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Streamlining or watering down? Assessing the 'smartness' of policy and standards for the promotion of low and zero carbon homes in England 2010-15

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The knowledge and enforcement problems faced by governments in defining traditional 'command and control' regulation are well known. Significant legal scholarship offers alternative models of 'smart,' 'responsive' environmental regulation, emphasising the need for policy instrument mixes, including the vital role of voluntary, industry-led sustainability standards. Yet, as is being increasingly recognised, these contributions leave open the need for detailed, qualitative evaluation of instrument mixes as a complement to primarily quantitative cost-benefit analyses that predominate in regulatory impact assessments by governments. Addressing this need, this paper evaluates policy and standards for low and zero carbon homes in England during the Coalition government (2010-2015) when the ecological modernisation discourse of the previous New Labour government became subsumed by a deregulation agenda. Our study, incorporating 70 stakeholder interviews, suggests that, in supplier-driven markets such as housing in England, a 'smart' mix of mandatory and voluntary standards requires a strong, central role for government in setting national, mandatory standards and supporting their delivery. There is an important potential supplementary role for voluntary tools and local authority discretion, though our study highlights problems that can arise when such different instruments promote diverging roadmaps towards a policy goal.

Keywords: smart regulation; zero carbon homes; deregulation

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1. Introduction

A central challenge for contemporary governance is developing policy strategies and regulatory tools that steer towards goals, such as a low carbon economy, while allowing industry sufficient flexibility to adapt to change (author, 2012). In western, industrialised countries, recent years have seen a shift from traditional 'command and control' regulations to increased use of new instrument types, including market-based and voluntary tools. These shifts reflect an ecological modernisation (EM) approach, in partly transferring steering capacity to non-state and private sector actors (Jordan et al., 2013) and emphasising potential innovations that improve both environmental and economic performance. Yet a contrasting, market liberal, deregulation agenda has also had significant influence. This paper addresses the identified need for detailed evaluation of policy instrument mixes (Enevoldsen, 2005; Jordan et al., 2013) to assess the competing claims of these prominent, competing ideologies. The focus is on policy and standards for low and zero carbon (LZC) homes in England, where ambitious targets set by Labour were a key example of the influence of EM discourses (Lemprière, 2016). Our study focuses on this agenda under the Conservative-led coalition government 2010-15 where discourses of deregulation became prominent.

Section 2 introduces our theoretical framework, drawing from literature on the politics, design and evaluation of environmental regulation, particularly EM and the notion of 'smart regulation' (Gunningham et al., 1998). Sections 3a and 3b introduce the LZC homes policy agenda under New Labour and the Conservative-led Coalition government respectively. Section 3c discusses previous academic studies, highlighting the need for evaluative research on LZC homes policy strategy, with a particular absence of research on Coalition policy. Section 4 presents our methods and key findings. Section 5 discusses the implications of our findings, while Section 6 concludes.

2. Evaluating regulation

2a. Ideologies and the politics of regulation

The 'new right,' market liberal deregulation agenda, which views regulation as a cost, or 'burden,' that hampers economic competitiveness, has been influential in the UK since the 1980s. The deregulation discourse became especially prominent under the Conservative-led Coalition government who introduced the 'One In, Two Out' rule and the 'Red Tape Challenge' that aimed to reduce the costs of regulation. Previously, New Labour's proposed 'Third Way' involved a more substantial role for states in shaping markets and promoting public goods provision than is countenanced by the new right. The international 'Better Regulation' agenda, concerned with improving the *quality* of regulatory instruments and processes, was influential in the late 1990s (Radaelli and Meuwese, 2009). However, the emphasis was that much regulation represented a burden in need of reduction (Tombs, 2016) and the move towards a 'risk-based' regulatory model after the 2005 Hampton Review (2006)¹ represented a significant shift in emphasis towards a de-regulation approach (Dodds, 2006). This involved a targeted approach to enforcement, based on careful calculation of the risks entailed by non-compliance.

