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The future of policy and standards for low and zero carbon homes

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Report for Royal Institution of Chartered Surveyors

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Executive Summary

This project evaluates policy and standards for promoting the delivery of low and zero carbon (LZC) new homes in England, in the context of the 2012 Housing Standards Review and the recently withdrawn 2016 zero carbon target. The low/zero carbon homes agenda was launched by the Labour Government in 2006 with the aim of establishing 'performance orientated' policy tools, including a complementary mix of mandatory national regulations, voluntary and quasi-voluntary standards. In principle, such a mixed approach can be considered a 'smart' way of establishing a clear baseline national standard, while further driving innovation towards higher standards that might not be feasible nation-wide. However, the numerous policies and standards for housing developed and adopted in the private market and by local authorities were widely viewed as over-complicated and not always steering towards the most cost effective and sustainable building solutions.

The analysis of policy and standards for LZC homes presented here draws from 70 interviews with a broad range of stakeholders, including designers, developers, consultants, valuers and key industry representatives. Interviewees were asked to assess the strengths, weaknesses, opportunities and challenges facing policy and standards for LZC homes.

The Standards Review was launched to cut 'red tape,' that the Coalition Government saw as imposing an unnecessary burden on house builders. Although there was wide support for the Review's aim of streamlining, the 'red tape challenge' also sought to promote deregulation in a way that more strongly divided opinion.

Based on this research, there is wide support across the sector for the strong emphasis of Government upon national Building Regulations as the primary policy driver for achieving LZC homes, especially given that consumer drivers for higher energy standards are weak. However, opinion is far more divided about what many view as the recent 'watering down' of energy-related regulations for new homes. Many view the Coalition policy, which led up to the later abandonment of the 2016 zero carbon target, as having overlooked the key role for stronger regulations as drivers of innovation.

To promote policy goals in a 'performance orientated' way that secures support from industry, assessment tools need to be designed carefully to enable industry to innovate and respond flexibly to local circumstances. Problems were experienced with the specific methodology of key policy tools, including the Code for Sustainable Homes and Part L. Yet there is significant scope for such problems to be addressed through further processes of learning.

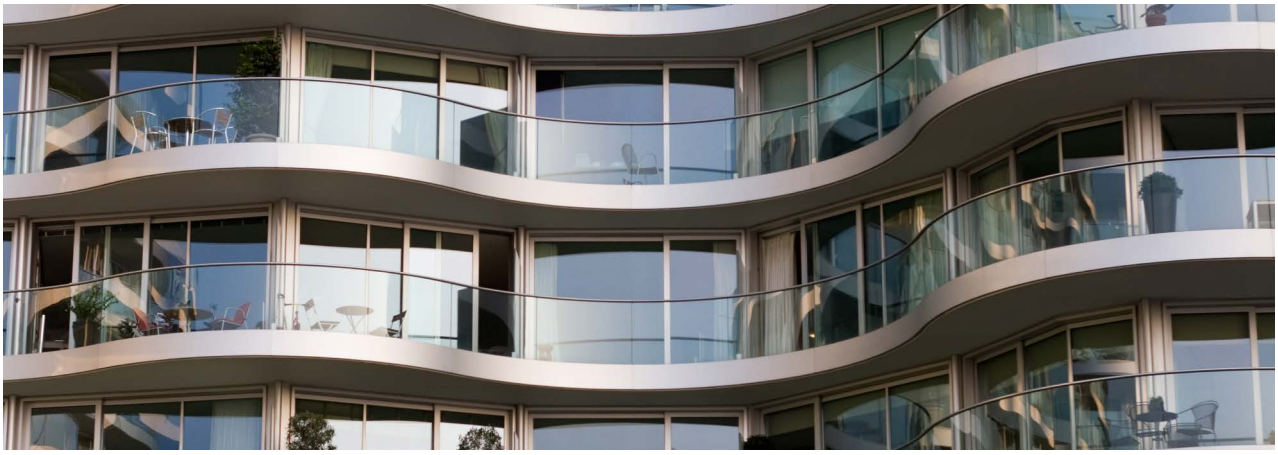
This gives cause for questioning the Coalition's deregulatory approach of removing particular standards without replacing them, as with the decision to wind down the Code. This decision meant that a range of broader sustainability issues not captured by mandatory regulations will now be inadequately covered by policy, notably ecology and the sustainability of building materials, including their embodied energy.

Regarding energy standards in particular, this report highlights a range of concerns that underlie debates about the specific level at which regulatory standards are set:

- Significant uncertainty caused by delays in confirming future policy and the role of particular standards. This uncertainty causes additional costs for industry (e.g. in hindering land price negotiations, undermining research and development).
- The additional costs of transitional arrangements arising when key parts of the regulatory approach are altered or withdrawn.
- The need to develop skills and working practices across the sector to ensure that such standards are achieved in practice.
- The gap between the energy performance of buildings, as specified at design stage, and their 'as built' performance.
- Policy tools not adequately capturing dynamic factors (e.g. climate, solar gains, airflow and thermal mass) that are important influences upon building energy performance and risks.
- The need for standards to encourage greater engagement with sustainability issues from the home buying public. Although underpinned by some significant technical achievements, the Code failed to gain recognition amongst home buyers, which limited its force as a driver towards higher sustainability standards. However, since the Housing Standards Review and the winding down of the Code, there is reduced appetite in many parts of the industry for the uptake of a new, replacement standard.

Although the 2016 target has been scrapped, concerns about the capacity of the sector to deliver LZC homes remain important, with ambitious UK climate change targets and EU 'nearly zero energy' buildings targets for 2019/2021 still in place. Even if and when building regulations do become aligned with the nearly zero target, there would still be a potentially significant role for voluntary standards in driving innovation beyond the regulatory minimum.

1.0 Introduction: 'Smart Regulation' for LZC new homes?



The delivery of new homes has recently risen further up the political agenda, with both the Conservatives and Labour pledging to increase the rate of house-building. The subject of less mainstream political debate is how far and in what ways these will be 'sustainable' homes. Buildings are a key area for achieving EU and UK targets from the Climate Change Act of 80% CO_2 emissions reductions by 2050 (from the 2006 baseline). Given the limits to how far such reductions can be achieved by retrofitting existing buildings, the emissions reductions target for new homes is even higher.[1]

Recent UK Governments have taken an active role internationally in climate change policy. The current government, under the UN Sustainable Development Goals has pledged support for "urgent action to combat climate change and its impacts" and the integration of climate change measures into national policy. In addition to national targets many cities including London and Manchester have set ambitious emissions reductions targets for greenhouse gases and the built environment plays a central role in strategies for implementation.

In 2006, the Labour Government introduced the target that from 2016 all new homes built should be 'zero carbon,' stressing that one in three homes for 2050 were still to be built. In 2010, the EU set a target that all new buildings should be 'nearly zero' by 2021. These ambitious targets resonated with what many stakeholders and researchers view as the need for a 'transition' towards more sustainable built environments. Yet home buyers and occupants lack awareness of such policy goals and tend not to prioritise environmental sustainability considerations[2].

In this context, this report assesses current policy and standards for low and zero carbon (LZC) homes, and their implications for the housing market. In particular, we evaluate the effectiveness and balance between mandatory and voluntary standards, national and local policy in promoting innovation for delivering and marketing more sustainable homes.

Emissions reductions targets for new homes intersect with a range of other economic, environmental and social issues, ranging from ecological impacts and water efficiency to the provision of public transport and other public amenities and services. There is of course also a need to ensure economic viability and to foster market drivers for such homes. The complexity of the challenge is compounded by the diversity of the house-building sector. Large house builders have had a markedly higher share of the market since the 1980s, though small house builders remain a significant part of the sector[3]. The challenge of designing policy and standards needs to consider the impacts across the full range of housebuilders, with their varying business models and scales of operation.

Although this policy area is subject of little public awareness, the question of how policy and standards can effectively enable industry to balance these goals has been the subject of intensive debate amongst a range of industry stakeholders since 2006. After the introduction of the 2016 target, exactly how 'zero carbon' should be defined was the subject of significant debate and controversy. Initially the term was defined as achieving net zero carbon solely through on-site measures, such as the on-site installation of micro-renewables.

1 Due to factors such as the orientation and historic character of existing buildings, those built from now to 2050 will have to exceed 88-91% savings for the whole building stock to meet climate goals (Europe 2011). 2 (Watts, Jentsch, and James 2011; E.ON 2014) 3 Significant structural changes since the 2007/8 financial crisis mean that the number of active small house builders has declined by half. This decline is part of a longer-term trend from about 8,000 small builders in the 1980s and early 1990s to 2,700 in 2013 (DCLG 2014d).

Later, the definition was modified to allow for off-site measures, or 'allowable solutions' to count towards achieving zero carbon (see Appendix 3). Of course, defining policy is only part of the challenge of achieving low and zero carbon, sustainable homes. It is often commented, both from within and outside the housing industry that this agenda brings into focus the need for broader change in design, planning, construction methods and training. Nonetheless, with market drivers of change widely seen as lacking, regulation is broadly agreed – both by academics and industry experts to be of vital importance.

In defining regulations, governments must inevitably negotiate and address stakeholders' contrasting interests and expertise. Some prior research suggests that house builders have a strong influence in the process through which the Building Regulations are determined.[4] This influence has often been suggested to be rather conservative, reflecting a reluctance to change long-established practices[5]. Several of our interviewees involved in policy-making hold this perception, with house builders often viewed as primarily concerned with a perceived short-term interest in lobbying against stronger regulatory standards due to the costs and changes to construction methods they entail. Aside from this issue of vested interests, there is the challenge for policy-makers of acquiring the knowledge needed to define effective policy, particularly in a complex area such as sustainable housing. As is well known, such knowledge problems can lead to policy decisions having negative unintended consequences. An example of this would be a new home that performs well in terms of energy efficiency but where occupants suffer from overheating. These challenges concerning interests and knowledge raise the question of the most appropriate roles of central government and local authorities in steering the housing industry towards LZC homes while allowing sufficient flexibility for innovation and adaptation to local context.

The traditional 'command and control' approach to environmental regulation, in which governments require firms to adopt particular technological solutions, has been highlighted as being especially susceptible to negative unintended consequences[6]. Since the 1990s, there have been significant moves away from such overtly prescriptive regulatory approaches. Industry now expects to be allowed flexibility in choosing technologies for achieving sought-after outcomes. Nonetheless, regulatory standards in many fields still often face the criticism that they encourage a 'tick box' approach to compliance, with industries focusing on satisfying pre-specified compliance standards without seeking to achieve what might be

4 (Pickvance 2009; Raman and Shove 2000) 5 (Ball 1999; Barlow 1999; Glass, Dainty, and Gibb 2008; Williams 2012) 6 (Rosenbaum 1991)

better outcomes in broader terms. Short-term pressure for results based on known technologies, even where initially effective, can lead to a sacrifice of opportunities for longer-term continuous innovation[7]. In the case of buildings there is concern that sub-optimal solutions can be 'locked in' for long periods. In the domestic retrofit sector there is concern that 'shallow' retrofits using sub-optimal windows and external insulation products could be kept in buildings for 15-20 years and that those buildings will need retrofitting again in the future. Such a danger is especially pronounced in new build, where the effectiveness of practices and technologies encouraged by policy and standards can vary according to local circumstances and the rapidity of technological change. This is the case with some policy and standards for LZC homes, with the Code for Sustainable Homes having been notably susceptible to this criticism[8].

In response to these concerns, 'performance orientated' regulations and assessment have become increasingly popular. This approach involves assessing firms in terms of attaining particular outcomes, allowing them flexibility in choosing technical means for achieving them. The associated idea of 'smart regulation[9]', which involves a blend of mandatory regulation and voluntary standards, has also become popular. One of the key arguments for such a policy mix is that voluntary standards can spur increased innovation, leading to a learning process which informs a strengthening of mandatory regulations.

These debates prompt a series of vital questions, explored in this report, about regulatory strategy:

- How can policy and assessment tools for LZC homes be defined to enable designers to effectively balance economic, social and environmental values?
- What should be the balance between mandatory regulations and voluntary assessment tools in fostering innovation towards achieving sustainable, LZC homes?
- In what areas should local authorities have discretion in adopting LZC homes standards within their local planning decisions?
- How should these aspects of policy strategy respond to wider challenges involved in delivering LZC homes in England relating to the need for learning and skills development?
- In what ways should regulatory strategy respond to consumer perceptions and preferences regarding LZC homes?

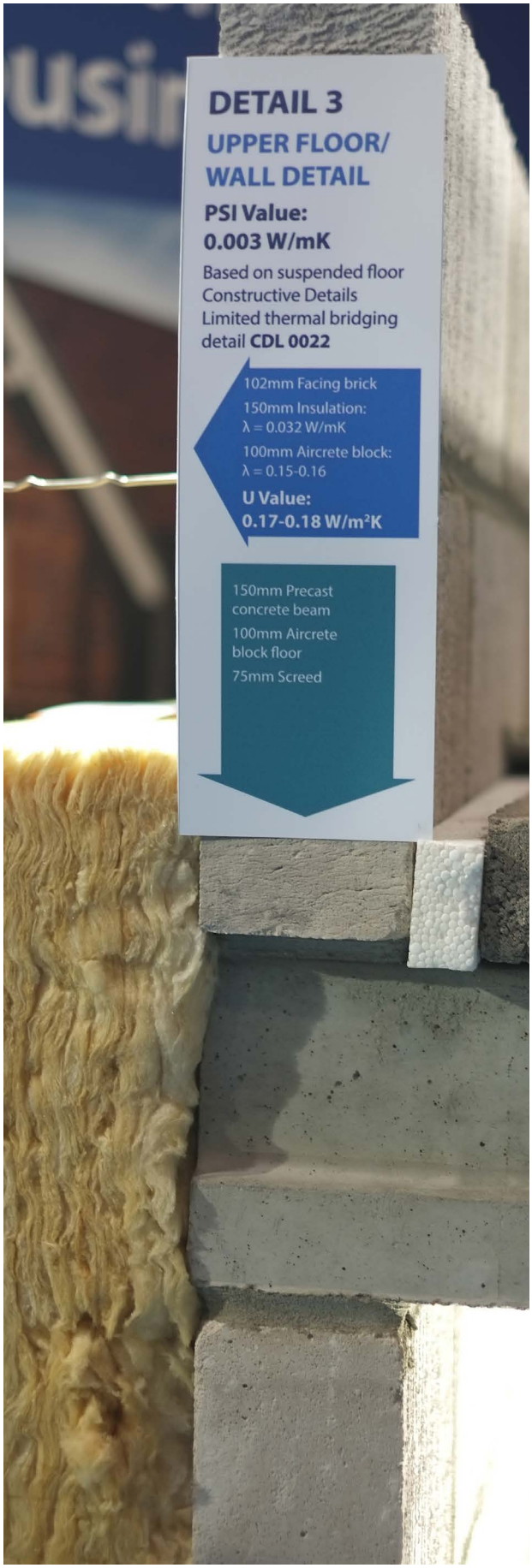
7 (Porter and van der Linde 1995) 8 (Greenwood 2010) 9 (Gunningham, Grabosky, and Sinclair 1998)

1.1 Policy background

In addressing the challenge of policy-making for LZC homes, successive governments have emphasised the importance of working in partnership with industry. The 1997-2010 Labour Government, after introducing the zero carbon target in 2006, sought to encourage key industry stakeholders to conduct research and disseminate information about the design approaches, technologies and construction methods involved in delivering sustainable, LZC homes. In 2008, it established the Zero Carbon Hub, an independent organisation tasked with promoting delivery of the 2016 target through industry networks. The 2010-2015 Coalition Government adopted an even more strongly industry-led approach. For example, industry was given full responsibility for developing packages of construction details to be made widely available to housebuilders. Central Government funding for the Zero Carbon Hub ended in 2011 and this industry-led organisation, given pivotal responsibility for the attainment of the 2016 target, is now almost entirely industry funded.

A concern to achieve a performance orientated approach was reflected in New Labour's stated commitment to 'provide flexibility' and 'drive innovation' towards delivering zero carbon homes[10]. Incremental moves to a performance orientated approach can be seen in the revisions to the Building Regulations. In the 2000 Building Regulations compliance could be demonstrated either by meeting specified U-values for fabric elements or a target U-value that allows for some flexibility in design. In the 2006 Building Regulations compliance is achieved by a Dwelling Emission Rate that must be better than the Target Emission Rate for that building type and builders have considerable flexibility in achieving this. As well as proposing a roadmap for the future incremental strengthening of Building Regulations, Labour initiated and funded the establishment of the Code for Sustainable Homes, which also sought to allow developers flexibility in how higher sustainability standards are achieved. The Code was intended to further encourage innovation beyond mandatory regulations, as envisaged by advocates of 'smart' regulation.

Policies for a range of sectors have an impact upon the LZC homes agenda, including planning, design, energy, transport and fiscal policy and areas of environmental policy such as water and ecology. There are a number of voluntary standards, ranging from home design standards such as Building for Life and Secure by Design, to industry certification schemes for construction products. Local authorities have had powers to establish sustainability policies and check lists, as well as to stipulate in planning conditions that particular standards are attained. Notably, the Code for Sustainable Homes was widely used by local authorities to set required sustainability standards and minimum Code level 3 became mandatory for social housing nationwide from 2008. Meeting higher levels of the Code than building regulations was linked to securing funding from the Homes and Communities Agency.



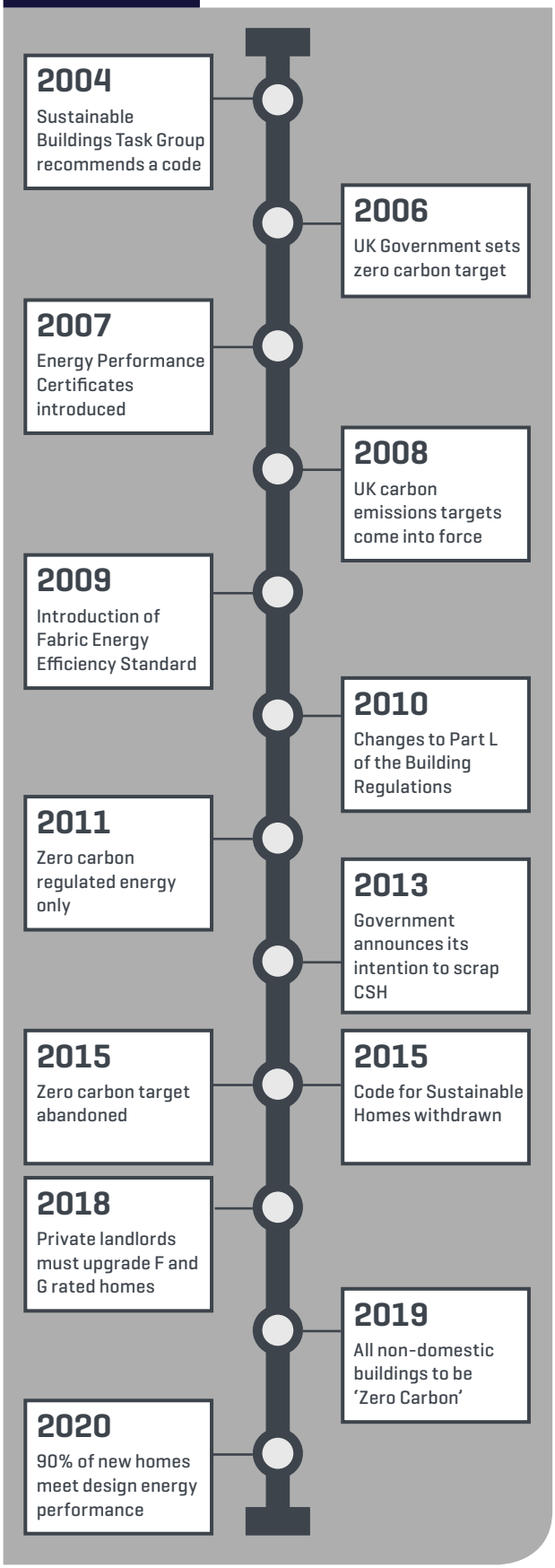
10 (DCLG 2010).

The planning system allows room for trade-offs, so higher sustainability standards might be set instead of more exacting targets for access or affordable homes. The Code was influential in driving the sustainability agenda. However, concern was widely expressed from industry about the number of such policies and standards, their consistency and the need to simplify the regulatory environment[11], not least due to impacts upon the viability of some developments[12].

