All Party Parliamentary Group for Excellence in the Built Environment Inquiry into Sustainable Construction in the Built Environment:

Consultation Response from the School of Construction Management and Engineering, University of Reading

1.0 Introduction

This response is from the School of Construction Management and Engineering at the University of Reading[1]. The School was established in 1972 and has built up an international reputation for the academic rigour and industrial relevance of its research into the policy, theory and practice of the design, construction and use of the built environment. In recognition of the growing need to adapt our existing built environment to climate change, the School has recently made a number of strategic investments within this area, appointing three professors and three lecturers in positions relating to energy, sustainable futures, sustainable construction and sustainable technologies. These have not only contributed to our academic research base, but also to our teaching programmes, with postgraduate courses on Design and Management of Sustainable Built Environments and Renewable Energy: Technology and Sustainability. The current head of School is Professor Stuart Green.

We have five key areas of research activity within the School, two of which relate to issues of sustainability: Innovative and Sustainable Technologies (IST) and Transition pathways to a low-carbon economy. A selection of current projects demonstrate the breadth of our research: retrofitting cities for the future (Dixon), low-carbon innovation in housing (Sexton), energy markets (Torriti), 'people-centred' technologies for energy demand reduction (Shao), and urban microclimates (Yao). In addition, the School leads on a cross-university research network in Sustainability in the Built Environment (SustBE)[2], which provides visibility and collaboration opportunities to academics working across the numerous disciplines in this arena. Finally, our EPSRC-funded engineering doctorate Centre for Technologies for Sustainable Built Environments (TSBE) ensures industry practitioners and researchers of tomorrow are fully versed in the practical and theoretical considerations relating to this commercially relevant issue.

Further details on our work are available at: http://www.reading.ac.uk/cme/

[1] This response is by individual academic staff working in SCME at the University of Reading and listed in this document by section, and at the end of the document. The response does not represent an official view of SCME or the University of Reading as a whole.
[2] See http://www.reading.ac.uk/sustainability-in-the-built-environment/

2.0 Evidence of best practice of sustainable construction in the built environment - and how could this be repeated? (Professor Li Shao)

The construction industry faces a collective challenge to close the yawning gap between design and in-use performance, which affects a wide range of new and existing technologies for low carbon retrofit or new build. Gaps of 40-100% are common and even routine issues like wall insulation are affected by unexpected wasteful energy use in recent construction projects – the substantial heat loss through un-insulated party walls is a well-known example.

Against this background there has been increasingly strong, if still limited, evidence of the major energy saving potential of energy monitoring and management, based on the latest ICT and control technologies, which integrates holistically the optimisation of building energy systems, and the engagement of users and facilities management (FM) in the process. Major energy and carbon savings have been repeatedly demonstrated. For example, savings of 27% (CIBSE, 2012) have been achieved across the retail and office building stock of one of the largest commercial landlords of the UK, based on an energy monitoring and optimisation process and through working with building occupiers and FM. Similarly, savings of 25% in a chain of 22 retail stores have been achieved (Carbon Trust, 2010) through cost-effective measures centring on engagement of staff and facility managers and monitoring energy use, leading to targeted equipment upgrades. Some individual buildings within a given portfolio would achieve even higher reduction rates. Indeed, individual office building case studies have revealed savings of 40% and higher (CIBSE, 2012; Carbon Trust, 2010) often reflecting better practices in monitoring and action by building users and FM. Recent research led by the University of Reading revealed energy reduction of 70% in an individual case study (Shao, 2012). These are encouraging achievements in in-use energy reduction

Further remarkable features of this energy monitoring and management approach include the lower costs of its implementation compared to fabric- or HVAC-based building retrofit solution. The cost difference is often an order of magnitude, with the former enjoying rapid payback in many cases, thus greatly increasing the likelihood of its uptake. The two approaches are not mutually exclusive, though it makes a lot of sense to reduce the demand first by improving energy efficiency and minimising waste, using energy monitoring and management, which may lead to cheaper HVAC and fabric interventions at a later stage.

Building user engagement facilitated by the ICT feedback of the energy monitoring and management system is probably one of its most valuable features as it deals with the source of energy use and waste much more effectively. Active and continuous user participation in identifying and removing the energy waste form an integral part of the energy monitoring and management solution, leading to lasting energy efficiency and durable behaviour change. Many of the faults and problems resulting in the gap between design and in-use performances were identified and resolved this way, which would have been much harder to track down otherwise.

