

The rhetoric associated with the UK's 'zero carbon' policy drive is admirable; ambitious targets outlined in advance in order to provide market certainty for strategic land purchases and investment in Research and Development and supply chain capacity, with a series of scheduled intermediate steps to ease the transition. Unfortunately the reality 'on the ground' for many of those having to respond to the new policy landscape is quite different. During early policy iterations the terms 'energy' and 'carbon' were used almost interchangeably, highlighting policy makers own lack of understanding. Regular significant changes have been a common feature in UK 'green construction' policies, sometimes unannounced or without consultation; the calculation methodology for the London Plan for example, was changed after the Examination in Public (EiP) had been concluded. The CSH has also seen a number of significant changes and the recommendations from the UK-GBC report are expected to be bundled in with two other large consultations placing increasing strain on those in the industry trying to contribute to the debate. Even when consultation occurs there is no guarantee that the right questions will be asked: After the details of the SDLT relief scheme were published the Government consulted informally on a single definition of 'zero carbon'; an idea which clearly many in the industry would welcome whole-heartedly. However, the details of the definition were not covered in the consultation and the result, as the RAB and UK-GBC work [15,16] has shown, is far from satisfactory.
When the idea of 'zero carbon buildings' was originally broached, many in the industry responded positively and there were a number of developers and design teams eager to demonstrate how this might be achieved. But as the detailed requirements have been unveiled many found the requirements to be unrealistic and unnecessarily complicated and have either downscaled their ambitions or abandoned projects altogether.
There remains significant confusion and uncertainty around the CSH and definition of 'zero carbon'. As the industry awaits its opportunity to contribute via a consultation on the UK-GBC recommendations more problems continue to emerge.

6.1 Dwelling Emission Rate

The Dwelling Emissions Rate (DER) is an estimate of the predicted carbon dioxide emissions as a result of energy used in the building due to space-heating, hot water, lighting and ventilation equipment expressed in terms of $kgCO_2/m^2$. The Government's Standard Assessment Procedure (SAP) dictates a standard methodology for calculating the DER, and this methodology is adopted by the CSH albeit with additional modifications to some aspects.
The DER calculation methodology outlines strict criteria for Low and Zero Carbon (LZC) generation equipment in order to count towards a reduction in DER. This calculation methodology contains a number of counter-intuitive requirements, such as restricting the size of wind turbines that are allowed to count and not including LZC systems (other than CHP) that serve multiple dwellings. Conversely communal CHP systems are allowed to contribute to a reduction in DER as long as they are connected via private wire and district heat network. This apparent inconsistency in the way energy is treated depending on its exact origin is confusing and sometimes pushes projects towards some rather contrived design solutions just to meet the policy requirements rather than allowing designers to concentrate on delivering buildings with reduced GHG emissions.

6.2 Private wire

Under the current definition electricity that is not generated on or within the curtilage of the building must be supplied via a private wire network. This requirement was first introduced by HM Revenue and Customs (HMRC) for the SDLT relief scheme and the Electricity (Class Exemptions from the Requirement for a Licence) Order 2001 [19] defines the qualifying criteria for 'private wire' arrangements. Importantly the definition requires that the owner of the wires is not a licensed distributor and furthermore, the exemptions order imposes a maximum peak capacity for any single system of one megawatt and a cumulative limit of 2.5 megawatts electrical power for any private wire network operator supplying domestic customers.
The strict requirements for private wire add significant complexity to larger projects due to the size constraints and could be detrimental to consumers as private wire removes some of the safeguards that exist for standard public wire schemes.

6.3 Energy Services Companies

A common approach to navigating these complex new policy requirements is to engage with an Energy Services Company (ESCo) in order to manage energy supply. Typically ESCo's provide an upfront capital contribution towards the cost of installing the generation equipment, in exchange for the right to operate the network upon completion typically for 15 – 40 years. In order to qualify as a private wire operator the ESCo must not be a licensed distributor, and therefore many of the large utility firms have established subsidiary companies to function as ESCo's. It is

currently unclear what the preferred solution would be to deliver LZC energy to larger developments where the demand exceeds the one megawatt system limit. It would appear that a domestic development must supply the renewable energy in numerous individual private wire systems of less than one megawatt each and possibly establishing multiple companies (without common stakeholders) if the 2.5megawatt limit per operator is exceeded.