In light of the complicated array of policies and standards, housing was viewed by the Coalition as a key sector with scope for streamlining what they referred to as the 'regulatory burden' and 'red tape' that they saw as hindering economic growth. In October 2012, following the housing and construction 'Red Tape Challenge', the Coalition launched the Housing Standards Review, which aimed to cut red tape for the sector, emphasising the need to simplify and streamline the regulatory environment for house builders. This reflected concern about the costs of meeting regulatory standards and was informed by the 'Better Regulation' agenda that emerged in the late 1990s, emphasising the need to evaluate the monetary costs and benefits of regulation. The Coalition introduced a 'One In, Two Out' rule aiming to reduce the net costs of regulation across a range of sectors. However, critics[13] have emphasised that the cost-benefit analysis methodology underpinning this rule excludes certain costs and benefits from consideration. These include the costs of policy uncertainty (a theme further explored in this report), the business benefits that might arise from achieving higher standards[14], in terms of adding to the market value of the product being produced, as well as the value of public and non-monetised goods[15]. Criticisms of this agenda by some academics and policy analysts emphasised that, whilst regulations might entail additional costs in the short term, markets require a clear regulatory framework in order to function.

The Coalition continued to state a commitment to the 'zero carbon homes' target, first set by the Labour Government in December 2006. Grant Shapps, who became housing minister in 2010, had pledged to confirm the zero carbon definition 'within weeks' of coming to office. However, the full definition remained to be confirmed at the end of the Coalition's five-year term. One of the final pieces of legislation passed by the Coalition was the Deregulation Act, which scrapped the Code for Sustainable Homes and limited the flexibility for local authorities to set their own targets for energy efficiency in new homes. Shortly after forming a majority government in May 2015, the Conservatives scrapped the 'zero carbon' target[16]. Hence, the zero carbon definition shall no longer be incorporated into building regulations, as had been the intention for 2016. Indeed, the long awaited 2016 update to Part L, the energy section of the regulations, was no longer to go ahead. Although the position of the UK within the EU remains to be settled by a referendum to take place by the end of 2017, the UK as a current EU member remains committed to the EU target for 'nearly zero' buildings by 2021.

Figure 1 Timeline for Low and Zero Carbon



11 (NHBC 2012a: 11). 12 (Local Housing Delivery Group 2012). 13 (e.g. Housing Standards Review Challenge Panel 2013). 14 Porter and van der Linde 1995) 15 (Rosen and Callanan 2014: 856-57). 16 (HM Treasury 2015).

Methodology

There is now significant recognition of the limitations of purely quantitative approaches to evaluating regulatory impacts. The question of how far regulatory standards will spur innovation involves significant uncertainty. The range of costs and benefits arising from regulation are often contested. For example, it is often argued that the benefits of sustainable, energy efficient buildings are not always fully considered because they accrue over a longer time period, as emphasised by advocates of 'whole life' costing for buildings.[17] Evaluating homes requires consideration of a range of factors, from well-being and health, to ecological and social 'costs' that cannot all be easily measured in monetary terms. Especially where complex mixes of regulations and standards are present, there is an important, identified need for qualitative studies of actual and prospective impacts of regulatory approaches to complement quantitative studies[18].

This report is based on a comparative, qualitative analysis of the views held by a wide range of stakeholders from industry and policy-making about policy and standards for LZC homes, supplemented by an academic literature review. 28 of our 70 interviewees were selected due to being closely involved in policy-making and debates at a national level ('national level interviewees'). 38 were 'local' stakeholders involved in the delivery of selected new housing developments in three selected localities in England: Brighton, Manchester and the London Borough of Greenwich. Four were based outside of the U.K. with an international perspective on policy and standards for LZC homes.

There was a small overlap between the 'national' and 'local' categories. For example, a leader in an industry body may also themselves be a developer on local projects. These three localities were chosen because of the significant number of new homes being built there. They also all contained a number of different types of developments including apartments as well as terraced and other low-rise housing developments.

Table 1 **Environmental sustainability goals in Brighton, Greenwich and Manchester**

	Climate change targets	Levels of Code required	Number of Code completions 2008–2014	Other policies and initiatives for new homes
Brighton and Hove City Council	A 42% reduction in carbon dioxide emissions in 2005 by 2020	Initially 3, raised to 4	685	Mandatory Sustainability checklist includes embodied carbon
Manchester City Council	CO_2 emissions by 48% on 1990 levels by 2020	Initially 3, raised to 4	1,545	Low carbon economic area
Royal Borough of Greenwich	60 per cent by 2025, on 1990 levels. (London wide)	Initially 3, raised to 4	3,540	

17 (Kishk et al. 2003). 18 (Local Housing Delivery Group 2012: 13; Jabobs 2006; Baldwin 2006).

The interviewees within each locality had contrasting levels of experience in terms of the standards they had worked towards, ranging from developments working solely according to Building Regulations, to those being built according to higher and broader sustainability standards, notably Level 4 and above of the Code for Sustainable Homes. As shown in Table 1, the local authorities in Brighton, Manchester and Greenwich have each stated strong goals in terms of promoting sustainability, including lower CO_2 emissions.

The experience of a significant proportion of designers and developers working to standards above Building Regulations in these localities means that they can offer potentially valuable insights into the implications of recent policy changes under the Coalition, such as the winding down of the Code for Sustainable Homes and revisions to building regulations.

As Appendix 7 shows, the selection of interviewees reflect a range of roles and areas of expertise related to the planning, design delivery and valuation of new homes. It was beyond the scope of this research to survey the perspectives of home buyers and residents and the research draws from prior market and academic research.

We did, however, ask for interviewees' perceptions of homebuyers' perspectives. The semi-structured interviews were conducted between October 2014 and June 2015. They typically lasted between 45 and 60 minutes, involving a series of standard questions about the strengths and weaknesses of policy and standards for LZC homes. The questions also explored the opportunities and challenges involved in achieving sustainable homes, with a particular focus on the zero carbon target and its inter-relationship with other social, economic and environmental goals.

Section 2 of this report discusses the broad challenges for industry of designing, delivering and developing the market for LZC homes in 2015. In the context of these challenges, Section 3 analyses stakeholder debates about policy and standards during the Coalition Government. Section 4 concludes. Section 5 makes recommendations for the future of policy and standards for LZC homes. These sections assume prior knowledge of key policies and standards for LZC homes in England, although an introductory overview is provided in Appendices 1-6.

2.0 The Challenge of LZC Homes in 2015

Research by the National House-Building Council (NHBC) shows that delivering new homes in England involves several challenges, ranging from the cost of land and obtaining financing, to the difficulties of obtaining planning permission as well as additional costs such as Section 106 agreements and the Community Infrastructure Levy[19]. Interestingly, achieving LZC standards does not feature in the NHBC's list, suggesting significant progress in this respect[20]. Yet ensuring that new homes achieve higher LZC standards itself involves a range of challenges, as reflected in the doubts raised about the feasibility of the ambitious 2016 zero carbon target during the Coalition government.

2.1 Supply side challenges

2.1.1 Costs

The costs of 'zero carbon' homes

When the zero carbon target was first announced in 2006, there was much debate and considerable disagreement among industry professionals about the impacts on costs. This partly reflected divergence between the size of firms, their business models and supply chains[21], which are key factors affecting costs. Large house builders (those building over 2,000 homes per year) have a 54% market share[22], while there are around 2,700 small house builders (those with 1-100 starts per year)[23]. Other important factors affecting the additional costs of LZC homes are:

- Built form: detached homes, semi-detached homes or apartments
- Location: construction costs are typically higher in London and the South-East
- Size and design: as well as the floor area of the property, specific design features such as integral garages
- Construction methods: brick and block; timber frame; modern methods of construction

Table 2 Costs of LZC homes

Dwelling type	Additional cost range for achieving the zero carbon standard (compared to proposed 2013 Part L)[25].
Detached house	£6,700-7,500
Semi-detached house	£3,700-4,700
Apartment (low rise)	£2,300-2,500

Code level	Additional cost above basic build	
	2011	2014
5	£16.5-23K	£6.5-10K (10-15% of total)
6	£28-38K	£15-26k (25% of total)

Since 2006, the cost of LZC homes is widely recognised to have fallen significantly. Zero Carbon Hub research, which stakeholders frequently refer to and express confidence in, shows that the additional cost of building to zero carbon halved between 2011 and 2014[24].

As shown in 2011 and 2014 studies by Element Energy, the additional costs of achieving the highest levels of the Code are significantly higher.

Energy requirements for the Code, LZC energy technologies in particular, are by far the largest factor in these additional costs of Code levels 5 and 6. However, water consumption is also significant, representing a quarter of the additional Code costs. As well as being a concern for developers, the additional costs of LZC homes are also a concern for those promoting the provision of more affordable housing for lower and middle income households.

19 (NHBC 2014). 20 Morgan et al (2015) also find that a range of other costs facing house builders are much more significant than the costs of achieving low and zero carbon. Knight Frank (2015), in a study of 160 housebuilders, of varying sizes and locations, found the costs of environmental standards was not a primary concern. Amending environmental standards was only the 6th priority, concerning only 39% of builders. This fell far behind improving resources in local planning authority (82%) and improving skills (58%). 21 (Adams, Croudace, and Tiesdell 2011: 291; Morgan et al. 2015). 22 (Savills 2015). Between the early 1990s and the mid-2000s, the market share of the top 11 firms doubled to around 45 per cent of all dwelling sales (Europe Economics 2014). 23 (DCLG 2014c). 24 (DCLG 2011; Zero Carbon Hub and group 2014; H.M. Parliament 2013; Element Energy 2013). 25 This is based on achieving zero carbon via the lowest cost route (FEES + efficient gas boiler + Solar PV + Allowable solutions)(Zero Carbon Hub and group 2014). Figures were compiled prior to the Part L 2013 update being finalised. 26 This finding is also reached by Morgan et al (2015).

The costs of higher fabric energy efficiency

In terms of the cost of achieving higher fabric energy efficiency standards, achieving Code Level 4 without the need for renewables is now widely viewed as feasible[26]. Of key importance in this respect has been the AIMC4 project, that focused on developing robust technical and commercial solutions that could be delivered at volume in future projects. Some interviewees emphasised that a significant proportion of additional costs of achieving high fabric energy efficiency standards lay in the overhead costs of developing new designs, construction details and working practices, rather than costs necessarily associated with these new designs themselves. There were some concerns that fabric efficiency standards are driving industry towards more 'boring' and 'boxy' house designs. This could be addressed, supporters argue, if renewable energy solutions remain part of the mix. Meeting higher fabric efficiency standards involves some significant uncertainty, compared to established renewable technologies such as PV, where supporters claim there is greater confidence that they deliver predicted performance. The inclusion of PV is also supported by the cost analysis carried out by the zero carbon hub, that predict that while energy efficiency costs are likely to fall, these will not outstrip the cost reductions in solar PV.

Measuring costs

There is some variation in how far different cost analyses have been accepted by the sector as accurate. Measuring additional costs of LZC involves several challenges:

- Ongoing processes of innovation and varying supplies of materials mean that costs are subject to continual change[27].
- Obtaining reliable cost data can compromise commercial confidentiality, hence developers providing cost estimates usually remain unnamed. There is significant suspicion about the accuracy of some cost studies based on cost estimates by unnamed developers.
- There have been relatively few developments in England built to high sustainability standards. Notably, few Code 5 and 6 homes have been completed (only 233 completed Code 6 Homes could be included in the 2013 Element Energy Study). A significant proportion of these have been demonstration projects, which often include especially innovative techniques or technologies to assess them for future schemes.

27 The House of Commons Environmental Audit Committee was critical of DCLG's Housing Standards Review for not taking sufficient account of the falling costs of achieving Code for Sustainable Homes standards. In particular they highlighted the September 2013 study by Element Energy and Davis Langdon[House of Commons 2013c].

Finance

Financing new homes involves a range of challenges, including some which are specific to LZC homes. In one case covered by this research, an LZC home development had initially been refused mortgages, despite complying with national standards[28]. There is a lack of research indicating how widespread this problem is in the U.K. This experience contrasts with other European countries where lenders are more inclined to finance LZC home developments. For example, the German bank KFW offers low interest lending to projects meeting more stringent energy efficiency standards than the building regulations[29].

The costs of uncertainty

Policy uncertainty was emphasised by many of our interviewees to have caused increased costs. Developers require significant advance notice about future regulatory policy in negotiating a price for land and preparing plans. It takes two to three years to go through planning and start construction for larger schemes. Hence, uncertainty about future policy leads to cost inefficiencies in the land supply chain. The construction products sector in general will be especially reluctant to invest in expansion in the context of such regulatory and financial uncertainty[30].

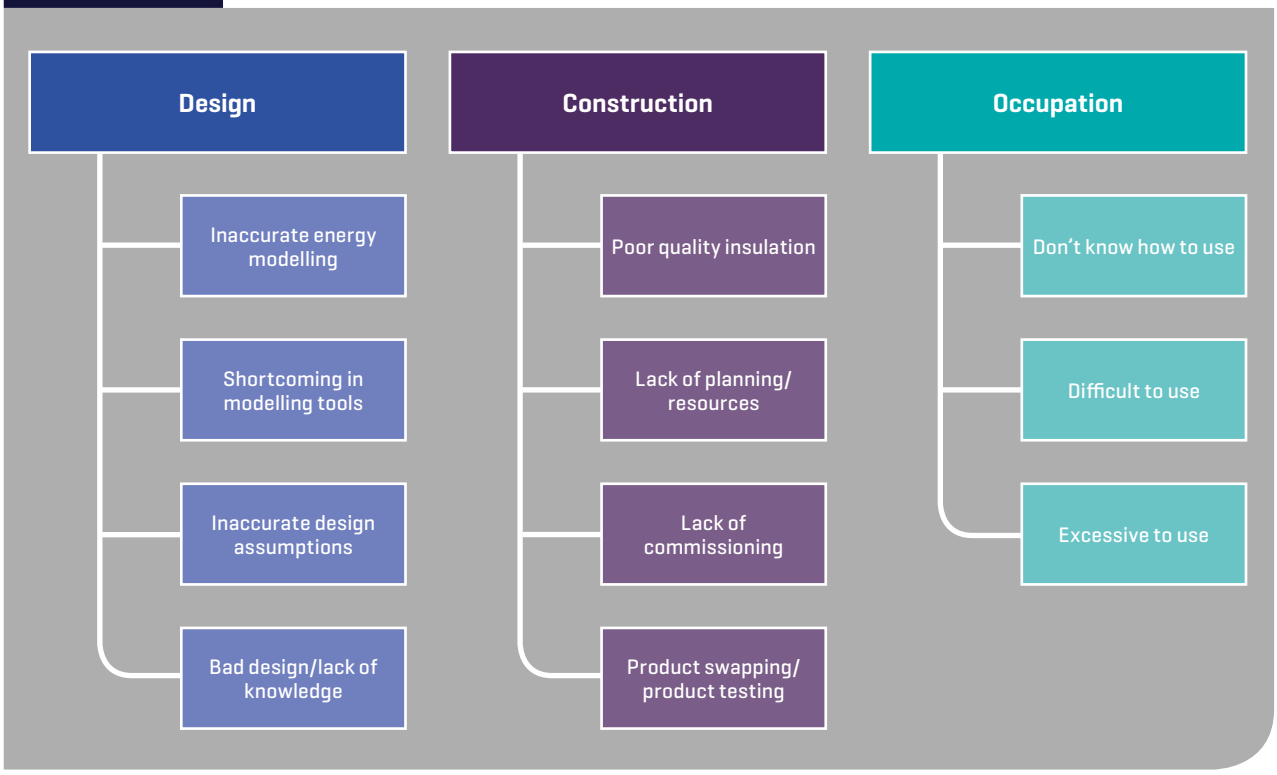
2.1.2 Delivering fabric energy efficiency

Aside from costs, delivering homes that achieve LZC standards in practice involves a broader range of challenges relating to skills, construction methods and the performance and quality of homes in practice.

Performance

Relating to the energy efficiency of the building fabric in particular, the focus has shifted from costs to the 'performance gap' between the design stage and as-built performance. The Zero Carbon Hub have set the ambition that by 2020 at least 90% of all new homes meet or perform better than the designed energy/carbon performance. To achieve this, Zero Carbon Hub emphasise the importance of the construction sector developing and improving in terms of skills, knowledge and tools, throughout the construction process, from design through to compliance checking[31]. Several of our interviewees gave examples of homes not having been built as designed. There are occasions where departures from the original design are necessary to overcome unforeseen issues that arise on site. Yet examples were reported of bad quality work, often covered up.

Figure 2 The performance gap



28 In this case, the developer had a BBA agreement (certified by British Board of Agreement) and a national warranty provider. 29 (Griffiths 2015). 30 Similar concern about the impacts of such sudden policy changes have been made about decisions in other related policy areas, notably the recently proposed cuts to subsidies for the renewable energy industry (Green; 2015). 31 Zero Carbon Hub 2015).

Overheating

As experts point out, including in recent projects by the Hub, there is a need for attention to potential unintended consequences of energy efficient buildings, notably overheating and poor indoor air quality. The Zero Carbon Hub defines overheating as the "phenomenon of a person experiencing excessive or prolonged high temperatures within their home, resulting from internal and/ or external heat gains, and that leads to adverse effects on their comfort, health or productivity"[32]. Addressing this risk requires careful attention to the ventilation of buildings with high levels of air tightness. There is significant concern about this issue amongst some developers, designers and homeowners and serious overheating problems have led to legal action being taken against some landlords[33].

Skills and practices

Addressing these challenges of performance and potential unintended consequences such as overheating requires the development of skills across the sector, an issue highlighted by previous recent research[34]. The seriousness of the problem was especially emphasised by our interviewees with most direct involvement in skills and training.

"The quality of workmanship in the UK and the culture of building quality is poor so actually delivery to real low-energy or low-carbon homes is very tricky. There is a cultural thing. House-building has always been about keeping out rain, whereas in central Europe it's about keeping heat in. For us as long as you keep the water out that's OK. This idea of being airtight and of being very closely controlled hasn't been what we've needed to do. It is only over the last 20 years we have tried to go down this route. It is a new culture and skills that go with it and then new systems. Traditionally we have brick and block and a cavity wall. The brick is effectively a rain screen and the block holds up the house. Now we are moving to system-build. We are moving away from something that everyone knows how to do. Bricklayers have learnt how to be bricklayers for 100s of years, there have been apprenticeship schemes. And now we want you to construct with pieces like Meccano. We want you to lock together SIPS panels onto a timber or metal frame. It's a completely different set of skills."

32 Zero Carbon Hub 2015). 33 (NHBC 2012b). 34 (Morgan et al. 2015).

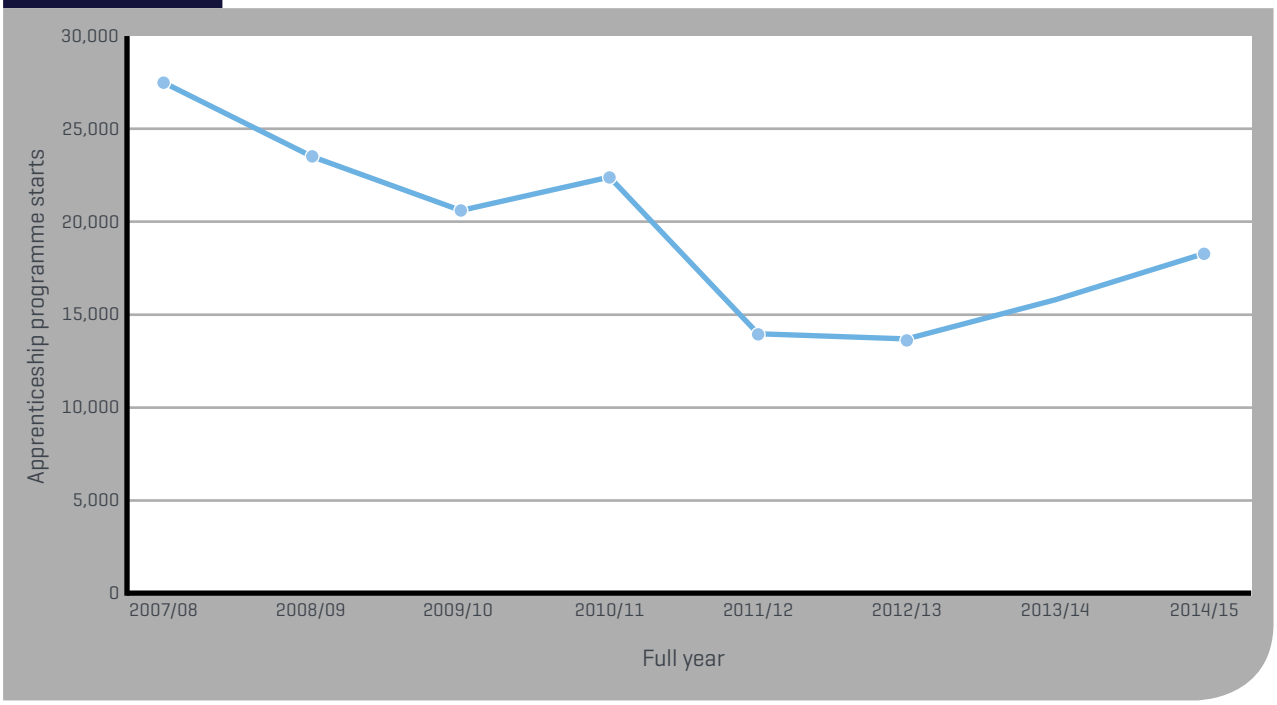
The skills gap applies to the full breadth of professions involved in the planning and delivery of new homes, from architects and SAP assessors, to surveyors and valuers.[35] Some challenges in delivering energy efficient homes cut across the remit of different traditional trades or professions. For example, linear thermal bridging and calculation cuts across skills in construction and architecture.