The energy monitoring and management, facilitated by ICT and controls, complements other major industry initiatives. The Soft Landings framework (BSRIA, 2009) is widely recognised as an important answer to the challenge of the design-operation performance gap, addressing the all-important (early-) design and commissioning/handover/POE stages. The energy monitoring and management complements soft landings by providing a useful tool for

the commissioning and performance tuning at these stages. The tool remains valuable and powerful beyond the stages by underpinning the operational energy efficiency and maintenance of facilities through the life of the buildings.

A further major initiative in recent years has been Building Information Modelling (BIM), which also has shown promise as a platform for a step change in FM and operations. The energy monitoring and management system could complement BIM by providing the all-important operation data, people engagement and behaviour-related energy management. In other words energy monitoring and management could provide essential input for effective BIM in the FM stage. One similarly envisages a link between Soft Landings, BIM, and energy monitoring and management.

There is further rich interaction with (or influences on) other significant elements/programs of the construction industry. Given the developments described above, it is possible that building energy management systems (BEMS) will evolve in alignment with BIM and energy monitoring and management, thus becoming more effective in engaging people and enabling their involvement in energy efficiency. Smart meters for non-domestic buildings are still in a developmental stage and will benefit from the behavioural and people engagement insights gained in the implementation of energy monitoring and management. Many organisations are committed to reducing energy consumption either voluntarily or under the CRC and other mechanisms. The strategies of many organisations for achieving this objective rely to a significant degree on changing user behaviour, although there are few reliable tools and methods to support the realisation of such change. The energy monitoring and management system would help to bridge this gap.

There are also important economic implications in this: according to BIS (2012), the ICT Services and Construction Services rank respectively as the 5th and 14th largest net exporting sectors of the UK economy. The ICT based energy monitoring and management in buildings builds on the existing strength of these sectors and would contribute to their continued health and success in the future.

3.0 Barriers to sustainable construction - what is holding the industry back and how could this be improved? (Professor John Connaughton)

3.1 Background and key issues

The barriers to sustainable construction and property development are many and varied (Sourani and Sohail, 2011). They are present at all key stages of the property development and construction processes. They affect all aspects of these processes including financing, design, construction, operation and use – and indeed the disposal of unwanted and/or obsolete buildings. They arise at an industry/institutional level as well as at the level of individual businesses and consumers/householders. This response does not purport to cover all of them; instead, it concentrates on a small number of significant barriers that represent a real block on progress towards developing more sustainable construction and property sectors.

The more significant barriers to sustainable construction may be grouped into a small number of key themes, and this helps to understand the interrelationships between them:

1. **Demand-side barriers –** Fundamentally, there is insufficient demand for (and, indeed, buyer insistence on) sustainable construction and sustainable buildings. Some of the reasons for this in the housing sector are highlighted in our separate commentary on the Green Deal (section 5.0). More generally, the underlying reasons continue to be the lack of an explicit link between investment in sustainable construction/buildings and an increase in property value, together with a lack of consumer understanding of, and interest in the benefits – environmentally, financially and in terms of user comfort and wellbeing.

2. **Supply-side barriers –** While the best of UK construction is world class, many businesses on the construction supply-side see sustainable construction as difficult, costly and risky. Sustainable technologies for buildings can attract a price premium that is not always justified in terms of market supply and demand. Furthermore, the construction sector's unfamiliarity with many technologies can result in poor installation and commissioning, leading to reduced performance – and unmet customer expectations – in use.

3. **Institutional barriers –** Related to demand-side failings are a similar set of institutional barriers that stem from a lack of understanding of the value of sustainable construction. Financiers/funders, particularly in the current market, are risk averse and wary of funding construction/property that may appear unusual and/or novel. They are advised by property experts whose valuation methodologies traditionally did not take account of any link between higher sustainability standards and property value.

4. **Legislative/regulatory barriers –** Not so much the existence of legislative/regulatory barriers; more the absence of appropriate regulation that would require the provision of more sustainable construction and buildings. Despite claims to be the 'greenest government ever', the current UK administration has shown a reluctance to institute new regulation in key areas of sustainable construction and property, including a proposal to require all commercial property to provide Display

Energy Certificates (DECs) to publicise their relative energy efficiency. The Government's proposed review of the Code for Sustainable Homes and how the concept of Zero Carbon Buildings may be re-defined suggests a lack of regulatory commitment to higher sustainability standards for new housing (from 2016) and for new non-domestic buildings (from 2019). The UK Green Building Council, in its 'Half Term Report' on the Government's sustainable building commitments is critical on these and other key provisions.