The deregulation discourse has origins in the public choice and Austrian schools of political economy, which offer somewhat contrasting reasons for scepticism towards regulation (Parker, 2002). Public choice theory emphasises the danger of regulatory processes being 'captured' by specific interest groups. The Austrian school, particularly Friedrich Hayek, stress the inevitably limited knowledge available to regulators (author, 2012). The indispensable functions of markets in transmitting knowledge and promoting innovation, Hayek argues, will be impeded by even the most well intentioned governmental efforts to promote public policy goals through regulatory interventions. Yet the assumption underpinning new right arguments that regulation is a cost to business has been subject to

¹ Christopher Hampton was commissioned by the British government to conduct a review regulatory systems.

recent challenge, notably in the literature on environmental regulation. Dieter Helm (2006) is critical of what he views as generalised claims about macro level costs of regulation that overlook the potential benefits of regulation in providing public goods, such as reducing pollution and promoting more equitable social outcomes. He argues that there is not necessarily a tight, negative causal relationship between regulation and economic efficiency. The de-regulation agenda, Helm contends, lacks an evidence base. He stresses the need for more detailed evaluation of the costs and benefits of specific policy instruments, given the significant variation in their susceptibility to problems of information and regulatory capture.

Helm's argument can potentially lend support to 'ecological modernisation' (EM), which involves use of a range of regulatory instruments for fostering 'win-win' environmental and economic outcomes. EM is sensitive to the epistemological challenges involved in selecting and defining instruments for addressing complex problems, emphasising the need for 'governance' to draw from the expertise of state and non-state actors (author, 2015). However, some vested economic interests can be resistant to EM-inspired regulatory initiatives. This would seem to partly explain why, although EM discourses have had significant international influence, especially in Europe, this influence has been somewhat patchy (1998).

The term 'ecological modernisation' has been used to refer to a range of approaches to promoting ecological sustainability in the context of a thriving economy. Useful here is the distinction drawn by Christoff and Dryzek between 'weak' and 'strong' versions of EM. Weak EM, they suggest, focuses on environmental policy as promoting 'win-win' innovations that both improve environmental performance and foster economic competitiveness. The danger with weak EM, Christoff argues, is that it suggests a "technocratic" view of achieving change (Christoff, 2000). Strong EM is advocated as promoting a more holistic approach (Dryzek, 1987) involving broader socio-cultural transformation of established production and consumption patterns, which are viewed as significant constraints upon the achievement of

ecological sustainability goals . Strong, as well as weak, versions of EM recognise the significance of regulatory instruments as potential drivers of ecological improvement. Indeed, the EM literature, with its challenge to the deregulation agenda of the new right, opens up the need for further evaluative research on regulatory policy, starting from recognition of the conflicting interests and epistemological challenges at stake (author, 2015).

2b. Evaluating instrument mixes and the challenge of complexity

The need for alternatives to traditional command and control is identified in the legal studies literature on regulation. However, rather than focusing on the challenges of instrument definition, the primary focus is on incentivising regulatory compliance. Proposed alternative compliance models start from the premise of the prohibitive costs involved in seeking to uniformly enforce mandatory regulations through a command and control approach. The 'responsive regulation' model (Ayres and Braithwaite, 1992), which influenced the Hampton Review, proposes that non-punitive measures, such as persuasion and education, be used initially with action only being escalated up the pyramid to increasingly punitive measures for firms who are found to fail to behave as required. Proposals for 'smart regulation' (Gunningham et al., 1998) similarly advocate an escalator approach, including the use of voluntary tools as supplements to mandatory regulations. In proposing 'really responsive regulation', Baldwin and Black (2008) seek to build on the above models whilst advocating greater sensitivity to the norms, understandings and institutional contexts that shape the incentives and behaviour of individuals and firms being regulated.