The need to develop skills for delivering LZC homes is part of the wider challenge of labour shortages and skills gaps across the sector[36]. Some stakeholders comment on how this was exacerbated by the recession from 2008. Others view that gap as reflecting a cultural tendency for non-academic training to be under-valued and an associated under-investment in training, though local authorities are making up for some of the training shortfall through the use of planning obligations for large developments. A recent study by the Local Government Association highlights the work that city councils, including Nottingham and Southampton already do, acting as a single point of contact for developers, working with local training providers to upskill local residents to take hard-to-fill vacancies[37].

Although the need for skills development is a well-documented challenge, our research highlights the following specific issues:

- Current policy uncertainty is contributing to under-investment in training, research and development.
- Our local interviewees tend to take an especially pessimistic view on the prospects for these skills challenges being addressed to achieve LZC homes in the coming years.
- Architects we interviewed more strongly emphasised concerns about skills than developers.
- There is potential for Section 106 agreements to include apprenticeships[39], though this is not currently common practice. One interviewee, a volume builder working in Greenwich, highlighted the recruitment of eight apprentices as a S106 requirement on his current project, but noted that it was much more common for training to 'be paid lip service'.

Figure 3 **Construction, planning and built environment apprenticeship achievements (England)**



35 This finding was also reached by Zero Carbon Hub (2014). 36 (CITB 2015a; LGA 2015). 37 (LGA 2015). 38 The way the data was collected changed between 2011 and 2012. However, in 7 of the other 10 subject areas there was an increase in recorded apprenticeships, making this unlikely as the cause of the drop.
39 A well-known example of this is the King's Cross Construction Skills Centre where over 3,500 people have gained a construction industry qualification and over 1,200 people have gained employment in the industry. King's Cross Construction Skills Centre provides training, apprenticeships and employment advice, working with various developers including Argent and their development of King's Cross (BIS 2014; CITB 2015b).

Construction methods

Related to the skills gap is the need for dissemination of technical information about how to construct energy-efficient homes. Prior to the Part L 2010 update under Labour, Department for Communities and Local Government (DCLG) had supported the development of generic Accredited Construction Details (ACDs). These were intended to aid designers and developers for achieving compliance with thermal and air tightness performance standards. This work remains ongoing, with the need to take into account continually emerging evidence, while covering a range of different house types and designs. Under the Coalition, the DCLG continued to provide support for the development of ACDs as part of the Part L 2013 update. This was through an NHBC-run project covering the most common house types and construction technologies. Whilst a small number of national interviewees were familiar with this work, these recently developed construction details had not yet been taken up by our local interviewees. One expert with particular knowledge in this area commented on how currently available details are more advanced for some construction methods (notably modern masonry) compared with others (e.g. timber frame). Designing effective details involves balancing the need for accuracy, fostering understanding of the fundamental principles of building physics and design underpinning the details, with tolerance to imperfections during the construction process. This interviewee commented on the contrasting approaches to this challenge adopted by NHBC and Local Authority Building Control (LABC)[40].

In addition to a shortage of skills to deliver an efficient fabric there is also the question of availability of materials. The current shortage of traditional building materials, especially bricks has been well reported[41]. Higher environmental standards required by the Building Regulations and a shortage of some traditional building materials, in particular bricks are making house builders look to other building technologies apart from masonry. This shortage, and the resultant higher costs, have led a volume developer, that commonly worked with brick, to question if it was the right product any more. Bricks have become an expensive and decorative 'feature' and there are alternative materials that are robust and cost efficient. These modern methods of construction (MMC) include a range of building technologies including timber, concrete and steel. There are three main types of MMC. In volumetric construction modules, which could be, for example, a finished bathroom or even a finished house, are assembled in the factory, transported to site and then assembled onsite. In panellised construction, the insulation, plasterboard, plumbing, wiring, doors, windows and cladding are added to pre-cut panels on the production line. They are then taken to the site and slotted into an existing onsite frame, usually made of either timber of steel. In hybrid construction both volumetric and panellised techniques are used. For example, modular kitchens may be used throughout a panel-built development.

40 This interviewee commented that NHBC details sought to avoid highly exacting assumptions about construction practice, given that they were intended for developers and contractors who might lack experience and skills in building to the most recent, higher energy efficiency standards. This interviewee commented that Local Authority Building Control (LABC) ACDs are, by comparison, much more specific and detailed, recommending specific products and more "unforgiving" in terms of expected construction standards.

MMC processes of manufacturing and fabrication in a factory environment can achieve higher levels of energy efficiency, due to improved quality control[42]. For example, recent studies suggest that MMC can achieve higher standards of insulation and air tightness without any increase in delivery costs[43]. It is not always possible to attribute environmental benefits to the construction method and other factors, such as modifications to on-site practices, are also important.

Kate Barker's review of housing supply advocated MMC as a way to speed up the delivery of housing,[44] recommending a 25 per cent target for MMC in new affordable housing. This was supported by the HCA and English Partnerships 'Designed for Manufacture' competition. Through demonstration projects, this initiative showed how MMC construction can reduce on-site construction time and decrease waste, although the introduction of innovative components was linked with more delays when first time developers used the technique[45]. Because much less time is required on-site this can help developers better manage their financing costs. There is less time between arranging finance and the first sales. This feature of MMC is particularly appealing to developers building apartments when the first units cannot be sold until the whole building has been completed[46]. National support for MMC targets was dropped in 2008 but some local authorities have maintained a requirement and Manchester City Council require MMC when developments are built on their land. MMC may not always be a green building technique, as the embodied energy of the materials used also needs to be considered. However, life cycle assessment studies have indicated that MMC homes can have a lower embodied energy overall than traditional methods of construction[47].

Compliance

Compliance checks and penalties for non-compliance by local authority building control inspectors and other approved inspectors are of course vitally important in addressing the performance gap. There is a lack of data concerning the problem, although initial qualitative studies of Part L 2002 and 2006 compliance[48] suggest that compliance levels are poor, a finding supported by a more recent quantitative study of 2006 compliance[49].

Currently, legal responsibility for ensuring compliance with Part L lies with the house builder. Building control face the significant constraint that there is no statutory requirement for inspections to be undertaken during the course of the works, only to notify building control of the commencement and completion of works. Although building control are required to carry out reasonable inspection checks, this is subject to risk assessment and financial constraints.

SAP assessments take place at design stage and prior to completion but are reliant upon information provided by the designer and contractor, which might be of varying quality and accuracy. The only specific test that the house builder is legally required to independently carry out is the air permeability on a sample of properties.

Assessing buildings according to stronger Part L standards requires increased attention to detail on features such as insulation, installation and construction joints, to avoid thermal bridging and air leakage. The need to develop skills across the sector as achieving Part L compliance becomes more technically demanding (see Section 3.4 above) also applies to building control officers[50]. Yet important questions arise concerning the role of inspectors in relation to other professionals involved. Interviewees commented that it is not feasible for building control officers to take responsibility for quality control and that there is an important role here for site managers and the clerk of works.

41 (BIS 2014; CITB 2015b). King's Cross Construction Skills Centre provides training, apprenticeships and employment advice, working with various developers including Argent and their development of King's Cross. 42 (Morgan et al. 2015). 43 (Miles and Whitehouse 2013). 44 (Barker 2004). 45 (HCA 2006). 46 (Miles and Whitehouse 2013). 47 (Monahan and Powell 2011). 48 (Bell, Smith, and Palmer 2010). 49 In a study of 376 new build dwellings, Pan and Garmistan (2012) found that levels of compliance was poor, at a level of 35%. This was accompanied by 43% 'grey compliance' and 21% 'grey non-compliance' (due to insufficient evidence of achieving required carbon emissions reductions). 50 (Zero Carbon Hub 2014: 20-24).

2.1.3 LZC on-site energy generation technologies

There is broad acceptance and often a positive commitment to the use of LZC energy generation technologies on-site and renewables in particular, as was reflected in the large majority of our local interviews. However, a range of challenges involved in the planning, installation and use of these technologies were highlighted.

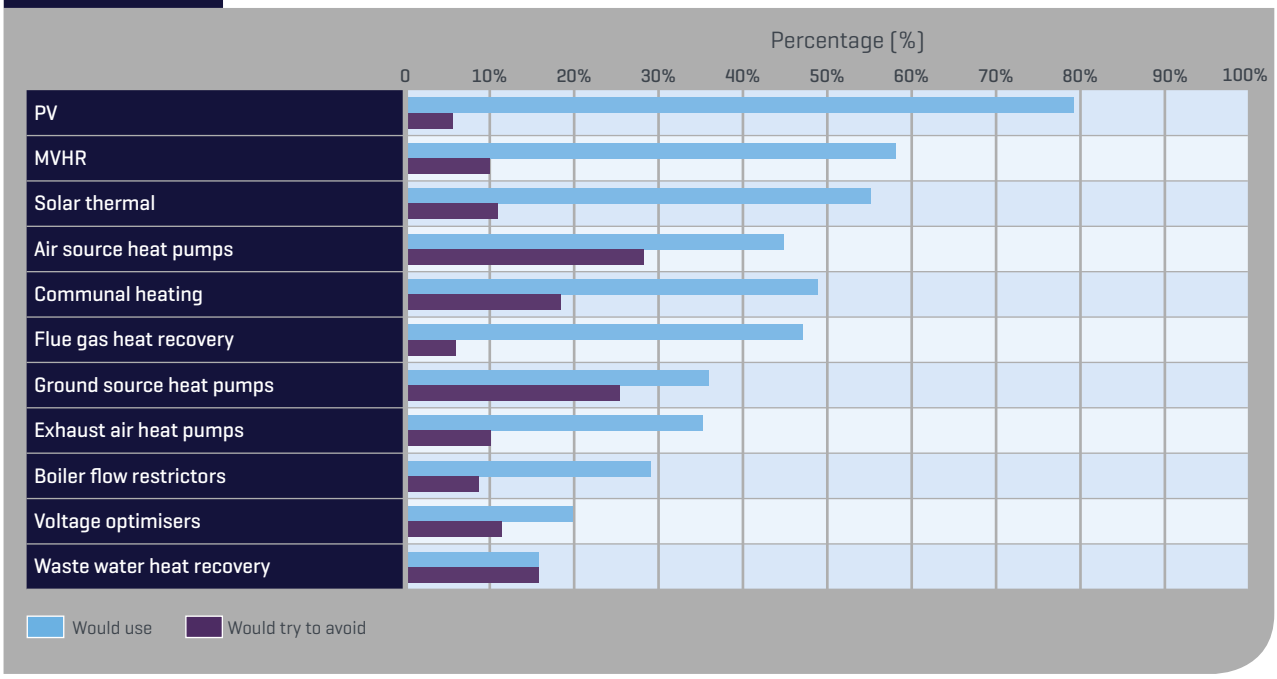
- As with debates about fabric efficiency, concerns have been expressed about the gap evident between the claimed and actual performance of low and zero-carbon technologies. The related challenge of improving skills given the difficulties of installing some of these technologies was also discussed by several local interviewees.
- There is significant variation in how the reliability of the technologies themselves is viewed by stakeholders[51]. Some are seen as emerging, including: PV, heat pumps, district heating systems and solar thermal. Heat pumps and biomass[52] in particular are singled out as problematic or uncertain. By contrast, some interviewees commented that the early problems with air source heat pumps had now been largely addressed. Solar PV is widely regarded as established and reliable. Part of this relates to the relative ease of installing solar PV compared to heat pumps and biomass systems. Client experience has developed in the retrofit market in both commissioning and installation, supported by funding through the Feed in Tariff.
- The way occupants use LZC technologies is crucial to the energy savings achieved, in particular the information and support that they are given[53].
- Generally, the costs of installing on-site renewables have fallen significantly and are less of a concern than during the early years of the Code[54]. Interviewees did highlight the impacts of grants and financial incentives on the renewables sector. The selection of a particular renewable technology might, it was suggested, have been due to an appealing Government grant, rather than due to being the most cost effective or suitable technology. It may also encourage developers to choose renewable technologies which can gain funding rather than fabric-based solutions.
- How to calculate the whole-life costing of LZC/renewable technologies. Most installations have not been in place long enough to encounter challenges around end-of-life and disposal.

51 Osmani and O'Reilly (2009) found a lack of confidence amongst house builders in emerging green technologies, with 76% of those surveyed commenting that it is a significant to major barrier. 52 Steve Luker Associates (2014) carried out a review of existing research and evaluations of Biomass boilers. While there were examples of systems that performed well, with some systems performing at over 80% efficiency, there was overall a 10-20% underperformance. Their study recommended field trials of emissions from boilers in the UK, as studies in the rest of Europe indicate that emissions rise with inefficient schemes. This could be a particular problem for cities such as London and Manchester, which already experience problems with air quality. Fawcett (Fawcett, 2011) notes that the UK heat pump installation industry is not currently of high standard, and there are concerns that the Renewable Heat Incentive will wrongly encourage growth before quality, training and skills are improved. This could lead to premature adoption and consumer disenchantment putting at risk the longer-term market for heat pumps. Gleeson (2015) notes ongoing problem of a skills gap for heat pumps. Training is largely unregulated with no strict adherence to a common syllabus or detailed training centre specification, and participants are not screened to make sure they have the skills to effectively participate. 53 (McManus, Gaterell, and Coates 2010). 54 (Zero Carbon Hub and group 2014).

Due to being at the forefront of installing renewable technologies, the social housing sector has sometimes been vulnerable to problems of early adoption. This early adoption has been driven in part by funding requirements to meet higher levels of the Code and in part by enthusiasm in the sector to innovate. NHBC found that 45% of housing associations had experience of installing back-up systems and 27% have had to decommission a technology (NHBC 2012a: 10). Doubts were expressed about the technical competence of those carrying out maintenance and 79% of associations thought this should be done by approved installers[55].

In the social sector in particular, there is concern that some of these technologies, such as exhaust air heat pumps and grey water systems, leave tenants with high services charges where there is poor commissioning or installation. Concerns about performance and maintenance of renewables have been compounded by a number of recent bankruptcies among renewable energy companies and the status of warranties. A minority but notable view was that some developers were reluctant to include renewables on market housing because it looks unsightly and could carry a stigma of being associated with social housing. More generally, developers are reluctant to spend significant capital sums on renewable energy when any revenue benefits would go to the occupiers. Perhaps more importantly these technologies tend to be incompatible with the use of standard house types[56]. Concerns were also expressed about grid connections being permitted in larger developments, to enable excess energy to be sold back to the grid. This cannot take place if the electricity grid in that area is not sufficiently robust, and the high costs of upgrading the grid would often not be feasible given the amount of energy generated.

Figure 4 **Energy efficiency – mainstream technologies**



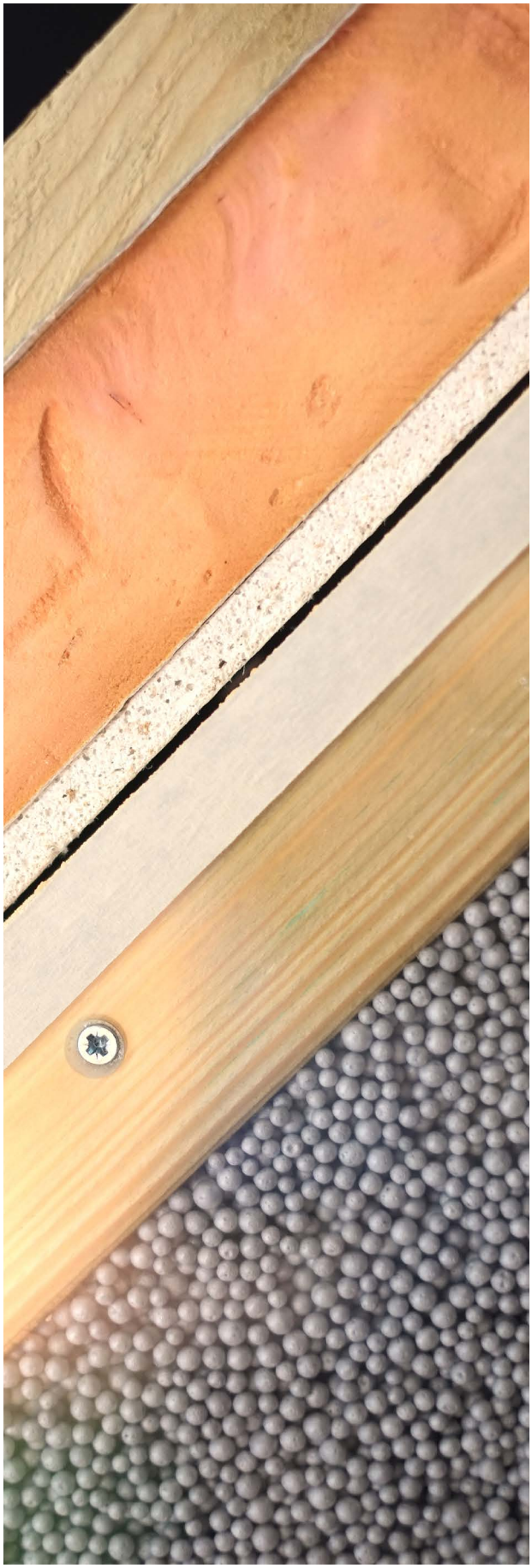
55 (NHBC 2015). 56 (Goodchild and Walshaw 2011).

2.1.4 Challenges and opportunities for small house builders

Just as contrasting views about the cost of LZC homes reflect developers' different business models and scales of operation, so do developers' contrasting perceptions and understandings of the performance gap. Small house builders face some especially pronounced challenges in achieving low/ zero carbon standards[57]:

- The risks involved in making changes to their development practices on a particular project are proportionally higher than for larger developers working on a number of projects simultaneously.
- Lacking the in-house design teams that some larger house builders have which enable them to prepare more fully for the introduction of new standards.
- They are often the first to have to build to a new standard. Larger developers often purchase land and gain planning and Building Regulations approval well in advance of starting to build a development. Because they are only required to work to the policies in place when they obtain planning permission and building control consent, there is often a significant 'time lag' before they have to work to a new policy[58].
- Larger house builders are often able to negotiate lower prices with suppliers because they are able to buy their required products in bulk. This approach of focusing on the supply chain to take forward the volume production of low carbon homes has been developed by the AIMC4 partnership[59].

Despite these challenges, smaller house builders can also arguably have more opportunity for innovative work and experimentation. There is scope for them to develop a niche market, with LZC being one potential specialisation. Where smaller builders use in-house labour, this could potentially give them more control over quality and training. However, this requires motivation and buy-in from the small company. It was commented by some interviewees that a large proportion of small house builders currently lacked awareness of proposed zero carbon standards, as well as the capacity and skills to achieve them.



57 (NHBC 2014). 58 Building Regulations approval lasts for three years and can last indefinitely if work has commenced. 59 This involved three large developers (Stewart Milne Group, Crest Nicholson plc, Barratt Developments plc) the Technology Strategy Board and BRE in developing fabric and building services solutions to achieving Code level 4 homes.