3.2 Some suggestions for improvement

The barriers to sustainable construction and property development across industry demand- and supply-sides, and covering institutional and political/regulatory areas are closely interrelated**.** Their removal/amelioration requires a co-ordinated programme – involving government, the construction and property industries, and user communities – of research, awareness raising, policy development, training and skills development, and regulation. Key areas include:

1. **Research –** with a particular focus on demand-side issues, to develop a clearer understanding of:
    a. The use and benefits of sustainable buildings in operation
    b. The value inherent in sustainable buildings, and how this can be more accurately reflected in conventional industry approaches to property valuation and marketing
    c. Funding risks associated with sustainable buildings, and how these may be addressed/mitigated (for example, through the development of improved design assessment tools; new forms of assurance and guarantees, etc).

2. **Awareness raising, training and skills development –** in parallel with new research on the effectiveness and operation of sustainable buildings, as well as on the relationship between sustainability and investment/property value, a new national programme is needed to raise awareness of the value and benefits of sustainable construction and property among both the demand (investors, occupiers and individual households) and supply sides (designers, constructors, installers). This would need to be evidence-based – drawing on the research programme and the practical experience of leading clients and practitioners from demonstration projects and exemplar case studies – and linked to a new skills development initiative focused on the particular challenges of sustainable construction.

3. **Policy development and regulation –** The extant UK Strategy for Sustainable Construction (2008) needs to be brought up to date, aligned with the Innovation and Growth Team Report on Low Carbon Construction (2010) and the Cabinet Office Construction Strategy (2011), and republished and championed by the recently formed Green Construction Board, with a renewed commitment by Government to promote and support the development of more sustainable construction and buildings. In particular, the updated Strategy should contain clear provisions for:
    a. Reducing energy use in existing non-domestic buildings
    b. Improved Green Deal provisions (see separate commentary)
    c. The definition of Zero Carbon to be adopted by government and industry, and in relation to planned changes in the Building Regulations Part L

d. Development of a renewed ‘green construction skills programme’, including new arrangements for apprenticeships.

The potential exists for significant improvements to be made by targeting the removal of key barriers in a multidisciplinary, coordinated approach. This could be led by the Green Construction Board with representation from Government, research funders, industry and the user communities.

3.3 Existing construction procurement business models (Professor Will Hughes)

There are major barriers to sustainable construction in the business models that are used in the construction procurement process. The procurement methods that are in use across much of the industry reward conservatism and make it very difficult for technology providers to get new products into buildings. The procurement of construction work is based on paying contractors for work in progress related to labour and materials used each month on site. Since the design and specification of the technologies is not usually carried out by the contractor, even using a design and build form of contract, there is little scope for a contractor to innovate (Hughes et al. 2006).

The current procurement routes have become outdated and unsuitable such that they require warranties, guarantees, third party arrangements and all sorts of complex legal and financial structures (Hughes, Hillebrandt and Murdoch 1998). Worse, innovative technology providers are faced with the need to persuade architects and their insurers to specify untried technology. The best of the new approaches that overcome this kind of problem is the kind of deal that involves performance-based contracting (Gruneberg and Hughes 2011), such as Energy Performance Contracting. It is perfectly feasible, indeed it already happens, that technology attached to the building need not be a part of the building contract. Technology providers can, and often do, offer a service, rather than a product. Innovators can, in this way, take informed business risks, and stand to reap the rewards if they get it right. Moreover, if this is lined up properly, venture capitalists will be interested in investing in novel technologies in buildings. This is already happening with lighting technology, and this model can be extended more widely.

As long as the organization of construction procurement precludes innovative technology companies from taking the risks and rewards associated with sustainable technologies, it is difficult to imagine how the UK construction industry can move beyond Victorian ideas of how the business of construction should be transacted.