The epistemological challenges involved in instrument definition are recognised, at least implicitly, by smart regulation (Gunningham et al., 1998), which echoes EM in emphasising the need to draw from the knowledge and expertise of non-state and private sector actors (Gunningham et al., 1998). A prescriptive approach, involving industry adopting specific technological solutions, it is commented, requires regulators to acquire an especially large

body of knowledge about technologies which might be contested, uncertain and soon outdated (1998). Yet, epistemological challenges involved in instrument definition are not the subject of sustained focus in this literature. There is a need for closer consideration of approaches to this challenge, such as the 'performance-based' approach, articulated for UK building regulations, that defines a required outcome while allowing firms flexibility in how to achieve it, thus aiming to reduce vulnerability to negative unintended consequences². While it may be possible to provide a measure of some sought outcomes, such as for some maximum pollution levels, this may, as discussed in our policy study below, involve balancing difficult trade-offs between multiple qualitatively distinct criteria. Hence, a performance-orientated approach can still be susceptible to epistemological challenges (author, 2012).

The possible complexities of defining sought outcomes is reflected in debates about policy evaluation methodologies. Widely used cost-benefit analysis (CBA) methods have been criticised for assuming that costs and benefits are monetarily measurable, given the complexities and uncertainties involved (O'Neill and Spash, 2000). While some regulatory impact assessments have sought to combine CBA with qualitative criteria to capture public or non-monetised goods, these have often been criticised for being "vague and indeterminate" (Helm, 2006). Applying CBA to regulatory evaluation also involves significant methodological difficulties. Notably, there is a danger of businesses over-stating the time and costs of reporting their activities to the regulators, given that they would need to undertake a significant proportion of these reporting tasks in any case, as part of routine management (Black, 2012). More extensive qualitative analysis of actual and prospective policy impacts can complement quantitative methods (Taylor et al., 2012) as a way of

² Jordan et al (2013), in placing all forms of state-defined, legally binding regulations in the single category of 'command and control,' overlook differences between prescriptive and performance-orientated approaches. This distinction is important to consider in evaluating instrument selection. Jordan et al's definition of command and control is valid and reflects their focus on distinguishing 'new' policy instruments that are indicative of a shift to 'governance' in involving actors beyond the state, in contrast with government-defined regulations.

achieving such a more balanced, nuanced view of regulatory benefits, costs and their inter-relationships.

As Enevoldsen (2005) argues, the assumption of known, measurable costs and benefits becomes especially dangerous with the arrival of new forms of indirect regulation, such as market-based and voluntary tools, where, compared with traditional technologically prescriptive regulation, there is “even less reason to assume a one-to-one relation between policy outputs and outcomes.” The challenges of evaluating instrument mixes in the context of multiple institutions are especially profound. The effectiveness of policy mixes depends upon a range of factors, notably their parsimoniousness, as well as their complementarity both in terms of the standards they define (Gunningham et al., 1998) and their compliance processes (Baldwin and Black, 2008). Our study addresses this need for detailed, qualitative assessment of policy strategy and instrument mixes.

3. The LZC homes agenda: from ‘ecological modernisation’ to the red tape challenge

3a. New Labour and LZC homes

In 2006, the Labour government set a target that from 2016 all new homes built would be zero carbon. It was forecast that around one third of homes standing in 2050 were still to be built. Hence, policy for new homes was a significant part of the wider climate change mitigation challenge. In 2010, the agenda was reinforced when the EU Energy Performance of Buildings Directive (EPBD) targeted achieving ‘nearly zero’ energy buildings by 2021³.

The EM approach of this agenda, emphasising potential synergies between innovation and

³ 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. A nearly zero energy building (NZEB) is defined as having a “very high energy performance” and where “The nearly zero or very low amount of energy required” is “covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby” (European Union, 2010). This general definition leaves EU member states room for their own specific interpretation and definition of an NZEB.

housing sector competitiveness, has been highlighted by prior research (Gibbs and O'Neill, 2015; Goodchild and Walshaw, 2011; Lemprière, 2016; Reid and Houston, 2013)⁴.