2.2 Demand side challenges

2.2.1 Consumer drivers?

Whilst significant progress has been made on the supply side, there has been only limited and relatively slow progress on the demand side. NHBC research has attempted to disaggregate buyers' preferences, finding that most buyers place energy efficiency below other key criteria for people when choosing a home (e.g. schools, local amenities etc.). Home-buyers may state a significant concern about energy efficiency, and certainly come to value lower fuel bills after they have made their purchase.[60] Nonetheless, the evidence suggests that this will rarely be decisive when it comes to choosing a new home, not least given the current, and the well-known shortage of supply, in much of the English housing market. Hence there is a general lack of pressure from consumers upon the house-building industry to achieve higher energy efficiency standards. The view widely expressed by our interviewees was that even where energy efficiency and renewable energy technologies bring financial benefits in terms of lower fuel bills or Feed-in-Tariff revenues, these features only command a price premium in certain niche markets.

In relation to fuel bills, the most significant decision for home buyers is whether to buy a new or old home. As one interviewee commented, such is the pivotal importance of this decision for home buyers' future energy bills that it could overshadow the relatively minor marginal differences between different energy efficiency standards for new and recently-built homes. The difference in heating costs between homes built from the 1996 Building Regulations onwards will be relatively modest, especially for flats and smaller homes. In the NHBC study, over two-thirds of occupiers of new or enhanced new homes stated that they are satisfied or very satisfied with their energy bills, compared with a little over one-third of occupiers of existing homes. Over half said their energy bills are lower in their new or enhanced new home.

Stakeholders interviewed for this project did refer to a recent increase in awareness amongst consumers about the need to consider energy running costs of homes, anticipating a significant future increase in such awareness in the coming years. Such increased awareness, they expect, will be influenced by the development of more user-friendly heating control systems and smart metering technologies.

Market drivers for energy efficient new homes can also be significantly influenced by developers' business models. In the commercial sector, interviewees pointed out that, where the developer takes such a longer-term interest in the scheme, they will be more likely to include sustainability features. In England this is a key reason why social landlords have been prominent in developing LZC new homes. Whilst consumer demand for such features might be lacking now, the homes could be more sellable in future as the market evolves.

2.2.2 Marketing low/ zero carbon homes

A further challenge is identifying the most effective approaches to marketing LZC homes. It has often been suggested, for example by NHBC, that the house-building industry should emphasise the lower running costs that result from the energy efficiency of new homes through their marketing materials and sales staff[61]. Our interviews provide grounds for questioning how much can be achieved through a focus on the financial benefits of energy savings:

"There is very little evidence house-buyers are willing to pay a premium and RICS has quite a lot of responsibility for that because, having read their guidelines on sustainability and the values associated with sustainability issues, the impression is that the sustainable measures do not add to the value of a home and if that is the case why should a home owner. They can't borrow any more money against it so you end up with a vicious circle really whereby if it is not recognised that a home is more valuable as a result of having a low energy output then why can you expect consumers to attract a premium to it. Clearly there still will be the more savvy consumers will understand they will have a lower energy bill but there is very little evidence that is high up on the priority of the average home buyer"

Stakeholders from across the sector widely emphasise the limited impacts of an emphasis on the moral virtues of energy saving. Saving the planet and your children's future, they argue, are best approached as supplementary issues. Yet an emphasis on the broader quality of life benefits of LZC homes is viewed as having significant potential.[62] Pro-environmental behaviour-change campaigns, it has been argued, should promote the opportunities that come with taking action including an improvement in overall quality of life[63]. For new housing this means an emphasis on comfort, a healthy indoor environment, and using good quality materials when communicating to consumers. There is a need for marketing to shift towards appealing to the basic desire to live in a home that you feel good about.

A key challenge in marketing the energy efficiency benefits of new homes is that this can tend to have only limited impact at the time home buyers make their choice of purchase. It is often only later when they experience life changing events, for example retirement or a parent staying at home with a baby, do they find energy bills to be an important issue. Both these events are accompanied by a reduction in income, which may not make it feasible to carry out significant retrofitting or move to a more efficient home.

60 (NHBC 2012a: 8). 61 (NHBC 2012a). 62 (Futerra 2010). 63 (NESTA 2008).

2.2.3 Energy Performance Certificates – limited impacts

The introduction of Energy Performance Certificates (EPCs) has been found to have had relatively little impact in fostering consumer drivers for higher energy performance homes.[64] Results of the pilot evaluation suggest that only seven per cent of buyers thought that the information contained in the Home Information Pack helped them decide which house to buy and 76 per cent said it made no difference at all[65]. The sellers were unlikely to act on the EPC recommendations for improving the home energy performance at the commencement, or during marketing, seeing it as unlikely to affect buyer's behaviour. Most of the buyers and sellers understood the 'white goods' style layout of the certificates, but buying a house is a more complex decision than white goods such as washing machines[66]. EPCs have become a standalone measure not linked to other measures such as the mortgage market or retrofit funding. They do not provide, in the views of our interviewees an accurate enough picture of the running costs of a home to be useful in mortgage calculations. A national stakeholder with a remit for skills and training commented that "no one understands EPCs" and singled out a lack of understanding among estate agents in particular. There is also anecdotal evidence about a lack of enforcement from trading standards departments and homes being sold without EPCs. The timings of some of these measures were also perhaps unfortunate. Home Information Packs and EPCs were introduced around the same time as the Code for Sustainable Homes, creating the potential for confusion among buyers[67]. The EPCs are a legal requirement of the Energy Performance of Buildings Directive but detailed implementation varies across member states. Research by BPIE highlights good practice in France where the EPC has been prominently displayed when homes are sold or rented since 2011[68].

2.2.4 International comparisons

Internationally, experiences of consumer demand for green homes are mixed. Our interviewees with international policy knowledge gave the following examples of countries that have managed to foster consumer demand for LZC homes.

- In Denmark and Sweden, where there is more consumer interest in low energy homes and consumers are willing to pay more. In the Netherlands an academic study of 50,000 house sales has shown that homes with an energy label sell more quickly at higher prices[69].
- In the case of Hammarby Sjöstad, an internationally known, leading project in Stockholm, it was commented that "they didn't sell it as energy efficient, that wasn't their calling card. People there are quite pleased when they discover how green it is. People buy space and they buy location, they buy access to a school, they buy quality of space around them, the energy efficiency will be somewhere on that list but it will never be one of the primary ones."
- In Japan one third of new homes and three quarters of detached dwellings are customized modern methods of construction, which allows consumers a far greater level of choice over the design and specification[70].
- In Belgium, utility companies provide consumers with international benchmarks for assessing domestic energy use. O Power in the US provide this service to utilities and individual consumers. In the UK, the SAP and EPC methodologies do not include such features.

In summary, there is clear scope to further develop consumer drivers and more thought needs to be given to marketing new LZC homes. However, stakeholders need to be realistic about how far consumer pressure will shape the market for new homes in the short and medium term. Regulations and standards remain of vital importance as key drivers for achieving ambitious policy goals for LZC new homes, as discussed further in Section 3.

64 The NHBC study found that "Just over half of all respondents are aware of the mandatory Energy Performance Certificate (EPC). However, of the consumers looking to move or those who had recently moved, only around one-third recall seeing an EPC, with the figure being less than a quarter of respondents in the rental market. Of all those looking to move, or those who had recently moved, just 12% say that the EPC influenced them." (NHBC 2012a) 65 (DCLG 2008). 66 In this study, 82 per cent of sellers and 49 per cent of buyers had no intention of acting on any of the EPC recommendations, including the cheap and easy measures. In focus group discussions very few of the buyers thought that the information on energy performance affected their buying decisions (with the exception of a small number who were already concerned with green issues). Some buyers said they would use the information to negotiate with the seller about price rather than deciding between different properties. These findings are broadly similar to Watts and associates (2011) who reported that 95% of buyers stated that the EPC had no influence or not much influence on the sale price, with the overwhelming majority saying it had no influence. 67 (McAllister, Nanda, and Wyatt 2013). 68 (Arcipowska et al. 2014). 69 (Brounen and Kok 2011) note that the average sales price is 3% higher or 6,000 Euros and the speed of purchase is 24 days quicker. 70 (Barlow J 2003).

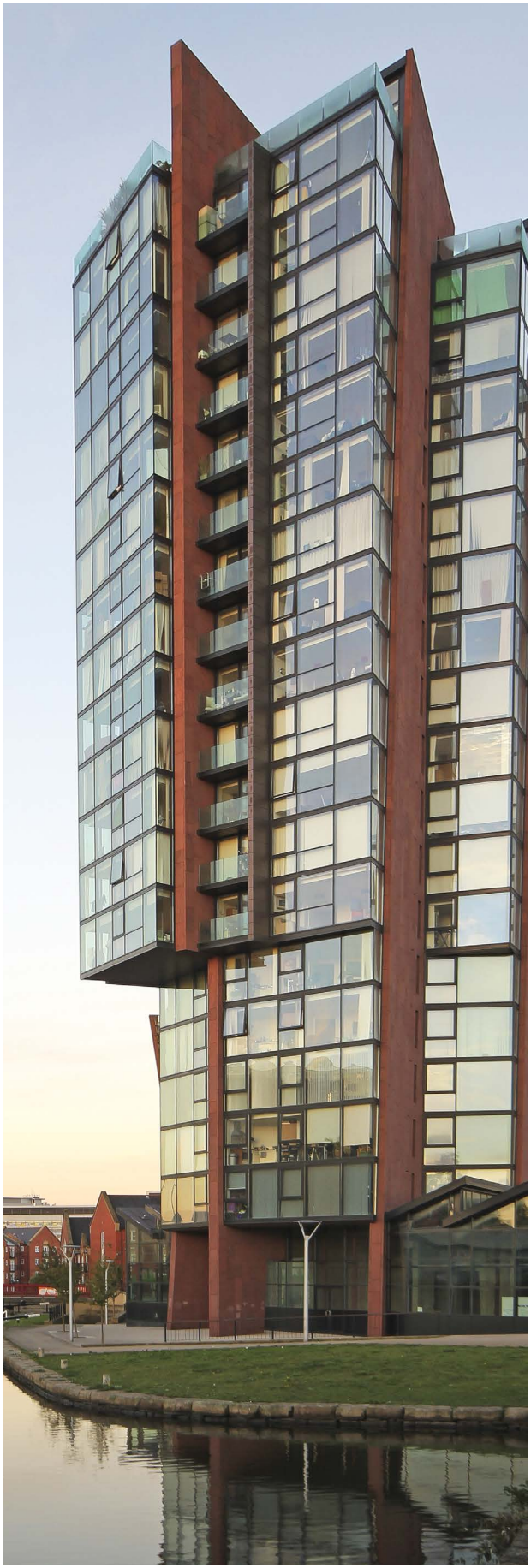


Image source: Alastair Wallace - Shutterstock.com

3.0 Assessing Policies and Standards

Policy and standards for LZC homes need to be assessed in the context of the challenges for industry discussed in Section 2. The weaknesses of market drivers of higher sustainability standards mean there is broad support for mandatory regulations having a central role. Interviewees advocating stronger mandatory regulations expressed concern at what they saw as the 'watering down' of policy during the Coalition. The skills and performance gaps discussed above raise the question of the feasibility of ambitious policy goals such as 'nearly zero' or 'zero carbon' in the short term. This section further explores how effectively policy and standards strike a balance between driving innovation and remaining aligned industry capacity to deliver. A further theme emerging is the uncertainty surrounding the future of different policies and standards during the Coalition government term.

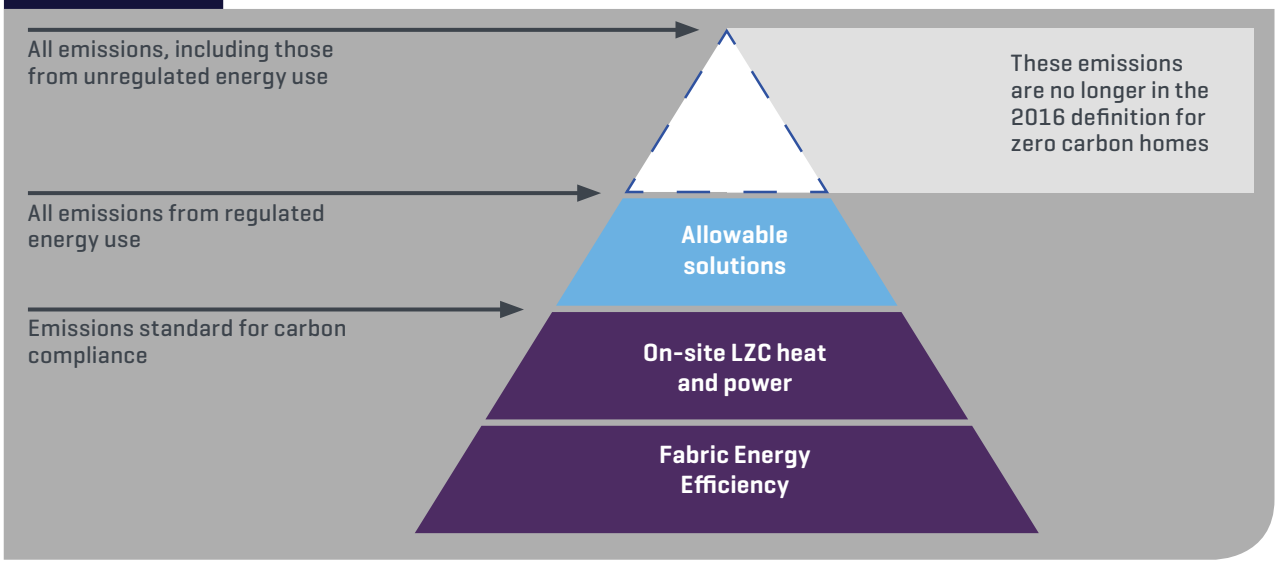
3.1 Building regulations towards 2016

An official commitment to the zero carbon 2016 target was maintained by the Coalition throughout their term. However, in spite of the Conservative's 2010 pre-election pledge to confirm the zero carbon definition "within weeks" of coming to power, the definition remained unconfirmed until it was withdrawn shortly after the Conservatives won the 2015 election. The debate about the zero carbon definition during the Coalition remains of significance in shaping ongoing debates about how the U.K. approaches the EU 'nearly zero' target that remains in place.

The Coalition, like the Labour government before, maintained a commitment to the central importance of Part L of Building Regulations as a core regulatory minimum, into which they planned to incorporate the zero carbon definition[71]. Stakeholders widely supported this approach, reflecting broad agreement on the need for a single nation-wide fabric energy efficiency standard[72] as of pivotal importance for a 'streamlined' regulatory environment that the Housing Standards Review was setup to promote. There is also wide acceptance that Part L is the most suitable vehicle for the zero carbon definition when it becomes translated into legislation.

71 The 2015 Infrastructure Bill stated that the scale and operational detail of the zero carbon definition would be included in the planned 2016 update to Part L. 72 This mirrors the finding of (Morgan et al. 2015: 45). This was evident in the 2013-14 Consultation on the zero carbon definition (DCLG 2014d: 14).

Figure 5 Revisions to the zero carbon definition



3.2 A moving target

During the Coalition government, there was considerable uncertainty about the exact definition of the 'zero carbon' target and how this would be translated into building regulations. The key developments were as follows:

- Government, in March 2011, announced that the zero carbon target would cover only regulated emissions, not unregulated emissions (e.g. emissions from cooking or plug-in appliances)[73]. This brought the U.K. into line with the European Commission Energy Performance of Buildings Directive (EPBD) which did not cover unregulated emissions. These were addressed by other EU regulations, notably the Energy Labelling Directive. This decision did significantly reduce the scope of the funds that would be raised through allowable solutions.
- The Fabric Energy Efficiency Standard (FEES), recommended by the Hub and adopted by the previous Labour government in December 2009, was still assumed to constitute the first layer of the zero carbon pyramid. Yet there was delay and uncertainty about the Part L 2013 update which was not brought into effect until April 2014.
- There was significant uncertainty about the 2016 carbon compliance standard and allowable solutions framework, as neither of these two parts of the zero carbon target were defined by the Coalition by the end of their term in 2015[74].

3.3 Fabric Energy Efficiency and Part L

There is wide support for the general principle of "fabric first," which emphasises the need to reduce the energy required to heat a building prior to considering the installation of on-site low and zero-carbon energy technologies. This was reflected in general acceptance of the Hub's proposed minimum mandatory FEES standard amongst interviewees for this project.

A significant minority of those with a keen interest in design explained that they would have welcomed a stronger standard. This latter view reflects the significant influence of Passivhaus as a design approach, which involves working to a significantly higher level of fabric energy efficiency (see Section 3.6). They viewed FEES as involving a compromise with the house-building lobby that opposed a stronger standard.

Those arguing for a lower standard do so on the grounds that the marginal costs of pushing FEES any higher are relatively high, suggesting that other ways of achieving emissions reductions, for example in transport and infrastructure, would be far more cost effective.

Aside from the actual level of FEES, the Hub's proposed move towards an 'absolute' measure of fabric energy efficiency received wide support. The DER/ TER 'relative approach' in Part L has been criticised for penalising smaller homes including apartments because it is harder to achieve large reductions in energy loss due to the relatively smaller external wall area[75].

73 (HM Treasury and Dept for Business 2011). Thus, the target became an emission reduction of 100% compared to 2006 standards (equivalent to Code for Sustainable Homes level 5), rather than a 150-170% reduction (equivalent to Code level 6 – See Appendix). 74 The July 2014 Queens Speech suggested a significant possible reduction in the carbon compliance standard, from the Hub's recommended 56-60% reduction for houses (compared to 2006 regulations) to 44%, the same target as previously set for flats. The framework for allowable solutions was not confirmed following the 2013 consultation on this issue and prior recommendations published by the Hub in 2011. This delays were criticised by key industry stakeholders, e.g. (Housing Standards Review Challenge Panel 2013) 75 (May, Warm, and Grant 2008)

3.3.1 FEE

The Fabric Energy Efficiency (FEE) refers to a specific measure of building energy efficiency, used by the Hub for their FEES recommendation and later incorporated into the Part L 2013 update. FEE does not allow for the mitigation of CO_2 through building systems and renewable technologies. In contrast with the target emission rate/ dwelling emission rate (TER/DER) approach, the FEE is not affected by the relative carbon emissions of different fuel types.

FEE considers the space heating and cooling demand of a dwelling and the Dwelling Fabric Efficiency (DFEE) is affected by:

- Building fabric U-values;
- Thermal bridging;
- Air permeability;
- Thermal mass;
- External heat gain (solar)
- Internal heat gains (e.g. metabolic activity; by-product of services such as lighting)[76]

Target CO_2

For Part L 2013, the Coalition decided to set the target CO_2 as a 6% improvement over 2010, less than either of the two options suggested in the consultation. The lower of the two consultation options ''FEES plus efficient services' would have been an 8% uplift from 2010. The higher, more ambitious option of a 'halfway point' towards the Zero Carbon Hub's recommended carbon compliance standard would have represented a 26% uplift[77].