4.0 Progress on sustainable homes - too much too fast? (Professor Martin Sexton)

4.1 The policy context

The UK Government Code for Sustainable Homes requires that all new homes be zero-carbon from 2016. The consultation document poses the question: has progress on sustainable homes been 'too much too fast'? The answer is no – rather, the Government is doing too little, too slowly to finalise the specification of zero-carbon new homes well ahead of the 2016 target. The Government strategy on the energy efficiency/carbon reduction aspects, for example, was to ramp up Part L of the Building Regulations (from a baseline of the 2006 version) in 2010 and 2013, before zero-carbon in 2016. The approach was intended to give the new build housing sector a structured roadmap to zero-carbon to manage business uncertainty and to undertake the required research and development investment in new designs and technologies, and to create new, stable supply chains to source new skills, materials and components. The Government and industry came together through the jointly funded and chaired Zero Carbon Hub to provide recommendations for the specification of zero-carbon in a fashion that was technically robust, commercially-viable and met the needs of consumers. The Hub made recommendations to Government in February 2011 for carbon compliance limits for detached, attached and low rise apartment blocks. The Government has not made a response to these recommendations to date (November 2012).

4.2 The implications for housing developers

The UK new house build sector is a concentrated one, with the top ten volume builders accounting for around 50% of house completions. These large developers are characterised by resilient patterns of standardised design and production templates. It is into this stable context that the Code for Sustainable Homes and its requirement that all new homes be zero-carbon from 2016 arrived. The on-going lack of clarity for the 2013 and 2016 Part L regulations has created business uncertainty for housing developers which is adversely affecting the investment and innovation required to change their designs and production processes. Research undertaken at the University of Reading has shown that this uncertainty has stymied 'radical' innovation towards sustainable homes as housing developers adopt a 'wait and see' strategy and limit themselves to incremental changes in order to meet current requirements. A survey of housing developers (Sexton and Lees, 2012) has reported, for instance, that they are already excluding a range of renewable energy technologies and are locking themselves into the 'bolt-on' technologies of solar thermal and solar PV technologies that minimise the disruption to their standardised design. This narrow range of solutions, however, may be in conflict with the best 'technical' solutions to progress the sustainable homes agenda.

4.3 The way forward

There is an urgent need for the detailed and stable specification of zero-carbon for new homes. To reiterate, this is needed to give the regulation certainty and business stability for house builders to deliver zero-carbon homes from 2016.

Looking beyond the specification of zero-carbon, the work of organisations such as the Zero Carbon Hub and the NHBC Foundation needs to continue with Government financial support to provide the independent guidance and support the housing sector needs to implement the Code for Sustainable Homes.

5.0 The Green Deal - is the policy the right one? What can be done to ensure take up? (Professor Tim Dixon)

5.1 Background

The Green Deal, which is described by the current government as a *'flagship piece of legislation which will deliver energy efficiency to homes and buildings across the land'* came into effect in October 2012 and is enshrined in the Energy Act (2011), although the full and final details of the detailed 'architecture' of the financing will not be known until January 2013 (Richards, 2012). In simple terms there is now a legal framework in place which will enable energy customers in England, Wales and Scotland to receive loans to carry out energy efficiency improvements. The repayment of loans attaches to the property and the 'golden rule' states that repayments should not exceed the savings on an average energy bill. In addition a new energy company obligation (ECO) is also available to tackle those in fuel poverty and for measures falling outside the golden rule. Existing schemes (CERT and CESP) are due to end in 2012 and the Green Deal will be financed through a not for profit Green Deal Finance Company, bringing together 16 companies, led by PwC.

5.2 Key issues

There are a number of problematic issues with the Green Deal in its existing form, which commentators and observers have highlighted. These are summarised as follows.

- **Overall impact:** the Government's own impact assessment of the Green Deal suggests that even after revision, loft and cavity insulation are set to fall dramatically by 83% and 67% respectively after the Green Deal commences. This is effectively the result of a transition from zero costs insulation to full cost plus the market rate of interest. Indeed recent research (Rosenow and Eyre, 2012) suggests that Green Deal/Eco will only deliver carbon reduction at a rate of one quarter of the rate of the policies it replaces. Moreover there is a wider issue regarding the disconnect between the Committee on Climate Change and DECC's projections that all lofts and cavity walls need to be insulated over the next 10 years in the UK, and the lower projections envisaged in the Green Deal itself.