Achieving emissions reductions in new homes without large scale public subsidy was seen as relatively feasible, compared with existing homes and other emissions sources such as transport (Williams, 2012).

The 2016 target nonetheless involved significant challenges for the house building sector, as indicated by Osmani et al (2009) in one of the very few studies of this agenda with a policy evaluation focus. This study found the most significant barriers to be costs, housebuilders' lack of trust in the required renewable energy technologies and housebuilders' reluctance to change traditional practices. Prior studies suggest that house builders' conservatism is a longstanding issue (Ball, 1999; Barlow, 1999). Combined with high research and development costs and a lack of consumer drivers for LZC homes (Osmani and O'Reilly, 2009), this makes for a strong case for regulation as a driver of change (Sanstad and Howarth, 1994), as was widely accepted across the sector (Zero Carbon Hub, 2014).

Typifying EM, the UK LZC homes policy agenda used a mix of policy instruments. However, state-led, national, mandatory Building Regulations (Part L for energy), were emphasised as having a central role, to avoid the cost of house builders having to adapt their practices to different regulations across different localities (DCLG, 2008b). The regulatory roadmap towards 2016 consisted of a series of Part L updates in 2010, 2013 and 2016, each requiring increased levels of building fabric energy efficiency (FEE).

Government was explicitly committed to a performance-based regulatory approach, evident in the following statement:

“As well as being adaptable to changing circumstances, the policy needs to provide flexibility to meet known circumstances. Government's preferred approach is, as far as possible, to specify outcomes rather than ways of achieving those outcomes and to avoid prescribing

⁴ Barry et al (2004) discuss the centrality of EM discourses to New Labour environmental policy.

particular technologies. This should help to drive innovation by house builders and their supply chain, allowing industry to use its expertise to explore how to minimise costs, and is consistent with better regulation principles” (DCLG, 2008a).

However, questions arose about how exactly to define the 2016 ‘zero carbon’ outcome. One question was whether, in a zero carbon home, energy consumed from ‘unregulated’ sources like cooking and plug-in appliances (i.e. those not covered by Building Regulations) must be from a renewable source. Initially, it was decided to include these ‘unregulated’ emissions in the zero carbon definition. A further, pivotal question was whether such renewable energy for zero carbon homes must be generated from renewable sources on the site of the home (e.g. solar PV, biomass). After widespread debate (author 2012) it was eventually agreed that the zero carbon definition would include a minimum emissions reduction level achieved through on-site measures, which became known as the ‘carbon compliance’ level. All energy consumed above this minimum carbon compliance level could be offset through a range of off-site measures, including off-site renewables, or ‘allowable solutions’. Government intended to confirm details of the carbon compliance standard and allowable solutions scheme before 2016, as part of the mandatory zero carbon target.

Table 1: zero carbon pyramid

Defining the sought performance outcome for LZC homes also involves complex trade-offs between energy performance and other environmental, social and economic criteria, such as water efficiency, health impacts and costs. Especially given this complexity, there is wide recognition in the UK construction industry of the important role for non-mandatory, industry-defined standards, as highlighted by the ‘smart regulation’ approach. Such standards can potentially aid designers, fostering innovation beyond the regulatory minimum, responding to variation in regional markets and the business models and practices of different house builders. Notable examples include Buildings for Life and Secure by Design, covering areas

such as security and functionality, as well as sustainability and energy efficiency standards such as Passivhaus and AECB⁵ standards.