Energy efficiency target

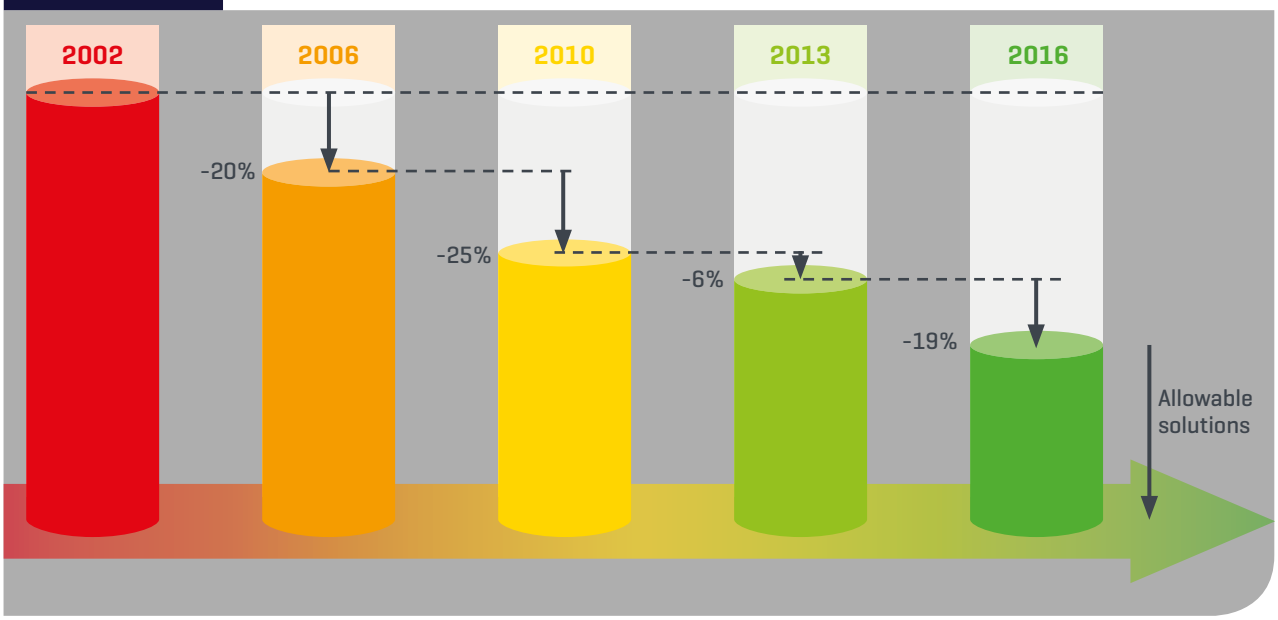
Given the need to plan for a transition towards measurement in terms of energy rather than CO_2, Government decided to set an additional fabric energy efficiency target to accompany the CO_2 target[78]. The two consultation options are shown below:

Table 3 Part L 2013 consultation options

	Semi-detached, end of terraces and detached dwellings (kWh/m²/yr)	Flats and mid-terraced (kWh/m²/yr)
Full FEES	46	39
Interim Fees	52	43

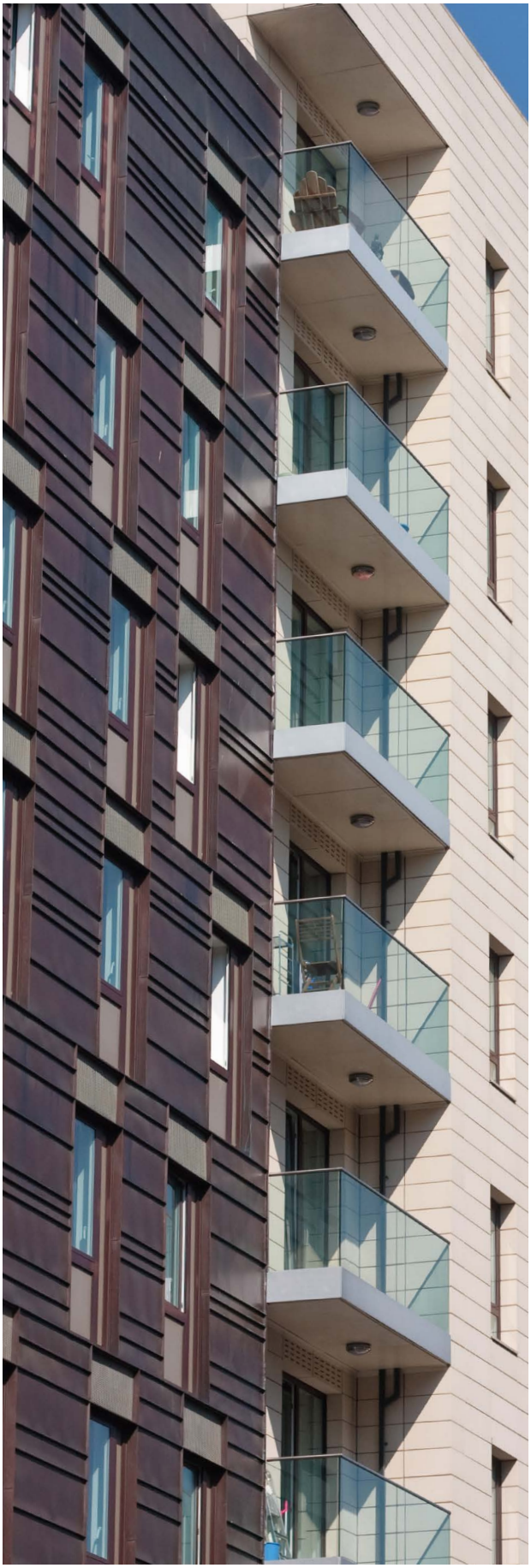
Government decided not to set the TFEE as equivalent to the Fabric Energy Efficiency Standard that had been adopted as part of the zero carbon 2016 target. Rather the target would be set at an 'interim' level, defined as a step towards the FEES standard recommended by the Hub, or 'full FEES.'

Figure 6 Revisions to the zero carbon definition



Source: Hilson Moran

76 (Zero Carbon Hub 2012). 77 (DCLG 2012: 24-25). 78 (DCLG 2012: 26-28).



3.4 Part L: 2013 update

The 2013 Part L update was delayed and did not come into force until 6th April 2014. It had been anticipated as a key milestone in the zero carbon roadmap. Many stakeholders, such as the UK Green Building Council and the Good Homes Alliance[79], expressed some disappointment with the eventual update, being lower than the consultation options. The view of Part L 2013 as being too conservative was candidly described by three of our interviewees, representing key parts of the housing and construction sector, as "hopelessly unambitious," a "fudge" and "much less rigorous than signalled"[80]. This view is informed by recent studies on costs such as that undertaken by Zero Carbon Hub, as discussed in Section 2. However, the update was still widely viewed as a step on the way towards the 2016 zero carbon target. One architect with considerable experience of working to high fabric standards argued that, although the 2013 Part L update fell "far short" of what many advocates of LZC homes wanted, there is also a need to be "realistic" given the challenge of the performance gap, reflecting the current state of knowledge and skills in the sector.

A significant feature of the update was the inclusion of a fabric energy efficiency (FEE) standard, measured in terms of kWh/m^2/year, to run alongside the Target Emissions Rate (TER)/Dwelling Emissions Rate (DER) measure of building CO_2 emissions. The SAP 2012 model can be used to calculate the performance of the dwelling in terms of these two measures, each of which is compared to a 'Target' level, representing the mandatory minimum standard in Part L.

3.4.1 SAP

Industry experts on the energy performance of buildings continue to express concern that the SAP tool, on which Part L assessment relies, is not conducive to sufficiently accurate analysis of the performance of current LZC homes[81]. There is concern about the accuracy of some parameter values contained within the SAP, ranging from assumptions about climate to the assumed performance of specific technologies such as boilers and ventilation. It is also widely suggested by designers that SAP allows unrealistic and inaccurate parameter values to be entered (concerning features such as ventilation and thermal bridging, for example) and that some of this scope for error could be removed by modifying the tool.

It is often commented that SAP is like a 'black box' in that the inter-relationship between the parameter values entered by the user and the DER/ TER calculations is not transparent. Reflecting these concerns, a number of our local interviewees used alternative thermal models to assist in the design process, even though they were also using SAP to demonstrate compliance with legislation. The lack of transparency of the SAP tool is not conducive to designers developing their understanding of the determinants of the thermal performance of buildings.

79 (Cutland 2014; Pitt 2013) 80 (DCLG 2012). 81 (Zero Carbon Hub 2014). 82 (Zero Carbon Hub 2014).

The importance of entering accurate parameter values into SAP, and the importance of the way SAP is used by designers was the subject of significant comments by interviewees. It is sometimes commented that the National Calculation Method (NCM) encourages designers to approach design as what one interviewee referred to as a "numbers problem" in which designers tweak their designs to achieve compliance according to SAP, rather than consistently applying design principles. Although potentially time consuming, the costs of such bespoke designs, according to the SAP calculations, are not factored into the build costs. Consequently, there is untapped potential for standardising designs and associated supply chains.

The SAP tool is based on a static model, the Building Research Establishment Domestic Energy Model (BREDEM) and there is some concern among experts that dynamic factors are not adequately captured. These include thermal mass, heat gains, airflow, orientation and climatic factors, which have an important influence on building performance. A related concern of experts is that the issues of overheating and indoor air quality are not adequately addressed by Part L and Part F. However, it should be noted that BREDEM has been developed to meet requirements specified by the Energy Performance of Buildings Directive (EPBD), hence there are legal requirements that must be satisfied by any alternative model. Furthermore, there might be significant scope for these issues to be addressed by revisions to the SAP tool, as indicated above, without the need for changing the underlying model.

Some significant upgrades were made to SAP 2010 and SAP 2013. However, national stakeholders echo the view of Zero Carbon Hub[82] that further research and development is needed to support the assumptions and methodology for SAP. This concern has been stressed over several years as the zero carbon agenda has evolved.[83]

Modelling overheating?

The Government admits that there are "no nationally adopted methodologies or standards dealing with the potential for overheating in new homes"[84]. SAP only considers the building and does not consider external factors relating to the site of the home, such as solar gains, shading, adjacent buildings and micro climate. The model relies upon monthly average climate data from 1990. These limitations of the SAP model mean that it does not predict the severity of the overheating risk[85].

3.4.2 Carbon compliance

The 2013-14 consultation on allowable solutions showed that work by the Hub is widely accepted by stakeholders as providing a suitable basis for determining on-site requirements[86]. The Government's suggestion in 2014[87] that the carbon compliance standard might be reduced would seem to reflect concerns from developers and key industry associations representing them about this layer of the pyramid. They stress that it tends to be the most costly way of achieving CO_2 emissions reductions. Two of our interviewees suggested that, from a developer perspective, it would be preferable to remove 'carbon compliance' from the definition of LZC homes. Yet the cost of technologies for achieving carbon compliance (especially PV) has recently fallen significantly[88]. Interviewees working in the renewable energy sector pointed to the experience gained in installations compared to the relative lack of experience in fabric approaches above Code level 4.

3.4.3 Allowable solutions

In keeping with their approach to the other two pyramid layers, the Government stated its preference for a single national allowable solutions framework that would allow developers choice about which solutions they fund. This principle of 'flexibility' received support from a majority of respondents in the 2013-14 consultation,[89] reflecting the preferences of developers in particular. Most developers also emphasised their preference for simplicity, favouring a scheme that would allow them to simply make a one-off payment to an allowable solutions provider.

They also recognised that while a very practical and lower cost way to achieve zero carbon, it could also be viewed as just another tax. One way to address this is to demonstrate how revenue is spent locally, rather than simply becoming part of a national fund. A further concern of developers was that the price of carbon should be comparable to other sectors. The range of carbon prices suggested in the consultation[90], from £36 to £90/ tonne, was significantly higher than the price of carbon for large industries under the EU emissions trading scheme, which is approximately £5.50. This is widely regarded as too low to bring about technical innovation and widely regarded by developers as unfair. In considering the home buyers' perspective, some other stakeholders, for example from local authorities or consultancies, also express concern about this charge being rather like a "tax," with no direct link or benefit to the building that consumers are purchasing. Acceptance for renewables projects can often be tied into some form of community benefit such as lower energy bills. Interviewees commented that residents of urban areas would not derive any benefit from offshore wind projects or large solar farms a long distance away.

83 (Greenwood 2010). 84 (DCLG 2013). 85 (Zero Carbon Hub 2015). 86 70% of respondents to the consultation expressed support for the Hub's recommendation in the 2013/14 Consultation (DCLG 2014d: 14). The Hub had pointed out the need for their evidence base to be further developed, with further technical work required, notably to model small dwellings and to set an appropriate carbon compliance standard for tall buildings of five stories or higher. This further work was not commissioned by the Government. 87 See above. 88 (Zero Carbon Hub and group 2014). 89 79% of respondents support a national framework for allowable solutions that would not allowing local authorities to establish mandatory local schemes. Although local authorities made the case for their being able to require developers to deliver solutions that would be directly for the benefit of the local area, the emphasis of most other respondents concerned the need to avoid a "post-code lottery" with rules being applied differently in different areas (DCLG 2014d: 17-24). 90 DCLG., 2014 pp. 44.

3.4.4 Zero carbon and small-sites

In the Queen's speech (July 2014), the Government announced a proposal for small sites to be exempt from the zero carbon target[91]. This, it argued, would help small developers, whose numbers have been in decline[92], address the particular challenges they face in working towards the zero carbon target. Although welcomed by many developers, the proposal was criticised by many as adding further complication to the regulations[93].

Criticisms were especially strong on the option of lowering Part L standards for small sites, given that this would entail two different energy efficiency standards. For example, in rural areas, where most developments would be ten units or less, owners of new homes would be left with higher heating bills. Yet the arguably simpler option of exempting small developers only from allowable solutions was also criticised. As evident in the consultation responses, there was significant concern about implementation of the exemption. The Government did acknowledge that the exemption might potentially create a loophole, with developers being able to split sites into smaller sites to gain exemption. However, critics of the exemption remained unconvinced that this potential loophole had been adequately addressed[94].

3.4.5 Zero carbon and consumers

The term 'zero carbon' was widely perceived as a source of potential confusion for consumers who might choose to buy a 'zero carbon' home. This problem was viewed as exacerbated by the Coalition's proposed revisions (for example, exclusion of unregulated emissions, proposed reduction of carbon compliance and small site exemption). These are viewed by some as having made the target still more "horrendously complicated." Nonetheless, others speak positively about the zero carbon target as establishing "a headline policy for everyone to rally round." Others comment that "low carbon" or "nearly zero" are more accurate, useful terms than zero carbon.

"There may be good reasons why we got to where we are but it takes 20 minutes to explain what a zero carbon home is and it is not what people expect it to mean; trying to sell it to consumers is not as straightforward as it could be; we will have to explain that what people thought they bought is not what they actually got".

91 This exemption follows exemptions on small sites in other policy areas. In December 2014 the National planning policy was changed to exempt developments of 10 homes or fewer from the requirement to contribute towards affordable housing. The Government had also introduced an exemption for small sites from Section 106 obligations, though this was successfully challenged in the High Court by two local authorities (West Berkshire and Reading) who argued that the consultation process had been unlawful. Justice Holgate accepted that the government had failed to take into account "obviously material" considerations, quashing government policy on affordable housing exemption thresholds, as a result of the which, planning guidance on planning obligations was amended to remove paragraphs 012-023.
92 Research by NHBC is cited which shows that the number of small firms active in house building in recent years – halving between 2007 and 2013, with only 2,710 estimated to have been building in 2013. 93 This was reflected in statements by the Home Builders Federation (HBF 2015), as well as the Federation of Master Builders (FMB 2015) and the House Builders Association who specifically represent small developers. There was support from some in the affordable housing sector, who pointed to particular problems of installing renewable energy technologies on small infill sites of 10 or less homes. Other national stakeholders were highly critical, stressing that the exemption entailed not all homes being built to a single regulatory standard from 2016. In the consultation, this consistency argument was especially evident in objections to lowering the fabric efficiency standard for homes on small sites. This latter option was rejected by Government who proposed that the exemption will be only from the allowable solutions part of the zero carbon definition. Nonetheless, the same consistency argument was applied by some of our interviewees as the Government proposed. 94 This is in spite of previous policy commitments to 'rural proof' new policy to avoid unintended consequences (H.M. Government 2013).

3.5 Code for Sustainable Homes

One of the most controversial outcomes of the Housing Standards Review was the decision to scrap the Code for Sustainable Homes. This has been the subject of especially strong and contrasting views amongst stakeholders. The purpose of the Code had been viewed by many as being, in the words of the House of Commons Environmental Audit committee (EAC), "to set a mark for Building Regulations to follow."[95]. It was intended to provide a clear roadmap for the direction of future regulation and avoid the problems that affected the 2006 Building Regulations, when the 'familiarity period', which denotes the period from the publication of Part L to its point of enforcement, was only three weeks.

There is broad agreement, including amongst industry experts, that the Code, especially during the early years of the zero carbon agenda, had encouraged the development, wider availability and affordability of innovative construction products. Examples given by our interviewees included mechanical ventilation and heat recovery systems and improved domestic boilers. The Code is widely viewed as having, as one interviewee put it, "increased considerably" the level of knowledge and understanding in the house-building sector and as having, in the words of another, "embedded change." Supporters of the Code, including developers and contractors, as well as designers, consultants and manufacturers, argued that it gave these different professions and industry sectors a common language through which to progress the sustainable homes agenda. Many local authorities adopted and supported the Code as a way of promoting higher standards in their localities and the Homes and Communities Agency to raise standards in the social housing sector. These varying sources of support for the Code as promoting green innovation were reflected in the recommendations of the Environmental Audit Committee, which in 2013 urged DCLG "not to wind down the Code for Sustainable Homes"[96]. However, uncertainty about the zero carbon definition during the Coalition government did limit the potential for developers to use the Code to explore the implications of future regulation.

In relation to fabric energy efficiency, as discussed in Section 3.4 above, building regulations were not strengthened by the Coalition as much as many stakeholders had expected and advocated. It was felt that the Code, as a 'quasi voluntary' standard that local authorities could require as a planning condition, still had an important potential role to play in driving innovation beyond the regulatory minimum. The more extensive use of the Code for social housing did cause some frustration from social housing developers that the private market was not being required to meet such high standards.

The Code's aim of fostering a 'holistic' approach by including a broad set of sustainability criteria was widely supported by stakeholders. Yet since its introduction, a range of practitioners expressed three particular areas of concern about the Code. Firstly, they questioned whether the credits system in the Code really did promote sustainable outcomes. Secondly, they saw the Code certification process as overly 'bureaucratic' and time consuming. Thirdly, they saw the Code as having failed to sufficiently engage with the home buying public. Contrasting perspectives towards these different sides of the debate are assessed below.

3.5.1 Outcomes of the Code

In incorporating a broad range of sustainability criteria rather than only focusing on energy, the Code drew on previous experience with Ecohomes, which had also aimed to be a comprehensive sustainability assessment tool. Despite the broad scope of the Code, some interviewees highlighted certain issues as important that were not being addressed. These included social issues such as public engagement, training, skills and apprenticeships. Transport accessibility, which was considered in Ecohomes but not the Code, was also mentioned. Developers that were building green developments in particular felt frustration at some of the limitations in the scope of the Code. One commented that there was too much emphasis on zero carbon and not enough on how to support sustainable lifestyles more broadly. Another developer gave the example of providing construction workers with healthy, locally sourced food and promoting space for food growing by residents.

Given that the Code uses the same methodology as building regulations to assess fabric energy efficiency, criticisms of the DER/ TER 'relative approach' and the related challenge of the performance gap also apply to the Code in general.

A common criticism of the Code in particular was that it encourages a 'box ticking' approach, by awarding credits for the inclusion of particular technologies and facilities within homes, without adequate consideration of how such technologies are used in practice, their costs, or even whether they are used at all . This criticism was not only made by developers, who might be viewed as having a vested interest in criticising the Code due to the additional

95 (House of Commons 2013b). 96 (House of Commons 2013c). 97 Reflecting this, a survey by Baba et al found that a significant proportion of architects do not consider the Code to be an effective way of providing high quality homes and offering design solutions. 58.8 percent rated the CSH as "effective," 5.9 percent "very effective," 32.4 percent ineffective and 2.9 percent very ineffective for achieving high quality new homes in the UK compared to 50 percent effective, 41.2 percent ineffective and 8.8 percent very ineffective in providing design solutions (Baba et al. 2012). 98 (Grant 2008). 99 (Local Housing Delivery Group 2012: 16).

costs it entails. The point was also made by designers and other industry experts with an especially strong commitment to high environmental standards. In this project, as in prior studies , examples relating to the water sections of the Code in particular were highlighted. Two examples, were mentioned where serious problems had arisen with the water section of the Code. In one case a rainwater harvesting system was not connected correctly, leading to cross contamination and health issues with residents. The environmental consultant stated that they would not consider grey water but would now consider rainwater again as technology has moved on and systems have been developed that do not depend on large underground tanks. In a second case rainwater harvesting systems had been installed in a large block of flats to gain Code credits, yet they were never used by the tenants and contributed to pipe blockages, in part caused by poor maintenance. Potentially, equivalent scenarios relating to the energy section of the Code could occur, as the Code awards points according to the installation rather than the use of LZC technologies. However, the actual extent of any such problems relating to LZC technologies and the Code is currently unclear.

Small developers also expressed frustration in how the Code requires fulfilment of other standards. A small developer discussed a scheme which sought to meet Code 6 but ended up being awarded Code 4. The steeply sloping site meant that Lifetime Home requirements for Code 6 were unachievable. The developer used a local manufacturer for windows, who as a small manufacturer had not got his products approved by Secure By Design. The contractor did not pay for Considerate Contractor so points were lost here too. The developer commented that 'the house is zero carbon and doesn't need a piece of paper to prove it'. This example highlights the case for rationalising standards that motivated the Housing Standards Review.

There is a related concern that the Code credits system can be over-prescriptive, as expressed by the Harman Review in relation to the energy section:

"Although there may well be merit in providing facilities such as drying space, cycle storage and home office space in new homes, many considered it inappropriate for these to be encouraged through an energy/ CO_2 requirement of the Code for Sustainable Homes" .