- **Financing and rate of interest:** under the new Green Deal regime, grants are replaced by market-based loans. Given that even under the previous grant regime of zero cost, the uptake of key insulation measures had fallen in 2010 (CCC, 2011), there is considerable concern that, at an expected rate of interest of 6-8% for loans, interest rates will not be attractive enough to incentivise homeowners to take up the Green Deal. Indeed a key recommendation of the Committee on Climate Change is that the Green Deal and the new Energy Company Obligation should be aligned with the ambition to insulate all lofts and cavity walls by 2015, as well as 2.3 million solid walls by 2022. There is thus a perceived disconnect between carbon emission reduction ambitions and policy implementation, which also raises issues of fuel poverty. Operationally there are also issues: the cost of assessment under the Green Deal, which may be £100 or more, is only refundable *'if desirable and if this option is made available by the Green Deal provider'* (DECC, 2012). Moreover, there is evidence to suggest that because the golden rule is met only 'on average', in some cases repayments may well exceed energy savings. This is in stark contrast to, for

example, Germany where the development bank (KfW) (a triple A-rated bank) has been able to dispense loans for retrofitting at low rates of interest (1-2%) (Carrington, 2012). Approximately one third of its annual lending goes to energy and climate change investments, including €24bn from 2009-2011 on energy efficiency in homes, and this leveraged a total investment of €58bn. According to Carrington (2012) since 2001, KfW loans have helped insulate and seal over 2m homes, employing 200,000 people a year in the process, and since 2006, 156m tonnes of carbon have been saved, equivalent to over a quarter of the UK's total annual emissions. German homeowners are able borrow up to €75,000 via KfW and on the most efficient Passivhaus homes up to 12.5% of the loan is returned to the homeowner. Alternatively, up to 20% of the cost of the works is also available.

- **Barriers to uptake and operational issues:** although the Government has recently introduced a range of incentives to attempt to 'kickstart' the Green Deal, there are a number of generic barriers. Research for EPSRC Retrofit 2050[3] found that: (i) some of the key barriers to retrofit continue to revolve around perceived disruption and upheaval when energy efficiency measures are carried out; and (ii) that people and businesses are more concerned with other priorities in the current economic climate (Britnell and Dixon, 2011). Moreover, as Rosenow and Eyre (2012) suggest, other related barriers include uncertainty over the ability of existing UK supply chain capacity to undertake the level and extent of installation required, particularly in hard to treat properties, and the ability of ECO to deliver its ambitions. There are also issues over whether current planning regulations are flexible enough to deal with, for example, the need to use external insulation, and whether this is tantamount to an 'extension' to the property or not, and indeed whether the Green Deal will be able to handle the complexity of heritage buildings (Hildyard, 2012a). Finally, there are issues as to whether the Green Deal can deliver fair results, particularly in respect of initial assessment criteria (i.e. average rather than actual energy use), early repayment penalties, and the impact of ECO (Consumer Association, 2012).

- **Non-domestic sector:** in the non-domestic sector there are also concerns that the Green Deal will not provide sufficient energy savings for the scheme to be worthwhile, with the golden rule running the risk of being a 'deal breaker' because technologies and building improvements which do not meet the rule are not likely to feature on the accredited list of improvements. Therefore only very poorly performing buildings will be worth retrofitting under the Green Deal (Quartermaine, 2011). With the Government also still delaying an announcement on the Green Deal and its roll out to commercial property there is concern that developers and investors will simply look for alternative ways of financing the energy efficiency measures required to retrofit poorly performing commercial buildings by 2018. There are also doubts over how the Green Deal would work in multi-let property, and the value and accuracy of EPCs as a basis for the agreement (Cooper, 2012).

[3] See www.retrofit2050.org.uk

- **Roll out at scale:** in its current form, the Green Deal relies very much on 'self-directed' market-based initiatives to achieve capacity and scaling up at community and city level. This is perhaps the area where city-based local authorities, in terms of the move to city-regional status, have the biggest potential role to play (Dixon, 2012). However, this is not easy in an age of 'austerity'. The Government has provided some £7m in Green Deal grant incentives to those cities forming part of the City Deal programme, but this is money for England's largest cities. Whilst there are opportunities for some of these 'core' cities to also tap into Tax Increment Financing (TIF) schemes and work more closely with Local Economic Partnerships (LEPs) to roll out the Green Deal at scale there are two problems which may mean progress is hindered, except in the largest and wealthiest cities: (i) the landscape is now very fragmented and complex at city level with City Deal, Green Deal and TIF all offering opportunities to large cities, but with the role of LEPs in some doubt; (ii) there is a danger of creating a 'twin track' city system where smaller and less wealthy cities do not have the capacity or opportunity to be providers or partners in the Green Deal whereas core cities do. In some cities and towns, 'alternatives' to the Green Deal are already being promoted in the private sector, thereby adding to complexity, confusion and uncertainty. Moreover, co-operative-based alternative schemes have also been developed in Oxfordshire, and the West and East Midlands ('Fair Green Deal') at a loan rate of 5.1% (Read, 2012; Ecology, 2012).