Reflecting an EM approach to governance, New Labour sought to work in partnership with industry. To address the need for higher, non-mandatory LZC home standards, the Government commissioned the firm BRE⁶ to define and maintain the Code for Sustainable Homes. The Code defined six sustainability levels for new homes (Level 6 being the highest), based on a detailed methodology for assessing each home on nine sets of criteria (including energy/ CO₂, water, materials and ecology). The Code became 'quasi mandatory,' being used to set mandatory national standards for social housing while also available as an option for local authorities and private developers setting standards for private market housing⁷. Some local authorities also established other kinds of policy. An influential initiative was the Merton rule, requiring that a percentage (usually 10%) of energy consumption be generated from on-site renewables in larger residential and commercial schemes. In 2008, as recommended by the Callcutt Review of Housing, the Government established Zero Carbon Hub, an independent organisation part-funded by industry, tasked with delivering the 2016 target. The Hub drew together numerous stakeholders (Schweber et al., 2015) through a series of projects. Addressing sometimes conflicting stakeholder interests, they achieved wide support for their policy recommendations for the zero carbon definition. In 2009, Government adopted their proposed FEE standard, a key element of the definition. Yet a complete definition was not finalised by New Labour. The uncertainty this entailed had significant impact on the policy debate (Osmani and O'Reilly, 2009) and continued to be an issue during the Coalition.

3b. The Coalition and deregulation

⁵ Published by the Association of Environmentally Conscious Builders.

⁶ Formerly the Government-run Building Research Establishment, now a private consultancy.

⁷ A recent report indicated that 48% of recent local plans had specific energy performance standards for buildings referring to the Code and/or BREEAM (TCPA, 2016).

Under the Conservative-led Coalition government (2010-15), a stronger emphasis on de-regulation subsumed the EM discourse evident in New Labour LZC homes policy. In response to uncertainty before the 2010 election, Shadow Housing Minister Grant Shapps had pledged to confirm the zero carbon definition “within weeks.” The Coalition maintained a formal commitment to the 2016 target throughout their term. However, a definition of the target was not forthcoming, with the government refraining from finalising the carbon compliance and allowable solutions elements. In the context of wide ranging public spending cuts, Government funding for the Zero Carbon Hub was withdrawn. The only key decision on the 2016 target was to remove unregulated emissions from the zero carbon definition. This brought the definition into line with the EPBD, with the effect of reducing the prospective scope of allowable solutions. There were delays to the 2013 Part L update, eventually introduced in April 2014, which set a lower minimum fabric efficiency standard than the two options presented in the Government’s consultation. These decisions were widely viewed as representing a ‘watering down’ of the zero carbon target⁸.

Yet, the Housing Standards Review, a key Coalition initiative following the Red Tape Challenge for the construction sector, had the arguably somewhat different aim of ‘streamlining’ the numerous national and local standards for housing. Five key areas were addressed: energy, water, security, space and accessibility. The focus was on the number of standards and their inter-relationships, rather than on their specific level. For energy, the key recommendation was to wind down the Code. Government did not confirm they would act upon this recommendation until March 2015, causing significant uncertainty about the future of local planning requirements during the interim period. The Coalition’s National Planning Policy Framework (NPPF) introduced in 2012 with the aim of streamlining planning policy, focused on ensuring ‘viability,’ reflecting 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

⁸ This point is further discussed in Section 4c.

standards, reflecting a debate about tensions between environmental policies and development that has been ongoing since the 1970s (Frieden, 1979). Shortly after the Conservatives won the 2015 election, they scrapped the 2016 zero carbon target. Also it was made significantly more challenging for local authorities to introduce Merton rule-type policies setting requirements for on-site renewables. The pending UK departure from the European Union will entail an end to the obligation for the UK to aspire to the EU nearly zero target and there may be no further upgrades to Part L as a substitute for this target in the coming years.

3c. Prior studies of the LZC homes agenda

Prior studies of the LZC homes agenda have applied contrasting disciplinary approaches, including sociological studies of the challenge of 'mainstreaming' niche eco-home developments (Smith, 2007), analyses of the framing of policy evidence (Schweber et al., 2015) and of policy implementation (Goodchild and Walshaw, 2011). Through contrasting approaches, prior research offers important insights for evaluating this policy agenda. Lempriere (2016) highlights the inevitably politically contested character of EM policy strategy. This reflects Hajer's more general point about EM that particular industry coalitions will vary in terms of gaining or losing from higher regulations (Hajer, 1993). After the launch of the agenda, developers often expressed concern about having to shoulder the cost of zero carbon homes, emphasising that investments in wider infrastructure such as 'decarbonising' the electricity grid or public transport would yield higher marginal gains (HBF, 2009). Yet, manufacturers of some construction products, such as insulation, along with housing developers specialising in the design of LZC homes, had vested interests as well as personal concern with progressing the LZC homes agenda (Lemprière, 2016).