6.4 The Citiworks case

A recent ruling in the European Courts of Justice found that a German law allowing networks to be classified as private wire thus precluding third party access contravened Article 20(1) of Directive 2003/54/EC of the European Parliament and of the Council of June 26th 2003 [20]. The judgement infers that energy supply systems are obliged to allow third parties open access to the distribution network. The ruling has potential implications for the private wire requirement in the UK.

Many of the major ESCo's, including several large Local Authority ESCo's, seek to contractually bind tenants to purchase energy from the ESCo in order to protect their investment thus preventing consumers switching to other utility providers. Although the definition of 'private wire' does not explicitly preclude third party access, in practice it is likely to prove complicated and costly, and the private wire operator is under no obligation to co-operate.

It remains unclear how this ruling will impact projects in the UK, many of which are currently trying to finalise energy strategies in order to meet CSH requirements. Although several attempts have been made to clarify the legality of requiring private wire networks, none have so far produced a conclusive answer, and Government have been unresponsive to calls for clarity.

7 Non-domestic buildings

Almost all of the discussion so far has centred around domestic development as this is still the main focus of Government policy and is the area in which discussions in the UK are most advanced. In 2007 the Communities and Local Government (CLG) Green Commercial Buildings Task Force asked the UK-GBC to investigate the potential for similar carbon emissions reductions policies in new non-domestic buildings en-route to 'zero carbon'. The UK-GBC convened a task group and conducted a preliminary study investigating the implications of imposing a definition and timeline on the non-domestic sector.

7.1 The UK-GBC non-domestic findings

The non-domestic stock is considerably more complicated than the domestic stock. Attempts to classify buildings more discretely have struggled due to the variety of uses and the diversity encountered within a given type [15].

The UK-GBC report concluded that, based on the available evidence, 'zero carbon' new non-domestic buildings were unlikely to be financially viable before 2020. However, the UK-GBC expressed significant concerns about the quality of the data available for analysis and concluded that significant further work was required and should begin immediately [14].

Despite these findings, during the 2008 budget speech the Chancellor of the Exchequer announced an aspiration to see 'zero carbon' schools from 2016, public buildings from 2018, and all other new non-domestic buildings by 2019 [21]. The enormity of this challenge cannot be understated, and there is still no sign of any of the UK-GBC recommendations being implemented. Without the proper research and funding it is difficult to see how these targets will be met and it looks like the UK construction industry will be grappling with these issues for some time to come.

7.2 Mixed-use developments

The lack of coherent policy objectives across the domestic and non-domestic sectors further adds to the confusion and may result in more segregated developments if developers decide to build domestic and non-domestic quarters separately in order to avoid unnecessary expenditure. The current policy framework ignores the potential for greater efficiencies through peak-shaving and load-balancing, and often prevents good engineering solutions. The ability to accurately include a variety of buildings in mixed-use developments is vital in order to encourage high-quality, genuinely sustainable communities.

8 Learning from the UK's experience

The UK has a strong engineering pedigree and good grass roots support for 'green building' within the industry. Government provided strong leadership and demonstrated significant foresight in outlining ambitious plans for radical improvements to the quality of the UK built environment, creating an ideal market in which to innovate. Furthermore in an increasingly competitive global market the UK stands to make significant gains by demonstrating leadership for developing nations seeking to improve efficiency and quality.

Instead, significant amounts of collective effort have been diverted into understanding the detailed requirements of changing definitions, responding to consultations and lobbying for change. No doubt similar amounts of time and effort have also been invested behind the scenes in various consultancies trying to understand the implications for current projects and attempting to advise clients. For all this collective effort there appears to have been little progress and many are still deeply confused about the policy requirements and frustrated about the convoluted design solutions towards which they are driven.