5.3 'Reconfiguring' the Green Deal: some observations

Although the Green Deal is a major step forward in potentially enabling energy efficiency measures to be carried out at a large scale in the UK, in its current form it suffers from a number of major defects and there is a danger this is likely to even reduce rates of insulation in the domestic sector, and provide little likelihood of success in the commercial property sector.

The Green Deal is one of a number of loan-based instruments which have been implemented internationally. However, other countries have more flexible schemes which offer lower rates of interest. Aside from the German KfW scheme, the US Property Assessed Clean Energy (PACE) programme in the USA, which was first introduced in Berkeley, California in 2009, is a local authority loan-based scheme, based on the property tax assessment (UNECAP, 2012). In this scheme the loan rate can be as low as 4.99% (Efficiency Maine, 2012) with additional tax benefits of tax deductible interest payments, although the scheme has met resistance from household lenders against adding additional risk to residential mortgages (UNECAP, 2012).

For the Green Deal to have a better chance of success than it currently has there needs to be a reconfiguration of the existing architecture of the scheme. This should be based around the following principles.

1. **A bigger and more direct role for the Green Investment Bank (GIB) is needed:** the important direct role that the GIB could play in the Green Deal, both in terms of underwriting and aggregating finance scheme is well-recognised (BIS, 2011). If the GIB were to play a more central role in the Green Deal this could enable better overall risk management of the scheme at more attractive (i.e. lower) rates of interest.

2. **Green Deal incentives should be wide-ranging and permanent:** although the Government recently announced a package of incentive measures these are temporary. More permanent and wide-ranging incentives are needed, and additional possible incentives might include differential stamp duty, council tax rebates, or tax breaks. In addition a lower rate of interest closer to 1-2% would be possible if the GIB were to play a more direct role akin to KfW in Germany.

3. **The Green Deal should offer more flexibility to homeowners:** Penalising those who pay back early under the Green Deal is unfair and this should be amended under the Consumer Credit Act as the Government plans to do. It would be better to assess actual energy use rather than average energy use as the basis for a 'personalised' energy assessment. Assessments should also be guaranteed as 'independent'. There is also emerging evidence to suggest that ECO would have greater impact if it is supplemented by using revenue raised from auctioned EU Emissions Trading System (ETS) allowances to invest in energy efficiency measures in fuel poor households (Verco and Cambridge Econometrics, 2012).

4. **A national Green Deal Roadmap is needed:** the Green Deal in its current form is almost entirely market-based. This means that clear guides through the process are needed for homeowners and businesses to feel comfortable about uptake. Although the new DECC guides are helpful, there is no clear strategic roadmap in place which shows how the variety of policies and funding streams fit together, and indeed this is related to the fact that the overarching framework for the UK Green Economy (*'Enabling the Transition to a Green Economy'* (HM Government, 2011)) lacks a long term vision. A national Green Deal Roadmap would help provide greater certainty to the process, and would help make important linkages with the existing UK Renewables Roadmap.

5. **Flexible city-based Green Deal initiatives should be encouraged on a wide scale:** there is now a complex city-level policy landscape in place. Greater consideration needs to be given as to how cities across the UK can play an important role in rolling out the Green Deal at scale given that the level of trust in local authorities is higher than in the private sector (Hildyard, 2012b). More focus should be given on packages which help smaller towns and cities, and which also link best practice together more closely, through a national 'Low Carbon Cities Network' (Dixon, 2012).

6. **A more integrated approach is needed within Government to planning regulations, building regulations, and the low carbon transition:** currently there is a disconnection between these three elements which needs to be urgently resolved. This requires a much more strategic approach to low carbon transition in the built environment so that energy efficiency measures at scale are incentivised and not prevented by contradictory planning and building regulations. This goes hand in hand with the lack of a coherent national strategy on the Green Economy (see section 3.0 above).

7. **The role of the Green Deal needs to be more closely defined in the commercial property sector:** there is considerable doubt as to whether the commercial sector will use the Green Deal to carry out the energy improvements needed. Given the important role of SMEs in the commercial property sector as businesses or tenants, it is critical that the Government provides greater coherence and confidence through more detailed guidance on how the Green Deal will interface with the requirements to let more energy efficient properties by 2016 and 2018. The rollout of mandatory DECs (which has now unfortunately been stalled) would also be a major and transformative step forward.

6.0 List of individual names

The following members of staff contributed to this response and are also listed against their authored sections above:

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