This general, widespread criticism of the Code was raised most markedly about Code levels 5 and 6. These higher levels of the Code are especially demanding in terms of the installation of technologies and facilities that they require, including renewable/ low carbon energy technologies. In this respect, they are widely viewed by some designers as entailing a trajectory that is not necessarily desirable or feasible for mainstream housing, a criticism that was echoed by our interviewees from outside the U.K. Clouding the debate and related to this has also been significant uncertainty about the performance of such technologies, as discussed in Section 2.1.3. A further related argument is that the high cost of such technologies encourages approaches to reducing national CO_2 emissions that are not the most cost effective. In addition to installation costs, there may be higher running costs, which in the case of communal heating systems could be passed on to residents, who in affordable housing will be on lower incomes. For example, a developer who specialised in green developments commented on how grey water treatment uses more energy and chemicals per building than conventional sewerage treatment systems. These criticisms suggest there is a need to allow developers and professional designers greater autonomy in deciding how best to achieve sustainability goals in general and reduced CO_2 emissions in particular, giving cause for questioning whether the Code is achieving a truly "performance orientated" approach.

3.5.2 Demonstrating compliance

A further common criticism of the Code[100] was that it entailed 'overly bureaucratic' and costly assessment and auditing processes. For example, one interviewee commented that many architects complain about how the average Code assessment requires them to refer to over 150 documents. Another commented that these "protracted" compliance requirements were much more of a "real burden" for housebuilders than the standards themselves. These concerns were prominent among those with a design and architecture professional background. Some volume developers commented that they found the Code reasonably easy to apply but hard to administer, which put off wider take-up. From smaller developers there were concerns about the direct costs of the certification process for them. There were also concerns about the way in which minor shortcomings, such as not providing boxes for recycling, were heavily criticised by Code assessors and the BRE. However, some stakeholders including some volume housebuilders, were largely supportive of the extra checks that the Code assessment process required. They thought that, without the Code, Building Regulations would need to be strengthened and reinforced to make up for the reduction in control. A designer commented that the Code provided an audit trail somewhere between Passivhaus and the Building Regulations thus filling an important gap.

Interviewees highlighted how the different approaches to development in commercial property and residential property made BREEAM potentially easier to implement than the Code. Interviewees who worked with both BREEAM and the Code commented on the differences between construction practices in commercial and residential property. In commercial developments, BREEAM is often used by the same design team working throughout the construction process. In comparison, the process for housing schemes can be more fragmented, with outline design work carried out by an architect prior to responsibility being handed to a design and build contractor. This fragmentation is widely regarded within the industry as impacting negatively on performance.

The Housing Standards Review has not impacted on requirements for non-domestic buildings to meet BREEAM standards. Local authorities can still require non-domestic buildings to meet higher energy and other sustainability standards using BREEAM as a planning condition. This means in a mixed use scheme the non-domestic parts of the development could be required to meet BREEAM standards but the housing parts would not. In this respect, the Housing Standards Review has added greater complexity rather than simplification, with developers on mixed-use projects required by local authorities to meet BREEAM for commercial buildings but not the Code for residential building. A large contractor argued that BREEAM and the Code should have been merged into a single code, which would give developers one set of documents to work to. Here, there are echoes of the call for a Code for Sustainable Buildings, as was originally proposed prior to the Code for Sustainable Homes being introduced.

3.5.3 The Code and consumers

A further key criticism of the Code is that, with its focus on technical assessment of supply side and design features and processes, it was not sufficiently recognised, let alone understood, by consumers as a way of grading the sustainability of homes. The strength of providing a common language for professionals became a weakness with consumers. This was also reflected, for example, in the comment of a sustainability consultant that the Code worked much better at raising standards in affordable housing than in the private market where uptake of the Code was voluntary (except when required by local authorities). This weakness of the Code in terms of fostering consumer awareness led some to question its overall influence in raising standards. In particular it lacks a 'brand value', hence it is questionable how far it has helped with the marketability of low carbon, sustainable homes.

3.5.4 Addressing sustainability issues through other policy tools

As shown in Figure 7 the decision to end the Code now means that some significant issues are not addressed, including building materials, ecology and waste recycling.

100 This was reflected in our interviews with several national and local interviewees making the point.

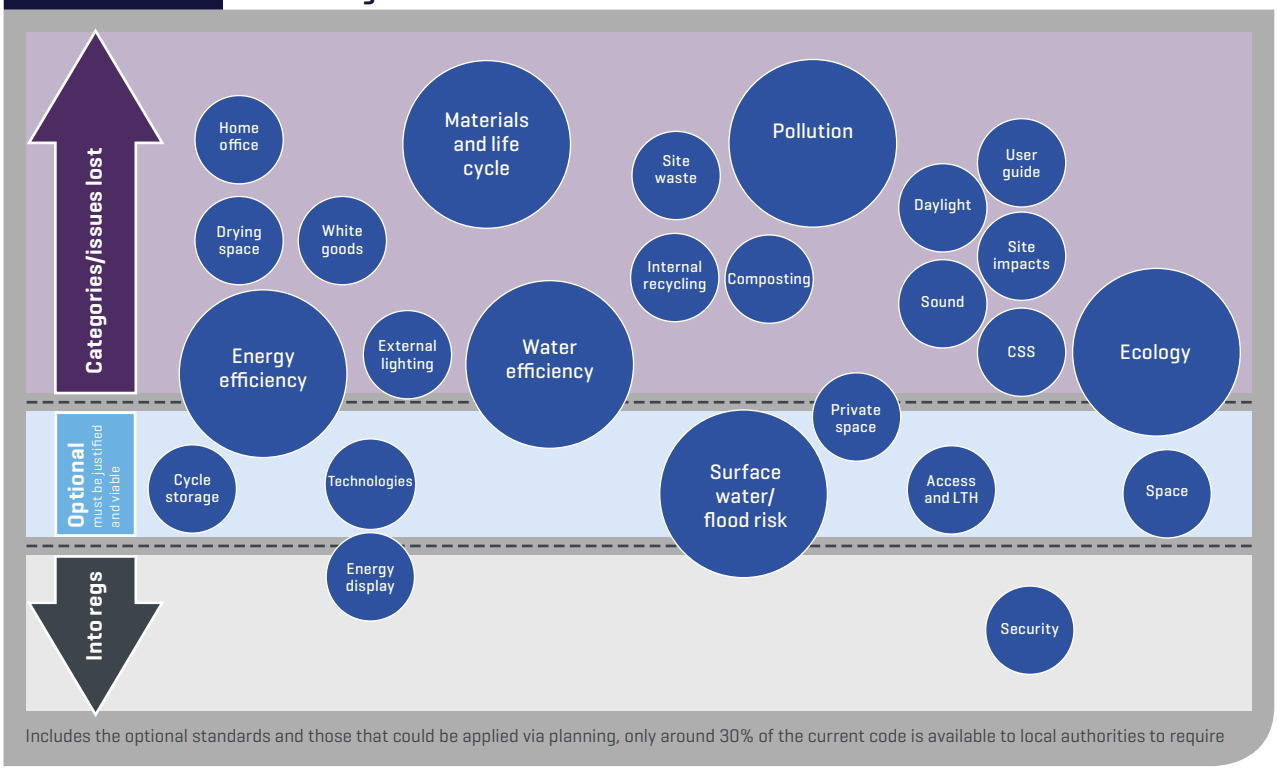
This has raised concerns within sections of industry, especially national stakeholders and local authorities, though their perceptions of the relative significance of this loss varied considerably. In a survey carried out by Sustainable Homes[101] (2013), of 200 housing professionals, 75% of respondents believed materials, waste and other environmental issues in housing should be regulated.

- Embodied energy is an issue that is only addressed in a very modest way in the materials section of the Code and is not covered at all by Building Regulations[102]. As new homes become more energy efficient the proportion of energy embodied in building materials is increasingly important to the overall lifetime costs.
- Requirements for waste reduction during construction have been dropped with the removal of site waste management plans as a legal requirement. Issues such as home user guides and energy display devices fall outside the scope of traditional planning permission.
- Sustainable Urban Drainage Systems are likely to be picked up by the Flood and Water Management Act, but there are significant concerns here about the skills base within local authorities to implement this requirement.
- Biodiversity is a topic that has traditionally been a concern of planners and could potentially be picked up through planning.

The Housing Standards Review Contestable Policy Panel reached a conclusion, widely shared amongst stakeholders that more consideration should be given in other standards or Government guidance to sustainability issues lost following the wind down of the Code[103]. However, several national interviewees, local authorities and housing associations expressed caution at planners taking on new responsibilities especially at a time of austerity in local government and planning departments. Other stakeholders, including the Royal Town Planning Institute who represent local planners, highlighted that the current review procedures of Building Regulations is slow and unwieldy. This poor performance should be addressed if local authorities are to forego the potential to innovate with local requirements[104].

Comments by some of our interviewees suggest that, if revisions to Part L 2013 and 2016 had been aligned with the FEES standard proposed by the Hub, which is viewed as broadly similar to Code Level 4 for energy, the Code might be viewed as having largely fulfilled its purpose, at least in relation to the energy. Water is another area where building regulations are widely viewed as having been sufficiently strengthened. Yet the scrapping of the 2016 zero carbon roadmap, combined with the winding down of the Code, creates a significant gap for higher energy standards.

Figure 7 **Categories and issues lost from the Code for Sustainable Homes resulting from the Housing Standards Review 2014**



Source: BRE

101 (Sustainable Homes 2013). 102 (McManus, Gaterell, and Coates 2010; Georgiadou, Hacking, and Guthrie 2013; Sodager and Fieldson 2008: 103).
103 (Housing Standards Review Challenge Panel 2013: 5). 104 (RTPI 2013).

in terms of the sustainability standards developers were required to meet. This creates scope for voluntary LZC/ sustainable home standards to have an important potential role, an issue further discussed below.

Alongside the absence of any updates to the Code from 2010 until its winding down, there was a lack of investment in further developing the tool. This contrasts with the development of LEED in the U.S. by the U.S. Green Building Council (USGBC), supported by a substantial income stream from accreditation that is reinvested in training, lobbying and developing buyer demand. The UK Green Building Council lacked such an equivalent revenue stream.

3.6 Voluntary standards

The Code, supported by Government, applied as mandatory for social housing and widely adopted on a 'quasi voluntary' basis by local authorities, has been the most widely used sustainability standard for new homes aside from the Building Regulations. However, other voluntary standards are viewed as having an important potential role in fostering innovation for LZC homes. Our research suggests that factors explaining the use of other voluntary standards include:

- Frustration with the Code and Code certification process
- Designers and architects now working in the UK having gained familiarity with other standards from working abroad
- Proactive promotion of other codes by certifying bodies.

However, the uncertainty surrounding the status of different standards can create difficulties for developers. On the one hand, there is pressure for them to invest in engagement with and piloting future standards that potentially become further established and recognised. Conversely, as reflected in our interviewees' responses to the withdrawal of the Code, there is also concern that such investment might be wasted if standards are dropped.

Our research suggests that it is far from clear which other, if any, voluntary standards might fill this vacuum. Passivhaus was the most widely recognised voluntary tool, aside from the Code. A recent study by AECOM reviewed in detail the costings on 11 Passivhaus projects, selecting dwelling types and a range of different construction methods. Their study found an average additional cost of 15-20% above Code level 4. This gives an idea of the additional costs of implementing Passivhaus in Brighton, Greenwich and other localities that were already familiar with Code four. In a similar way to the Code costing, their study found significant reductions in the additional costs over time[105].

Although the Passivhaus standard is familiar to many, there was concern about the low number of completions in England. Most question the feasibility of Passivhaus as a mass market standard, in particular the ability of house builders to achieve the required levels of as built performance. International experience, particularly Brussels, points to the types of policy measures and consistency required to successfully implement Passivhaus standards in mainstream developments. Local authorities in England are not able to require Passivhaus developments as part of planning approval. However, in some areas such as Norwich and Exeter they are using their powers as landowners of development land to set Passivhaus requirements for developers.

Aside from the feasibility of the Passivhaus standard, the process of Passivhaus certification is well regarded as rigorous by the majority of those familiar with it. The method for calculating the energy efficiency of buildings is emphasised by users as more transparent and accurate than SAP, though requiring more detailed inputs and understanding from the designer. Those familiar with Passivhaus commented that despite the higher costs, it delivered long-term and lower maintenance bills. There is also some evidence from the social sector that Passivhaus certification added value to properties.

Some suggested that there is scope for the SAP tool to learn from and incorporate features of Passivehaus Planning Package (PHPP). Interviewees commented that it was frustrating that we were not willing to learn in England from the 20-30 years' experience that had developed in other countries that have adopted low-energy building standards. This includes the Passivhaus standard, but also R2000 in Canada and the Swiss standard Minergie. This data could provide a robust evidence base covering energy saving levels, appropriate ventilation rates, avoiding moisture build-up and damp. Our building standards could then be better-informed by building physics rather than the financial viability assessments that drive current building standards.

The exclusive focus on energy in the Passivhaus approach is a source of concern, especially among local authorities wishing to raise standards on a broader range of sustainability issues. Two interviewees mentioned a standard called Active House which had tried to address this, and includes not only energy but also issues such as water and social wellbeing of occupants, to make the Passivhaus approach more 'complete'.

There are a plethora of other standards and benchmarks, based on a variety of different metrics. Not all voluntary standards address energy, for example the Building for Life standard supported by CABE, the HBF and Design for Homes aim to promote good urban design principals in housing but do not feature energy.

105 (Barnes 2015). 106 (Housing Forum 2015: 11). 107 (Alter 2013).

There was some criticism that many standards and benchmarks were aimed at industry professionals that, in the words of one national stakeholder, were "talking to each other".

A recognition of the need to develop a more consumer facing standard led to the establishment of the Home Performance Labelling Consortium. The working group has participation from large and small developers, contractors, and housing associations, with the aim of supporting a standard that enables the promotion of 'better performing homes'[106].

Developers will select the standards that are most relevant to them but which also show their work positively compared to competitors. For example, commentators noted that whilst Passivhaus favours insulation manufacturers the Active House standard emphasises healthy indoor conditions including indoor air quality, natural ventilation and daylight provided by windows and skylights. This is perhaps not surprising given that the window company Velux had an important role in developing the standard[107].

There was some limited recognition of the AECB standard, which was widely regarded as for the self-build market. It was also viewed as a standard for people who were interested in Passivhaus but did not feel ready to meet the full standard, including some social landlords. There is some recent evidence of land owners who wish to see developments above Building Regulations taking a hybrid approach. For example in Norwich, a number of sites owned by the City Council are being developed for housing. The City Council have set requirements for developers to meet either Passivhaus or AECB silver depending on the issues and constraints of specific sites.

3.7 A new BRE standard for new homes

As our research took place, BRE were developing the Home Quality Mark (HQM) as a potential alternative to the Code. There is already some limited evidence that local authorities are attempting to make the new HQM quasi-mandatory for new developments[108]. This clearly runs contrary to the Governments' intention though the Housing Standards Review to remove local autonomy to use the planning system in this way.

BRE also has a neighbourhood scale master planning and sustainability tool called BREEAM communities. We found no broader support within the sector for BREEAM Communities acting as a partial replacement for the Code, but this could be due to lack of familiarity with BREEAM Communities, which has yet to see wide take-up.

Overall, there was not expected to be a significant take-up of the HQM as a new voluntary standard by either volume housebuilders or SMEs. It was also widely expected that the only interest would come from a small number of niche developers trying to differentiate their products. A new standard could provide a framework to follow for a social landlord who wished to develop a sustainable project, above Building Regulations. Take up was, however, expected to be limited and negatively affected by the lack of requirements from the Homes and Communities Agency. Concerns about the timing of the launch of HQM were also expressed. This was a confusing time for the industry, working through the transitional arrangements for the absence of the Code.

Considering the detail of implementation, significant concerns were raised about the star system that BRE propose, in part due to it being reminiscent of hotel scorings. Politically, it would appear embarrassing if a local authority requires a two star home. Consumers, it is suggested, would not want a three star home. Others raised different problems with a star rating system. For example, The Housing Forum argue that a labelling system containing more detailed information is more informative for consumers than a single kite mark[109]. Finally there were questions about trust and the credibility of the new standard. Locally and nationally, many stakeholders questioned the motivation for the HQM, viewing it as BRE filling a gap in their standards portfolio, for revenue generation rather than the needs of the sector.

There was significant industry support, including in the private sector, for the Code's predecessor Ecohomes, which demonstrates there is potential for an industry-led code for homes. Any new code will need to be resourced, and one of the reasons Ecohomes worked better in practice than the Code was time and investment in improvements when implementation difficulties arose and UK and EU policy changed. A European stakeholder, not as familiar with the detailed dynamics in England, questioned the development from scratch of a new code, advocating training programmes to consolidate upon existing standards. There is already, in the words of one international interviewee, an "alphabet soup out there" of codes and standards.

108 (Rund Partnership 2015). 109 (Housing Forum 2015).

3.8 Planning policy and local discretion

This section focuses on the implications of planning policy for LZC new homes, including the National Planning Policy Framework (NPPF), in three key areas:

(i) Local planning policies requiring developments to meet a particular Code level

(ii) Policies requiring a specific level of renewable energy generation onsite ('Merton Rule' style policies)

(iii) Policies for offsite renewable/ low carbon energy sources

The primary focus of the NPPF on ensuring viability involves a concern about the planning system being a barrier to development, including the time and costs associated with planning policies. This focus on viability has been widely viewed as a challenge to policies seeking to raise environmental standards, reflecting a debate about tensions between environmental policies and development that has been ongoing since the 1970s[110]. Some statements within the NPPF are supportive of local energy and building polices. Notably, that local planning authorities should "adopt proactive strategies to mitigate and adapt to climate change" in line "with the objectives and provisions of the Climate Change Act 2008"[111]. This appears to give a clear mandate for well-constructed local climate policy, including local authorities taking action through their planning powers to raise standards. Yet, the NPPF requires that local authorities wishing to implement such local policies, such as Merton Rule type policies or Code/ BREEAM requirements, are key examples affecting new housing developments, provide sophisticated evidence that they would not undermine viability. This is a significant restriction, demanding for local authorities in terms of resources. As the Environmental Audit Committee stated:

"DCLG's proposed needs test on the application of sustainability standards by local authorities risks becoming a lawyers' charter. It could curtail local choice, delay the construction of new homes, drive down standards of sustainability and compel local authorities to incur unnecessary legal fees. The Coalition Agreement stated that the Government would "return decision-making powers on housing and planning to local councils."

The proposed imposition of a national standards set on local authorities is not congruent with the commitment to localism in the Coalition Agreement.[112]

Local government officials interviewed commented on the additional costs and administrative burdens involved for local authorities reviewing their local planning policies. This is especially a concern for authorities promoting standards above Building Regulations[113]. It is notable that Government does not provide definitive guidance to support viability testing, though professional bodies including RICS and NHBC have developed approaches for local authorities to address viability.

In the early years of the Coalition, the localism agenda prompted discussion of the possibility of local authorities being given discretion to set carbon compliance targets. This suggestion soon became superseded by a policy emphasis on consistent, national building regulations as the framework for promoting LZC homes. In relation, to energy in particular, there is broad support across a range of stakeholders for this principle, although, as discussed in Section 3.4 there is significant debate about the specific level at which this mandatory national standard should be set. Developers strongly support such a national framework as promoting economies of scale in their delivery of housing across the country. A key longstanding concern for developers is the additional cost potentially involved in adapting to locally defined sustainability requirements. This was reflected in their opposition to the introduction of Merton Rule type policies[114]. Cases such as this raise the question of how planning policy should balance the need for some national consistency with allowing local authorities to exercise discretion where there is a need to adapt to local socio-economic and environmental factors.

Aside from developers, a range of other stakeholders interviewed, including designers and consultants, focused on advocating strong national standards for LZC homes. Whereas some sustainability issues such as water scarcity and biodiversity are widely recognised to vary significantly across the country, energy is not viewed in the same way and the scope for a consistent national standard is widely emphasised.

In addition to this wide support for the principle of addressing energy through national, mandatory regulations, our local interviewees see an important role for local authorities in ensuring viability of developments and utilising local expertise. Yet there are concerns about whether local authorities have the expertise and capacity to establish local policies on energy standards for LZC homes. Several local and national interviewees provided examples of local authorities setting planning requirements that were technically impossible to achieve. For example, renewable energy installations in apartments without sufficient roof space.