Terms like 'zero carbon' and 'zero-net-energy' were coined in order simplify the topic so as to make it more 'accessible'; but it is these over-simplifications of the problem that are arguably causing much of the trouble by constraining debate and stifling innovation.

8.1 The existing stock

The vast majority of the policy measures have been aimed at the new-build domestic sector which accounts for around 1%-2% of the total building stock each year. Not only does the existing stock represent significantly more of the built environment than new-build, it is often less efficient and therefore has the potential to achieve significantly greater GHG emissions reductions. Practically however, it can be more difficult to influence the existing stock as there are fewer obvious opportunities for intervention. But it is vital that mechanisms are put in place that make significant improvements to the existing stock possible if we are to reduce our GHG emissions by anything like the magnitude that current science predicts are required in order to abate anthropogenic climate change.

8.2 Fuel poverty/security

Another reason to increase the performance of the built environment is to counteract rising fuel prices due to increased global demand and market instability. Inefficient buildings will cost more to run and there is a risk that the poorest citizens will be marginalised into the older, inefficient stock while the wealthy can afford to upgrade. The current policy drivers result in a preference for biomass powered CHP and the UK-GBC report 'the definition of zero carbon' estimated that the built environment would end up requiring enormous quantities of biomass [18], possibly more than the UK is capable of producing. Establishing an over-reliance on biomass in the absence of a mature market exposes consumers to greater risk of rapidly increasing prices as demand increases, thus forcing more people into fuel poverty or having them simply switch back to traditional fuels such as gas.

It is crucial that factors such as fuel poverty/security, internal environment and build quality, as well as the wider impacts on food prices and deforestation, are not eclipsed by 'carbon' as they form an equally crucial part of 'sustainability' in its truest sense. Also, the way in which these initiatives are funded must be thought out carefully in order to avoid the costs being passed onto the consumer, thus exacerbating the problems of fuel poverty. Currently it is unclear how supplier funded initiatives and feed-in tariffs will avoid this.

8.3 Research, debate, action

'In the 21st century, you might expect governments to be pragmatic about achieving their aims, to do what works. This means basing policy on hard evidence rather than on assumptions or ideology. Yet this seldom happens. Even when policies are tested before being rolled out to an entire area or country, the methods used to evaluate their effectiveness are often worse than useless' [22]

The problem of climate change is a scientific issue, concerning the chemical composition of the atmosphere and the impacts of our industrial emissions on the physical systems that we rely upon for survival. However, much of the debate around climate change is often far from scientific and carried out by the media in sound-bites.

Why should climate change be subjected to such factually impoverished debate? Some people may point to the fact that the actions science advises us to take in an attempt to mitigate anthropogenic climate change will inflict significant changes on people's everyday lives. This requires us to balance our own current well-being against that of our descendants which, some would say, makes our response to climate change as much an ethical issue as a technical one. But Medicine has balanced specialist technical knowledge with ethics for hundreds if not thousands of years. Modern medicine uses randomised control tests in order to assess the effectiveness of a particular therapy in order to be able to pursue the most promising avenues. Once a therapy is in development, it must then pass rigorous tests in order to ensure its suitability for roll out. Of course, the detailed technical discussions are rarely played out in the media, but at least they still happen. Experts examine a problem, conduct tests to improve their knowledge (by feeding the results back into the work), and then recommend a way forward. This process seems to have been completely reversed in respect of the British Government's approach to the built environment. Laurence Moore of Cardiff University says that *'politicians are not open to the idea that rigorous evaluation might help them get things better. Rigorous evaluations are perceived as threatening rather than supportive of better policy'* [22]. In this case the Government has plunged an industry worth 8% of the national GDP into turmoil by setting a policy target, then defining the policy, then trying to figure out if it's possible and if so, how.