In relation to the complexities of defining policies and standards, several studies suggest that a shortcoming of the LZC homes policy agenda is its focus on technological solutions with a

lack of attention to the broader social context that shapes the full ecological impacts of homes and their use by occupants (Gibbs and O'Neill, 2015; Reid and Houston, 2013). This social dimension of innovation includes building practices and skills, occupant behaviour and lifestyles. This echoes strong EM critiques of weak EM, providing cause for questioning how far sustainability goals are achievable through top down policy delivery alone (see Section 2a). Indeed New Labour environmental policy discourse in general has been described as reflecting 'weak EM' (Revell, 2005).

Prior work in engineering and housing studies has provided significant evaluative insights concerning the zero carbon definition, highlighting what Schweber et al (2015) observe is the contested nature of the concept. Key criticisms have been that the Code focuses too strongly on on-site renewables (Lowe and Oreszczyn, 2008), neglecting the embodied and lifecycle CO₂ footprint of these technologies (McLeod et al., 2012; McManus et al., 2010). With echoes of the enforcement challenges highlighted by 'smart' and 'responsive' regulation models, concerns about the levels of compliance with building regulations have also been raised (Fischer and Guy, 2009; Osmani and O'Reilly, 2009). Yet, as with the smart regulation literature generally, there is a lack of detailed evaluative studies of how, specifically, policies, standards and their inter-relationships are defined. Research on how this UK policy agenda evolved during the Coalition government is particularly lacking.

An international comparative study of policy for energy efficient buildings finds that a mix of mandatory regulations and voluntary tools, as advocated by the smart regulation model, are generally suitable for this sector (Shen et al., 2016). While mandatory regulations can potentially address market failures swiftly, they can suffer from poor responsiveness to change. Considerable resources are required to achieve a continuous, robust approach. Voluntary instruments can have an important role, by potentially offering flexibility and fostering public engagement with energy efficiency issues (Shen et al., 2016). Our study addresses this need to evaluate the definition and balance between mandatory and voluntary instruments.

4. Policy and standards for LZO homes under the Coalition government (2010-15): an evaluative study

4a. Scope and methods

Our evaluation of LZO homes policy draws from qualitative analysis of the perspectives of various types of stakeholder, including designers (architects and engineers), planners, contractors and surveyors. Where a significant degree of common ground can be identified between stakeholders' views about policy instruments' effectiveness in promoting particular goals, this can provide grounds for evaluative conclusions and recommendations (author 2012). We analyse the views of the following two stakeholder types:

- (i) *National stakeholders* involved in the national level debate about policy and standards⁹.
- (ii) *Local stakeholders* involved in the design and delivery of LZO homes locally, within three English cities: Brighton, Manchester and London Borough of Greenwich.

The three local authorities were selected because each stated strong commitment to delivering LZO homes and initiated a range of LZO home developments of varying sizes and home types¹⁰. Practitioners could therefore be expected to have significant experience of working to the higher sustainability standards we were evaluating. This selection also captures potentially different experiences between London, the North and Southern England. Stakeholders for each category were chosen to ensure that that contrasting

⁹ Note that some stakeholders in this category were themselves involved with the local delivery of projects.

¹⁰ Our analysis of their strategy documents and previous planning applications for these local authorities confirmed that they included a balance of private and social housing developments and home types (houses and apartments).

expertise and opinions of various stakeholder types were included¹¹ (detailed breakdown shown in Appendix 1).