There is considerable variation in resources and expertise across different local authorities[115]. Many have installed their own renewable energy systems on council buildings, developing their expertise for giving advice and questioning the suitability of some technical solutions proposed by developers and costs involved.

110 (Frieden 1979). 111 (H.M. Government 2012). 112 (House of Commons 2013b). 113 (LGA 2013). 114 For example, the Home Builders Federation (HBF) repeatedly lobbied Government to try and ensure that their members would not have to meet specific renewables targets. In their response to the Housing Standards Review the HBF argued that: "Any such local policies dilute and undermine successful achievement of the zero carbon policy and should not be allowed." (Slaughter 2013). 115 These findings have also been reached by prior research, e.g. (Goodchild and Walshaw 2011: 945).

A small number of authorities have emerged as leaders, developing significant expertise in the field. For example, Cambridge and Brighton produced sustainability checklists, monitoring how developers address whole life costing, the energy and wider environmental impact of building material and construction practices. Brighton have provided advice and support for other councils. It is more common for local authorities to require standards aimed at promoting good housing design, with many local authorities taking the lead from the Essex Design Guide. These can, as in the case of Essex, have a sustainable element to them, emphasising layout features including sustainable urban drainage and orientation in relation to solar gain.

Many developers involved in social and affordable housing felt they were at a disadvantage to the private sector. Often required to meet higher standards as a funding condition, they felt that applying such standards nationally would be fairer, promoting reduction in costs across the sector.

Given the variation in local authorities' capacity and expertise, our interviews found quite broad support for allowing some local authorities to take the lead in promoting innovation and higher sustainability standards. However, there were significant reservations about the role of local targets in relation to energy efficiency and LZC energy technologies for new homes. Stakeholders highlight the significant variation in housing markets across England. In London and the south east of England and in some larger cities they highlight the significance of greater market demand, translating into easier marketability of higher energy standards, such as Code Level 4 that became quite well established in these areas. Outside of these areas, weaker housing markets mean that marketing low carbon homes can be especially challenging.

There was further concern over how standards and policies were applied locally, for example practitioners highlighted that the Merton Rule, as it appears in Government guidance, made no distinction between renewable and low carbon technologies. A developer could install a gas combined heat and power system and meet all the requirements through this technology and not install any renewable technology at all[116].

Our interviews with stakeholders from outside England showed a different view, citing where cities had surpassed mandatory regulations, serving as exemplars. The role of city mayors has been increasingly recognised, given the potential to adapt to local circumstances and how people identify more with city-level governments, giving projects a sense of pride and ownership. It was suggested that this potential for local/ city leadership might be overlooked in England.

3.8.1 Planning for offsite energy infrastructure

There is broad acceptance that zero carbon cannot always be achieved through 100% on-site measures[117]. Local stakeholders, developers in particular, thus emphasised the need for integration between LZV homes policy and national energy policy. Two local interviewees felt strongly that renewable energy should be delivered through decarbonisation of the electricity grid, arguing that onsite renewables presented particular challenges

116 (Hewitt 2008). 117 The Hub had also proposed that local authorities be allowed to develop their own allowable solutions policy which developers would be required to comply with. The Coalition did not adopt this feature of the Hub's recommendations, emphasising their commitment to offering developers 'flexibility' in how they reached their commitments. In the 2013-14 consultation, local authorities expressed their concern that Government's proposed approach would prevent them from having the option of requiring developers to fund allowable solutions with a local focus. The 2013-14 Consultation did not invite views on this specific proposal from the Hub hence did not establish how far the Hub's proposed economic viability test would alleviate any such concerns.

for certain building types and areas and were inefficient to maintain. A number of other interviewees expressed frustration that current policy favoured gas over electric, where they felt that electric could ultimately provide a more sustainable means of energy.

For a number of local interviewees, district heating presented a potentially effective way of delivering LZC housing. This in part reflects our selection of case studies which included urban centres in Manchester and Brighton that are well suited to take forward district heating solutions. District heating can deliver low carbon energy at lower costs that solar PV and other renewables in higher density urban centres where there is also a mix of uses that consume heat in the day time when domestic use is low. However, they highlighted coordination challenges involved in such schemes. To be economically viable, district heating requires a number of developments to be connected to the network. Yet there is often uncertainty over whether developments will connect and the time scale involved. Temporary power supplies might be necessary until future, planned connections become established. Developers might therefore be required to provide information at the planning and design stage, including in their SAP calculations that would be subject to change. Hence, two interviewees in particular emphasised a greater role for local authorities in supporting coordination. In their experience local authorities had tended to assume that organisations would coordinate the scheme amongst themselves.

3.9 Streamlining the application process?

The Housing Standards Review provided an opportunity to consider the scope for a degree of integration between the processes of applying for Building Regulations and planning permission, which are currently separate[118]. For example, one option suggested by a national interviewee is an initial review of plans in terms of building regulations prior to submission of a planning application, to encourage closer assessment, at an earlier stage, of how proposed developments would achieve regulatory performance standards. In relation to Part L, this could be especially beneficial, given the complexities involved in achieving regulatory standards whilst also adhering to local planning policies. Furthermore, closer integration of the two processes could reduce the costs of compliance. This would be especially beneficial to smaller developers who spend proportionately more of their time on demonstrating compliance.

3.10 Policy uncertainty

The uncertainty surrounding the future of a range of specific policies and standards is a matter of strong concern to developers. Key areas of uncertainty, as explained above, have included the future of the Code, the delayed 2013 Part L update and the 2016 definition of zero carbon that was eventually scrapped.

Developers require time and resources to prepare their approach to achieving each new standard[119], so that this, in turn, can be factored into their planning and negotiation of a price for sites. It takes two to three years to go through the planning process for many projects. This was reflected in criticisms from sections of the housing industry of the scrapping of the zero carbon 2016 target. An open letter signed by figures representing 246 organisations argued there was "broad consensus for the zero carbon policy" and the policy U-turn would "undermine industry confidence in Government" and "curtail investment in British innovation and manufacturing"[120]. Many have highlighted the issue of wasted investment in research and development and the impact on the future of the industry.

"We have worked tirelessly over the past ten years, along with our clients, investing tens of millions of pounds to develop detailed solutions required to deliver against the zero carbon homes 2016 policy."

Rob Lambe, Managing Director of Willmott Dixon[121]

"It may not have been perfect but the zero carbon policy was an attempt to provide confidence to the construction sector, setting out future standards with enough notice for industry to be able to deliver. Scrapping the policy sends a terrible message to the industry and undermines all those who have put time and energy into making it work."

Mike Roberts, Managing Director at HAB Housing[122]

In this research, the delay to Part L 2013 was found to be of particular concern, for there is a tendency for developers to focus on the next update and to postpone consideration of the final 2016 target until it was further confirmed. Uncertainty about the 2016 zero carbon definition, prior to its cancellation, was especially prominent amongst our various national interviewees, who were especially concerned about the lack of progress in defining allowable solutions[123]. This also affected stakeholders working on local projects. For example, several local authorities have piloted allowable solutions schemes in preparation for 2016.

118 (Housing Standards Review Challenge Panel 2013). 119 (Fischer and Guy 2009). 120 (Ricci 2015). 121 (UKGBC 2015). 122 (UKGBC 2015).
123 Key issues relating to allowable solutions that remained unresolved including the price per tonne of CO_2, the list of measures that would count as allowable solutions and the discretion and responsibilities of local authorities in delivering and verifying them.

4.0 Conclusion

This report has highlighted the vital significance of the design of policies and standards for steering industry towards ambitious CO_2 emissions reductions, as well as the broader challenges that inevitably shape any assessment of their future. A profound challenge for industry is to develop the required skills and working practices. There is now a significant amount of experience across England in working to standards previously proposed by Zero Carbon Hub. There is wide acceptance of recent evidence from the Hub which strongly suggests that these standards are viable in cost terms. However, there is much concern about the gap between the energy performance of buildings as specified at design stage and their as built performance. There are similar concerns about the use and performance in practice of LZC technologies. The question of how to define effective policy and standards is inseparable from the broader question of the role of Government in supporting industry to address these issues of the 'performance gap.'

On the future of policy and standards, there is wide support from stakeholders for the Government's affirmation of the central role of national Building Regulations as the primary policy driver towards LZC homes. Given the variety of different non-mandatory standards available, there was broad agreement on the need for streamlining, the starting point for the Housing Standards Review. Opinion is far more divided about exactly what 'streamlining' entails in relation to LZC homes, with the Coalition's approach being widely criticised by advocates of environmental sustainability as 'watering down,' overlooking the potential for stronger regulations and Government support to promote innovation and changing industry practices. A further criticism, emphasised by this research, is that policy uncertainty, given the delays under the Coalition to confirmation of the future of regulations and the Code, has actually exacerbated problems of 'red tape' and additional costs that the Review sought to address. These additional costs arise due to:

- Difficulties of factoring sustainability standards into the prices at which developers purchase land
- Restricted scope for developers to prepare for future standards
- Transitional arrangements arising from key changes to the regulatory and assessment practices, such as the decision to withdraw the Code for Sustainable Homes
- Research and development associated with assessing prospective new standards.

There are widely accepted limitations to the Code as a tool for assessing the energy performance and wider environmental impacts of homes. However, following withdrawal of the Code, there is concern that key sustainability issues, that are not adequately captured by mandatory regulations, notably ecology and the sustainability of building materials, including their embodied energy, will be overlooked.

Designers of the Home Quality Mark, a new voluntary standard proposed by BRE, face methodological challenges, as well as the related, broader challenge of encouraging greater engagement with sustainability issues from the home buying public. Although underpinned by some significant technical achievements, the Code's failure to gain recognition amongst home buyers seriously limited its force as a driver towards higher sustainability standards. Again, there is scope for a new standard to be designed that will be more successful in achieving such engagement. However, since the Housing Standards Review and scrapping of the Code, there is reduced appetite for the introduction of such a new standard.

While the focus on national level Building Regulations is well justified in relation to energy, there is a stronger case for local authority discretion on other sustainability issues such as water and ecology. Even in terms of energy, the introduction of the viability test would seem to have gone too far in limiting any scope for local authority discretion. Where local authorities have the required resources and expertise, they can, if allowed a degree of discretion, perform a significant role in promoting innovative as well as viable use of LZC energy sources.

5.0 Recommendations

For policy-makers

- Strengthen the Part L standard to ensure that the zero carbon target is defined and aligned with the EU target of 'nearly zero' buildings by 2021.
- Evaluations of regulations and standards need to take more account of the costs of policy uncertainty, including wasted research and development costs and the costs of transitional arrangements arising from unexpected changes to policy and standards.
- Increase public investment in research and development to support SAP and Part L updates, including ensuring that key neglected factors are covered by Building Regulations, notably: overheating, daylighting, air quality, embodied energy, materials. While industry can provide technical advice and support, it is the role of Government to provide adequate funding for regulatory tools.
- Make changes to the Building Regulations to limit the time that permissions last. This would reduce the competitive advantage that large developers with land banks have over smaller builders. It would also reduce delays in new regulations leading to changing practice on the ground.
- Following the winding down of the Code, there is scope for some issues not covered by building regulations to be covered by planning policy, as well as by voluntary/ quasi-voluntary standards such as BREEAM Communities and the Home Quality Mark.
- Local authorities that have demonstrated technical competence should be allowed greater local discretion in policy making for LZC homes, balancing concerns about economic viability with other priorities including high quality design and meeting climate change targets. This is one of several environmental policy areas where local authorities are required to address technically demanding subjects. This could be similar to the Beacon Councils scheme for councils to demonstrate competence, which usefully promoted pilots and dissemination of good practice.

For industry

- The process through which standards are managed requires greater transparency to build greater trust amongst industry users.
- Factor energy efficiency savings into property valuation and mortgage assessments.
- Voluntary standards need to strengthen their consumer focus, emphasising the financial and quality of life benefits of LZC homes. There is a continuing need for voluntary standards, especially with the zero carbon target and Code having been scrapped.

6.0 Further reflections

- In markets such as housing, where there are only relatively weak consumer drivers for higher environmental standards, 'smart' policy mixes require strong mandatory regulations to serve as a central driver. These national regulatory standards need to be accompanied by a skills and knowledge base for translating them into practice. Where this is lacking, as is widely commented to be the case for the construction sector in relation to the LZC homes agenda, stronger public and industry-wide partnership to support training and research is needed, as highlighted by recent discussions of the 'performance gap' of LZC homes.
- Streamlining policy and standards, as the Standards Review sought to do, is of vital importance for enabling competitive, innovative approaches to achieving policy goals. Where skills and knowledge gaps are present, a strong case can be made for tackling this as a main priority, rather than further raising standards beyond what is achievable in practice. However, there is a need to distinguish streamlining, understood as simplifying regulations, standards and their inter-relationship, from 'deregulation' which involves reducing the standards towards which industry are expected to aim. Where there is broad agreement on the need for ambitious policy goals, as is the case with CO_2 emissions reductions targets for the built environment, streamlining can be welcomed, yet de-regulation might be viewed as a regrettable lowering of ambition, as found by this study of the LZC homes agenda under the Coalition.
- Regardless of the relative emphasis placed on deregulation or streamlining, clarity and certainty about the future trajectory of policy and standards is of vital significance. Uncertainty about future policy and standards causes significant additional costs for industry, as strongly highlighted by this report.
- Establishing effective, 'performance orientated' assessment tools requires that the standard be carefully defined to allow scope for innovation and the exercise of local discretion. This is essential for establishing the acceptance and support for assessment tools. Yet removing such standards without replacing them, as part of a deregulatory approach, involves the loss of important drivers towards innovation and learning for achieving higher standards. Problems experienced with how specific standards are defined, as occurred with the Code, can be taken as prompting further reflection and learning. They need not entail abandonment of a smart, performance orientated approach.
- Where strong national mandatory standards are established as a core driver of higher standards, there can still remain a significant role for non-mandatory standards to further drive innovation and learning, particularly in locales and markets where there is aspiration and potential to achieve higher than the minimum. Such an approach involves a shift in how 'smart,' streamlined regulation is achieved, rather than an abandonment of this goal.

7.0 Appendices

Appendix 1: Building Regulations Part L

- The Building Regulations for England define mandatory minimum standards for all buildings. Part L of the Building Regulations, which specifies requirements for the conservation of fuel and power, is of primary importance for the delivery of low/ zero carbon homes[124]. Part F on ventilation also has implications for this policy agenda, given the need to carefully consider ventilation in order to maintain air quality and prevent overheating in highly energy efficient homes.
- DCLG are responsible for building regulations for England. Northern Ireland, Scotland and Wales each have their own building regulations, with the powers to change them being devolved.
- The compliance process for Building Regulations is separated from the system of planning approval. Developers can choose from either a local authority building control officer or a private accredited assessor who has undertaken an approved training programme.

Energy performance certificates

- Energy Performance Certificates (EPCs) were introduced into UK legislation in 2004 to make sure the UK complied with the EU Energy Performance of Buildings Directive[125]. Separate from Building Regulations, EPCs show the level of the energy efficiency of a building and are required for all domestic and non-domestic buildings whenever they are sold or rented. EPCs for homes were initially part of the Home Information Pack (HIP), a set of documents that sellers were required to produce, though continued to be required after HIPs were phased out[126].

Tools for regulatory assessment of building energy performance

- To calculate whether a building complies with Part L, the **National Calculation Methodology (NCM)**, is used, which specifies how the calculation is to be performed and the software to be used.
- The NCM specifies that the estimated CO_2 emissions for a building, known as the dwelling emissions rate, (DER), be compared with the emissions from a hypothetical 'notional' building of the same size and shape, referred to as the target emissions rate (TER), expressed as $kgCO_2/m^2/year$.
- For dwellings, the DER and TER calculations are based on a model known as the **Standard Assessment Procedure (SAP)**, which contains standardised assumptions for factors such as number of occupants, heating patterns and room temperatures. SAP is based on a series of facts and assumptions about the energy efficiency of a variety of different types of building materials, dwelling designs and service technologies. Part L requires that the DER is equal to or better than the TER. Hence, this methodology provides a ***relative*** measure of the building performance.

124 These requirements for the conservation of fuel and power are specified in various "Approved Documents L" – published since 1995 and updated in 2002, 2005, 2006, and 2010, the 2010 editions of the Approved Documents L being the most current ones. Relevant for the present discussion here is the Approved Document L1A, which concerns new dwellings. (The other Approved Documents L1B-L2B concern existing dwellings, new buildings other than dwellings, etc., and are therefore irrelevant here.). 125 They were introduced as part of the 2004 Housing Act (H.M. Government 2004). 126 HIPs were suspended in 2010. They also included titles and ownership documents from standard local authority land searches, indicating any developments in the Local Development Framework that may impact on the property. Changes were made after the introduction of the HIPs, adding further criteria, including flood risk to the land searches.

Appendix 2: Code for Sustainable Homes

Although not part of mandatory, national regulations, the Code for Sustainable Homes, designed to assess new housing in terms of a range of sustainability criteria, was a key part of the U.K. Government's zero carbon homes agenda. Six 'levels' of sustainability are defined, with level 6 being the highest. Local planning authorities were given powers, which many adopted, to set target Code levels for new homes. From April 2007 all new publically funded housing in England, Wales and Northern Ireland was required to meet Code level 3. The Homes and Communities Agency specified Code level 4 as a condition of their funding of social housing. Private developers could also opt to achieve certain Code levels[127]. Approximately half of local authorities had Code policies,[128] though this did not mean all developments were built to the Code in these localities, and policies typically applied only to larger developments.

The Code was developed and administered, under the direction of DCLG, by the now private company BRE, formerly the Government-funded research body known as the Building Research Establishment, as part of their suite of assessment methods for different building types, known as BREEAM (BRE Environmental Assessment Methods)[129]. Other BREEAM tools are solely administered by BRE. The previous BREEAM tool for assessing new housing was known as EcoHomes, which itself was a relaunch of BREEAM Homes. In 2003, a Sustainable Buildings Task Group[130] proposed a unified Code of Sustainable Building to raise standards. While ministers accepted the report findings, they focused initially on developing the Code as a standard for new homes[131].

The Code assesses homes in terms of nine sustainability categories, with energy/ CO_2 emissions being one.

Table 4 **Issues in code**

Categories	Issue	Weighting factor (% points contribution)
Energy and CO_2 emissions	• Dwelling emission rate (M) • Fabric energy efficiency (M) • Energy display devices • Drying space • Energy labelled white goods • External lighting • Low and zero carbon technologies • Cycle storage • Home office	36.4%
Water	• Indoor water use (M) • External water use	9.0%
Materials	• Environmental impact of materials (M) • Responsible sourcing of materials – basic building elements • Responsible sourcing of materials – finishing elements	7.2%
Surface Water Run-off	• Management of surface water run-off from developments (M) • Flood risk	2.2%
Waste	• Storage of non-recyclable waste and recyclable household waste (M) • Construction site waste management • Composting	6.4%
Pollution	• Global warming potential (GWP) of insulants • NOX emissions	2.8%

Note: (M) denotes issues with mandatory elements

continued

127 Because of the way the data is collected it is not possible to determine precisely how many new homes certified with the Code are industry led and how many are planning conditions set by local authorities or funders. The Homes and Communities Agency always required completion certificates but for many planning authorities a design certificate only was required to comply. 128 (House of Commons 2013a). 129 The domestic market makes up a significant proportion of BRE's certification activity with 59% of all projects registered domestic (BRE 2014). 130 (Sustainable Buildings Task Group 2004). 131 (Thompson 2013). 132 (DCLG 2014a).

continued

Categories	Issue	Weighting factor (% points contribution)
Health and Well-being	• Daylighting • Sound insulation • Private space • Lifetime Homes (M)	14.0%
Management	• Home user guide • Considerate Constructors Scheme • Construction site impacts • Security	10.0%
Ecology	• Ecological value of site • Ecological enhancement • Protection of ecological features • Change in ecological value of site • Building footprint	12.0%

Note: (M) denotes issues with mandatory elements

Code for Sustainable Homes

- The energy and water categories include minimum requirements for achieving Code certification.
- The energy section covers fabric energy efficiency and installation of a range of other facilities and technologies for achieving emissions reductions, ranging from cycle storage facilities to LZC energy generation technologies.
- The level of the home is determined by calculating the sum of credits achieved in each of the nine sustainability categories (weighted according to their relative significance).
- Code assessors conduct an initial design stage assessment, issuing an Interim Code Certificate for the dwelling, if approved. Following construction, a post completion check is undertaken by the Code Assessor to verify that the home has been built as designed. To enable this verification process, items such as purchase invoices, manufacturer product specifications and photographic evidence are required. Site visits may be carried out but are not mandatory. There are currently 1,100 assessors who are licensed by BRE and two other approved licensing companies.
- Only one update was made to the Code in the autumn of 2010, mainly to ensure that the assessment of energy credits was aligned with the new Part L. Since then, the Code working group became dormant and further work to improve and develop the Code did not take place.