8.4 Acting on good advice?

Worryingly, despite all of the positive rhetoric about responding to the threats posed by anthropogenic climate change as 'a fundamental threat to our future' [23] and acknowledging the 'overwhelming body of scientific evidence' [11] the Government continues to ignore much of the advice it receives and seems to derive policy more for its newsworthiness rather than its effectiveness at reducing GHG emissions. The 'zero carbon homes' policy is often lauded as a ground-breaking policy demonstrating a long-term vision in order to provide certainty for private investment. However, ten years is not a long time in the construction/property industry, where developments can take years to plan and build, and should last for 50-100 years. Furthermore, nearly two years into the ten year schedule, there have been several different definitions of 'zero carbon' from different Government departments and there is still no clear and viable definition for 2016. Although a consultation is expected shortly, given the manner in which the Government interpreted the body of evidence for zero carbon non-domestic buildings, it is unclear how they will respond to the advice they receive regarding the definition of 'zero carbon'.

9 Recommendations

Campaigners of all forms will have had to ask themselves at some point, how much they are prepared to compromise their ideals for greater penetration. In this case, if the goal is to reduce GHG emissions from the Built Environment in order to help meet a target of 60% reduction in national GHG emissions by 2050, then, on the face of it, it is difficult to see how zero carbon new-build represents a cost-efficient intervention. Investment is pushed way beyond the point of diminishing returns in order to get 2% of our built environment to zero. Even if the energy consumption in the existing stock stopped rising, zero carbon new-build would only be enough to level off our national emissions rather than reduce them. The Callcutt review [24] recommended that the Government remain committed to the zero carbon agenda and not show any signs of wavering. This is understandable in so much as, further market uncertainty is clearly not desirable and having to back-track would likely damage the credibility of future attempts to galvanise the construction industry to reduce emissions. The benefit of the zero carbon policy, say its supporters, is its simplicity, and that stakeholders without specific technical knowledge can understand the aim. But the ultimate goal should be the greatest possible reduction in GHG emissions for the least possible cost, and this requires something other than reducing the predicted carbon emissions of our new buildings to zero.

9.1 Doomed?

Maybe not. The issue of the negative impacts of the built environment has probably never been more prominent then right now and many in the industry are investing a large amount of effort into effecting a change for the better. This impetus should be seized upon and, rather than expending the effort trying to negotiate prescriptive legislation, people should be allowed to innovate for real change and national emissions reductions.

In the UK-GBC report '*The definition of zero carbon'* [18] the authors return to the concept of using 'zero carbon new-build' as a mechanism for leveraging investment into the existing stock and low carbon infrastructure rather than literally trying to achieve it on an individual dwelling basis. The problem with the system as proposed in the UK-GBC report is that it would likely incentivise sprawling development on greenfield land and make it more expensive for urban infill and retrofit. However, what the UK-GBC appear to have over-looked, is that investment in the existing stock can achieve a significantly higher £/kgCO_2 saved ratio. Therefore, by allowing new-build to 'off-set' their carbon emissions via improvements to the existing stock and infrastructure, the same level of investment can achieve a greater reduction in overall emissions. Furthermore, there may well be other benefits to linking new-build developments intrinsically with the existing built environment in terms of social integration. For example, if a new-build development is built to exemplar fabric standards then it will have very little heat demand, therefore a CHP unit sized on the heat-load would be very small, whereas a CHP sized on the power demand would produce excess heat. If the developer were allowed to contribute to a fund that would extend the district heat network to the surrounding buildings, then more carbon can be saved then would have ever been possible for just the new building. The developer, having funded the new building and, at least in part, the infrastructure to reduce the emissions from the existing stock, should, arguably, be allowed to claim that their development is 'zero carbon' given that, not only would national emissions not be increased as a result of their development, but they may well even be reduced.

In essence, a focus needs to be maintained on the over-arching goal of reducing national GHG emissions, regardless of the name given to the initiative. 'Zero carbon' can be a useful tool if it is used appropriately; but if Government continues to insist on applying it literally then the UK is unlikely to achieve the GHG reductions that it is committed too, let alone the reductions that scientific evidence suggests are needed.

Other Government's and national industry bodies should recognise the lessons on show from the British experience and should refrain from simply engaging in 'carbon target one-upmanship'. Leadership and clarity are important, but so is a logical approach to implementation and appraisal.

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