Our semi-structured interviews were based on questions standardised for our national and local interviewees. Questions concerned how stakeholders viewed the challenges of delivering LZC homes and the strengths and weaknesses of specific mandatory and non-mandatory national and local policy instruments and their inter-relationships. These included Part L, zero carbon target, the Code and other voluntary tools and local policies of which interviewees had experience. Our focus is on energy standards, although we also consider sustainability issues more widely (notably in the Code) in so far as they inter-relate with energy. Our analysis of the interviews focuses upon identifying and comparing stakeholder views, including the extent of any common ground and identifying key cleavages in opinion. A supplementary review of policy documents and reports from Government and key stakeholders was undertaken. As explained below, we found a significant amount of agreement across the range of stakeholders on some key policy questions. Even where opinions were more divided, most notably on the withdrawal of the Code, the cleavage was not clearly aligned with particular types or backgrounds of stakeholder, though our analysis does indicate where possible the broad stakeholders categories expressing particular views. Presenting this analysis, Section 4b assesses challenges facing house builders in delivering LZC homes. Section 4c assesses Coalition policy strategy effectiveness in the face of these challenges.

4b. Challenges for the LZC homes agenda 2014-15

In contrast with the early years of the LZC homes agenda¹², costs were not the most frequently mentioned challenge of delivering LZC homes. The process of learning since the

¹¹ A set of housing developments in each of the three cities were selected and interviewees were contacted as practitioners involved with these projects. Further potential interviewees were then identified through a process of snowball sampling.

¹² See the discussion of research by Osmani et al (Osmani and O'Reilly, 2009) in Section 3a.

agenda was introduced in 2006 is often the subject of comment. Reaching Code level 4 through a high FEE standard without the need for renewables is now widely viewed as achievable¹³. Rather than costs, the main challenge is very widely viewed as addressing the 'performance gap' between how buildings are designed and as built performance. There is concern about the related issue of potential overheating in buildings with high levels of air tightness, hence the need for careful attention to building ventilation and orientation, given the potential negative impacts upon human health.

Stakeholders often suggest various ways in which government might more actively support industry towards achieving a transition to large-scale LZC homes delivery, addressing these problems of performance. Skills shortages across professions involved with housing are vitally important, from on-site construction workers, to architects and SAP assessors, to surveyors and valuers. Some of our local interviewees were especially pessimistic about the immediate prospects for addressing these skills challenges. A further factor concerns the performance of various LZC technologies, of which perceptions vary significantly. Some technologies such as solar PV are commonly viewed by designers and developers as having become established and more reliable since 2006, largely due to their widespread uptake in existing homes. However, local industry stakeholders expressed concern even about the performance and maintenance of PV. Other technologies are widely viewed as still emerging, with biomass and heat pumps often viewed as particularly problematic or uncertain¹⁴. With echoes of prior research highlighting the significance of the social dimension of technological innovation (see Section 3c), some of our local interviewees observed problems with incorrect use of technology by residents and those maintaining buildings, suggesting the need for a verification process, **an improved handover process for residents and performance monitoring.**

¹³ The AIMC4 project had a significant role in promoting the learning, through the development of robust technical and commercial solutions for large volume delivery.

¹⁴ This point is the subject of contrasting views. One interviewee commented on how early problems with air source heat pumps have now been largely addressed in more recent housing schemes.

Experts and practitioners emphasised the investment in research and development needed to support assessment tools for LZC homes, most notably the Standard Assessment Procedure (SAP) tool used to assess Part L compliance. Designers suggest that SAP both incorporates and allows to be entered unrealistic and inaccurate parameter values, concerning features such as ventilation and thermal bridging¹⁵. Furthermore, the static model underlying SAP is not designed to account for dynamic factors, such as thermal mass, heat gains, airflow, orientation and climatic factors, which have significant impacts, especially where high performance standards are sought. Leading design experts comment that there is often a tendency for designers to focus on Part L compliance or Code requirements as measured by the SAP tool, while neglecting this wider range of complex factors. Hence, in practice, building performance might not meet the sought energy efficiency standard and potential health impacts relating to air quality and overheating might not be adequately foreseen. Accredited Construction Details (ACDs) are a potential aid for designers to improve fabric efficiency performance, the development of which government could potentially facilitate. Our local interviews suggest there has been very little take up so far of the ACDs recently developed¹⁶.