In addition to social housing the Code was also expected to attract interest from developers of housing for private sale. By December 2014, there were 197,851 Code completions, 32% of them in the private sector. The majority of these, 76% are Code level 3. However, for the most recently published data, the period April-December 2014 there was noticeably increased uptake of Code level 4. During that time 11,744 homes or 29% of the number of certificates for completions were for Code Level 4 homes. The change is even more marked for design stage certificates with 19,969 or 34% for Code level 4. Code level 5 still appears challenging with only 600 design stage certificates issues in that nine month period, or 1% of the total design certificates awarded.[132]

Appendix 3: Zero carbon definition

When the zero carbon target was initially announced, it was defined as a home having net zero CO_2 emissions. This measure was to include consideration of both emissions covered by building regulations (from heating and lighting the home) and 'unregulated' emissions (caused by use of appliances within the home). Only on-site renewables, or off-site renewable solutions connected to the development by a private wire, would count towards achieving zero carbon[133]. Hence, the definition was equivalent to Code level 6 for energy.

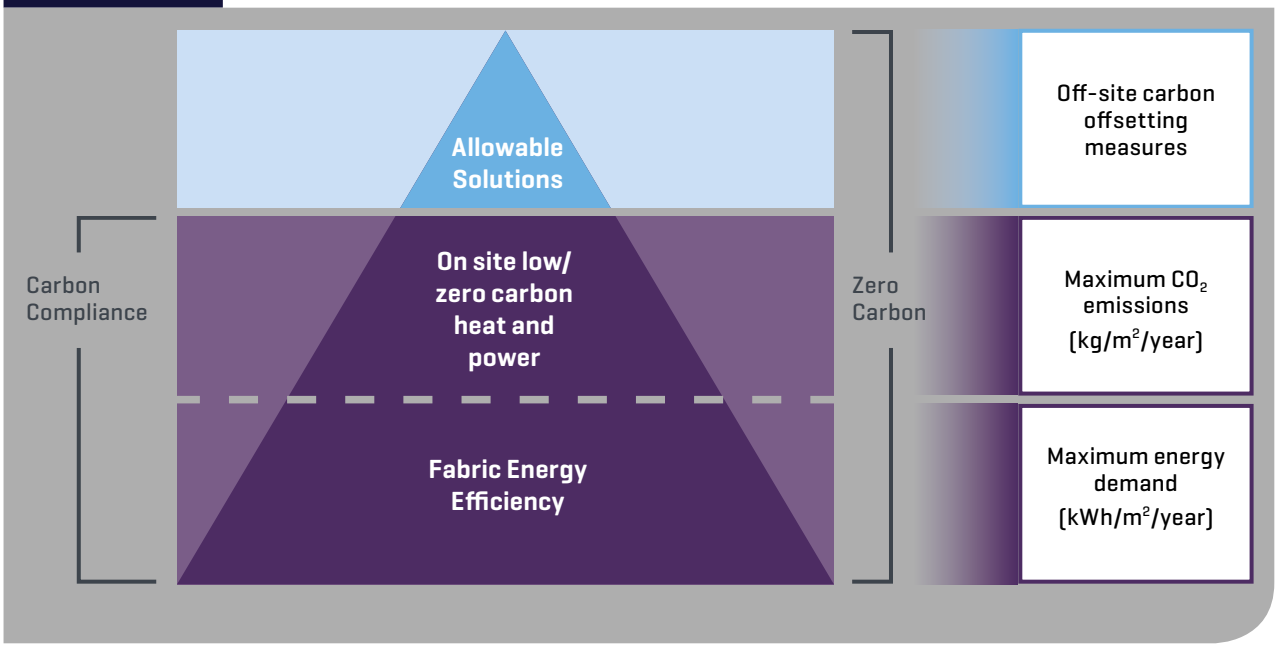
Two updates to Part L were proposed, to serve as milestones towards this zero carbon target, as shown in the table 5 below.

In 2008, the U.K. Government provided a different definition of 'zero carbon,' which allowed for the possibility of off-site measures contributing to achieving net zero carbon. The pyramid below, illustrating three types of measure for achieving net zero carbon, became widely circulated and discussed across the sector.

Table 5 **Issues in code**

Year	2010	2013	2016
Energy efficiency improvement (compared to 2006 Building Regulations)	25%	44%	Zero carbon
Equivalent energy/ carbon standard in the Code for Sustainable Homes	Level 3	Level 4	Level 6

Figure 8 **The zero carbon definition**



133 This first definition of zero carbon was published by the Treasury for the purposes of giving tax relief to zero carbon homes (H.M. Treasury 2007).

Layer 1: Fabric Energy Efficiency (FEE) Standard

A minimum standard for fabric energy efficiency of the home is of core importance to achieving a LZC home.

For a home to be 'zero carbon' requires that net usage of energy be supplied from renewable sources. Intuitively, the notion of a 'zero carbon home' would, for some at least, suggest that such renewable sources be positioned on the site of the home itself (for example, wind turbines or solar panels on the roof of a property).

Layer 2: Carbon Compliance

The term 'Carbon Compliance' refers to the combined contribution of fabric energy efficiency and onsite low-carbon heat and power towards achieving zero carbon.

Layer 3: Allowable solutions

Allowable solutions referred to a range of other CO_2 emissions reducing measures that might be taken additionally, where carbon compliance alone is insufficient for achieving zero carbon. Possible allowable solutions, including on-site options such as installation of smart appliances, heat storage systems, home electric vehicle charging and LED street lights for the site. Further allowable solutions were investments in a range of possible 'near site,' or 'off site' schemes, which might include, for example district heating, retrofitting existing homes, communal waste management, energy-from-waste, low carbon electricity generation, embodied carbon reduction and low carbon cooling schemes[134].

Fabric Energy Efficiency Standard (FEES) recommendation

The Zero Carbon Hub recommended that FEES be measured in terms of the energy demanded for the space heating and space cooling, measured as kWh/m^2/yr.

Following their recommendations, different minimum energy efficiency levels were set for two sets of dwelling types:

- 39 kWh/m^2/ yr for apartment blocks and mid-terrace houses
- 46 kWh/m^2/yr for semi-detached, end of terrace and detached houses

Dwellings of the first types have less exposed building fabric relative to the floor area. This means, as the report explains, that "they are able to achieve a particular kWh/m^2/yr space heating and cooling demand with a less challenging construction specification."[135]

Notably, FEES only covers the 'passive features' of a building – i.e. the efficiency of the materials and construction techniques used. The benefits of additional technologies such as mechanical ventilation systems and heat gain from hot water systems are excluded from consideration by this minimum energy efficiency standard. The benefits of such technologies, as the task group recommend, can be counted towards achieving carbon compliance.

Carbon compliance recommendation

In July 2009, the then Housing Minister commissioned the Zero Carbon Hub to convene a Task Group to recommend a suitable Carbon Compliance level. The Task Group made their recommendation in February 2011 to the Minister for Housing and Local Government under the Coalition Government. The recommendation was as follows:

- 10 kg CO_2/m^2/year for detached houses
- 11 kg CO_2/m^2/year for other houses
- 14 kg CO_2/m^2/year for low rise apartment blocks (four storeys and below).

Hence, this recommended performance standard is expressed in terms of absolute emissions, argued to be a superior approach to the previously measure relative to a 2006 notional Building. The above Carbon Compliance recommendations refer to as built performances, whereas Part L had referred to designed performances. Recommendations are therefore not directly comparable to current standards.

Nonetheless, the percentage improvement on the 2006 standards would be 60% for detached houses, 56% for other houses, and 44% for low rise apartment blocks.[136]

In terms of the Code of Sustainable Homes, level 4 is equivalent to 14 kg CO_2/m^2/year and level 5 to 0 kg CO_2/m^2/year.

134 (Zero Carbon Hub 2011). 135 (Zero Carbon Hub 2009: 9). 136 All in all, the above recommended Carbon Compliance level was at a reduced level, compared with the 2008 consultation target of 70%, which equated to Carbon Compliance levels below 6 kg CO_2/m^2/year.

Appendix 4: Planning policy

The planning system is the main framework used to regulate change in the built environment, balancing consideration of the expected economic, social and environmental impacts of development. As part of the Red Tape Challenge, the Coalition sought to streamline what they saw as the voluminous nature of planning policy, introducing what many argue is the most wide-ranging set of reforms to the planning system since 1947. The Planning policy statements (PPSs 1-25) and good practice guidance were removed and replaced with a single document, the National Planning Policy Framework (NPPF). The NPPF placed a much greater emphasis on economic viability and delivery in both determining individual planning applications and developing policies in local plans:

"to ensure viability, the costs of any requirements likely to be applied to development, such as requirements for affordable housing, local standards, infrastructure contributions or other requirements should, when taking account of the normal cost of development and on-site mitigation, provide acceptable returns to a willing land owner and willing developer to enable the development to be deliverable."[137]

The Coalition Agreement stated that the Government would "return decision-making powers on housing and planning to local councils"[138] and the removal of regional government structures and regional targets for house building were a central part of the reforms. Alongside this desire to promote and speed up development was a concern that local communities were often disengaged from the planning process and the Coalition expressed a commitment to 'Localism.'

Understanding the implications of these reforms for the LZC homes agenda requires consideration of three areas of planning policy in particular:

i. Policies requiring specific levels of energy generation onsite (e.g. the 'Merton Rule')

ii. Local planning policies requiring developments to meet a particular Code level

iii. Policies for the provision of offsite energy infrastructure

Both (i) and (ii) above were formalised by the Planning and Energy Act 2008. This gave local authorities the powers to require developers to meet higher energy efficiency standards through planning conditions. These were enforced through legally binding S106 agreements.

Policies for on-site energy generation

First developed in the London Borough of Merton in 2003, the Merton Rule required developers to provide at least 10 per cent of their energy requirements from on-site renewables. After being successfully introduced in larger non-residential projects[139], it was amended to include other larger projects, including residential, commercial and industrial development.

Having initially been opposed to the Merton Rule, in 2005 the Labour Government produced Planning Policy Statement 22 (PPS 22) that gave support to local authorities who wished to introduce their own Merton Rule. This was followed by further clarification of the procedures in PPS1 guidance on climate change in December 2007. The take-up of Merton Rule policies was rapid, with 80 local authorities adopting and a further 170 developing them[140]. Two London Boroughs, Merton and Barking and Dagenham due to concern that developers were neglecting the issue of effective implementation, focused simply on installation to satisfy the formal Merton Rule requirement. These two boroughs installed data gauges to measure renewable technology performance, information that fed into a website accessible by councils, developers, micro-generation installers and building occupiers. Merton used the data to help inform discussions with developers and architects about the suitability of technologies. They hoped the data would help avoid poor installations and inappropriate technology choices. Barking and Dagenham Council also used the data to enforce the Merton Rule[141].

Code requirements

Before the Housing Standards Review, many local authorities began to move away from Merton Rule policies and instead set requirements for larger residential development to meet Code for Sustainable Homes standards.

Offsite LZC energy infrastructure.

The European Commission Renewable Energy Directive (EPBD) provides an overarching policy framework, with member states required to contribute towards the EU target of generating 20% of final energy consumption from renewable resources. To boost the production of renewable energy, feed-in-tariffs were introduced in England in 2010, a policy measure that had successfully increased renewable energy installations in other countries,

137 (H.M. Government 2012). 138 (H.M. Government 2010:11). 139 The rule initially applied only to non-residential developments of over 1000 square meters (Wilson 2009). 140 (TCPA; 2006). 141 (ENDS 2009).

including Germany. As well as incentives, the Climate Change Levy is a tax paid by businesses on energy use. Electricity from renewable sources had been exempt from the levy, resulting in effective support of £5 per megawatt hour of output. In the 2015 budget this was changed so renewable energy would also pay the Levy.

Large schemes, over 50 megawatts, were until recently considered nationally significant infrastructure and dealt with directly be the Secretary of State. All renewable energy schemes that require planning permission are now determined by local authorities. There was a recent amendment, in June 2015, to Government Planning Practice Guidance relating to the development of onshore windfarms. The new requirements steer developments towards locations that are identified in local plans, although a majority of planning authorities had not allocated sites for windfarms in their local plans. No comparable changes have been made to other key areas such as biomass or solar farm guidance.

In the past 15 years policy measures have been brought forward to support the development of heat networks through the planning system and public procurement. District heating systems involve producing heat at a central source in an energy centre and distributing it through a network of pipes usually to new build schemes given the cost and disruption involved. Local plans for many larger urban areas require developers to conduct feasibility studies about connecting their new development to a heat network. The management of the district heating system is typically carried out in partnership between the local authority and an Energy Services Company ESCO. If only domestic properties are included the heating system needs to be able to cope with morning and evening peaks but has little use during the day when most people are not using hot water in their homes. Many district heating systems are supported by public procurement policies so that buildings with significant heat use during the day, including town halls, and leisure and educational buildings, are connected For London in particular, a decentralised energy master planning processes has sought to promote district heating developed by the GLA with funding from the European Investment Bank.

Appendix 5: Non-mandatory standards

In England, the use of non-mandatory standards is dominated by BRE tools. Between 1990 and 2012, nearly 90% of all green building ratings carried out in England used BRE tools, including the Code and BREEAM.

BRE has a master planning tool called BREEAM Communities, which it has suggested could help delivery broader sustainability benefits for new schemes, in the absence of the Code[142].

BRE is developing a new standard to replace the Code called the Home Quality Mark (HQM). It is intended to be "a mark of reassurance and quality for people who will live in a new build home". The quality is rated using a five star system with points awarded for performance in the environment, economic efficiency and wellbeing. The environmental component includes a wide range of issues including: energy and water efficiency, ecological enhancement, waste management and the use of building materials that have less impact on the environment. The economic indicator focuses on reduced maintenance and running costs. Wellbeing is featured much more prominently than in the Code to make the Home Quality Mark more consumer orientated. Unlike the Code, there is also an element of post occupancy evaluation of the performance of the home.

Internationally, there are now more than 600 codes and standards for assessing the sustainability of buildings, of which only BREEAM and LEED have established themselves at an international level[143]. These include:

- Product declarations such as NaturePlus and Environmental Products Directive
- Ecologically orientated specification aides such as WINGIS in Germany and
- Energy certificates such as Energy Performance Certificates in England
- Checklists and guidelines such as the guides prepared by Brighton and Cambridge Councils
- Interactive planning and assessment tools that can aid in decision making such as GaBi and Bauloop
- Building labelling, evaluation and certification schemes such as LEED and BREEAM.

Housing Standards Review

The Housing Standards Review (HSR) was launched in October 2012 following the recommendation of the Harman Review for rationalising standards in housing. The Review considered how policies and standards might be streamlined and more mutually complementary. The structure of the Review consisted of two groups, a local housing standards review group and a contestable policymaking challenge panel. The review group commissioned thematic working groups focusing on five different areas: energy, water, security, accessibility and space. An initial consultation August 2013 was followed by a technical consultation in September 2014.

In relation to energy, the HSR made the following recommendations:

- That it was unnecessary for local authorities to have discretion to set energy standards higher than Building Regulations, given the 2016 zero carbon homes target[144].
- That the Code be withdrawn and that local authorities should no longer have the power to set target Code levels for new homes, with some elements being included in new regulations[145].
- Regarding the Code for Sustainable Homes, it could be appropriate for local authorities with planned or previous investments in local renewable energy networks to require a connection.

The Housing Standards Review was implemented by the Deregulation Bill (26th March 2015), followed by a statement by Secretary of State for Communities and Local Government Eric Pickles (27th March 2015).

The HSR also made the following key recommendations for water and space:

Water

The introduction, for the first time, of an optional standard into Building Regulations of 110 litres/person/day rather than the standard 125[146]. Local plans would need to provide justification for adoption of this single, higher national voluntary standard in terms of local need. This is the first time the Building Regulations have contained optional elements. As a result, a statutory amendment to the 1984 Building Act in the 2015 Deregulation Act was required. There is also an overlap in responsibilities, as the condition would be set through planning approval but enforced through Building Regulations.

142 (Hyde 2015) 143 (Ebert, EBig, and Hauser 2013) 144 (DCLG 2014b: 1) 145 DLCG., 2014 p.2 146 (Local authorities would only be able to choose between these two pre-defined standards, with no discretion to set alternative water standards.

Space

Local authorities also have the option to set a nationally described space standard.

Any local authority wishing to adopt the water and space standards have to consider the impacts in assessing their local plan viability, providing detailed, supportive technical evidence[147].

The Housing Standards Review did not, as some commentators expected, lead to stronger integration between planning and Building Regulations through a unified portal[148].

Transitional arrangements for energy

Local authorities with policies in place may still ask developers to build to higher energy standards during the transitional period from March 2015-October 2015 in new developments. The March 2015 ministerial statement advised that this should not be above Code level 4.

The Code remains within existing planning conditions, hence house builders will have to continue to work to the Code for extant planning permissions for a number of years. The Code also remains a requirement in contractual arrangements for new homes funded by the Homes and Communities Agency under the National Affordable Housing Programme 2015-18. The Homes and Communities Agency has indicated it will not require social providers to use the Code or other standards beyond Building Regulations outside these existing contracts. BRE will continue to support new registrations and the licensing of Code assessors. It will not be possible for any of the voluntary standards discussed in Section 3 above, including Passivhaus and the new BRE Homes Quality Mark, to be mandatory.

The future of Merton rule type policies for new homes remains uncertain. The inclusion of percentage renewables targets in local plans will now have to be subject to demonstrating viability through supplying an even more demanding evidence base. It is now very questionable whether any such targets could achieve approval through such a process.

147 (H.M. Government 2015). 148 (RTPI 2013).

Appendix 6: European Union policy

The European Union (EU) has set the target of achieving 80% reductions in greenhouse gas emissions by 2050. Two EU directives in particular are of key importance for achieving this target in the design of new buildings: the Renewable Energy Directive (RED) and the recast of the Energy Performance of Buildings Directive (EPDB). These two directives emphasise need to ensure that minimum energy performance levels are cost-optimal. The EPBD requires that the energy that is still needed is met by renewable sources to a "very significant extent". This is normally interpreted as between 50% and 90% of the energy required the active supply systems in the home, such as solar systems and pellet boilers[149]. By 2020, RED stipulates that Member States must ensure that 20% of their energy is generated by renewables.

The EPBD requires member States to ensure that by 2019 all publically owned buildings be "nearly zero," with all other new buildings having to meet this target by 2021 (NZEB). Member States were given responsibility for submitting national plans for increasing their number of nearly zero energy buildings. This target is defined in general terms as follows:

The two directives provide definitions of the above concepts, e.g., 'primary energy' or 'energy from renewable sources.' Of special interest is the definition of an NZEB. This is defined as:

a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.

It is the responsibility of each member state to produce their own more specific definition of nearly zero. This might involve using their own existing definitions of low energy and high energy performance buildings and expanding them to create their national versions of NZEBs[150].

149 (BPIE 2011). 150 (McLeod, Hopfe, and Rezgui 2012).

Appendix 7: Interviewee details

Table 6 Interviewee details

Interviewees by expertise

	2010	2013
Architecture	4	11
Engineering	2	2
Project planning/ sustainability	17	11
Development management	6	6
Construction trade	1	5
Compliance	1	-
Surveying/ valuation	2	3

Interviewees by employer type

	Large (250+ employees)	Medium (<250 employees)	Small (<50 employees)
Developer	11	4	-
Design (architecture/ engineering)	6	2	7
Consultancy	-	4	5
Construction/ Contractor	2	2	2
Local authority/ public sector	6	3	7
Industry association	1	2	6

National

32 national interviewees involved in policy-making/ advocacy

Brighton

	Small site (<10 units)	Medium/ large site (10+ units)	Both sizes
Primarily private	2	2	
Social housing	6	-	-

Greenwich

	Small site (<10 units)	Medium/ large site (10+ units)	Both sizes
Primarily private	1	6	3
Social housing	-	1	

Manchester

	Small site (<10 units)	Medium/ large site (10+ units)	Both sizes
Primarily private	-	5	5
Social housing	-	2	-

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