A further challenge lies on the demand side. Consumer drivers for LZC homes are widely viewed as lacking, given the priority of other key criteria for homebuyers (e.g. schools, local amenities etc.) The consensus amongst our interviewees was that the zero carbon target and the Code had a primarily technical focus of internal interest to industry, which largely failed to foster interest and understanding amongst homebuyers. Several commented that even where energy efficiency and renewable energy technologies bring financial benefits of lower fuel bills or Feed-in-Tariff revenues, these features only command a price premium in niche markets. Marginal energy efficiency gains from recent Part L updates are in any case

¹⁵Several of our interviewees with design expertise expressed concern that some parameter values contained within the SAP, ranging from assumptions about climate to the assumed performance of specific technologies such as boilers and ventilation, are not sufficiently accurate.

¹⁶ ACDs have been developed by National House Building Council and Local Authority Building Control.

of much less significance to consumers than the key decision of whether to purchase a new or old home, given the markedly higher energy consumption that older, un-refurbished homes entail. A further factor weakening consumer drivers for sustainable homes is the well-known shortage of housing supply in much of England. Furthermore, the professional codes and associated training of surveyors and valuers do not require them to take into account energy efficiency savings when valuing new homes. Given the grounds for questioning whether cost savings can be sufficient as a driver, an alternative, or potentially supplementary approach emphasised by some experts is to communicate to consumers overall quality of life benefits including comfort, air quality and the use of good quality materials.

4c. Evaluating policy and standards for LZC homes 2014-15

Our findings provide significant support for Helm's emphasis on potential benefits of re-shaping markets through regulation. The Zero Carbon target and the Code are widely viewed by our participants as having promoted significant innovation and learning in construction. A very common theme stressed by interviewees was the importance of a clear, consistent national policy trajectory. Many of our national and local interviewees, including developers and designers, commented that uncertainty about future LZC homes policy hindered the development of working practices towards achieving higher FEE standards. Some national stakeholders also emphasised that this hindered developers in land price negotiations.

There was wide support from stakeholders for the policy approach of successive governments, including the Coalition, of emphasising Part L as the single FEE standard that should be the primary, mandatory driver towards LZC homes. This support was not only from developers who emphasise the economies of scale this can bring for delivering new homes across the country. As further explained below, a broad range of other stakeholders support 'fabric first' as a general principle, emphasising the need to reduce the energy required to heat a building as a priority before on-site LZC technology installation is

considered. A range of designers, sustainability consultants and some local authorities themselves are, at best, ambivalent, if not deeply sceptical, about local authorities having discretion to set local energy targets, such as for on-site renewables. This emphasis on the need for strong national policy reflects agreement that, unlike some sustainability issues, notably water scarcity and biodiversity, it is broadly agreed that the need for energy efficiency does not vary significantly across the country.

Reflecting general support for 'fabric first', there was broad agreement on the need to further strengthen the FEE standard within Part L. Several national stakeholders with design expertise, representing key parts of the housing and construction sector, expressed disappointment about the Part L 2013 update setting lower standards than suggested in the consultation. This was described candidly as "hopelessly unambitious", a "fudge" and "much less rigorous than signalled". The Hub's proposals for the FEE level within the 2016 target¹⁷ had gained much support, albeit with some designers who favour a Passivhaus approach advocating a higher standard. However, aside from this question of the exact level at which the standard is defined, a primary concern for many, as discussed in Section 4b, is the need to support industry in delivering the mandatory standard.

LZC homes policy reveals the need for close attention to the role and definitional characteristics of non-mandatory or discretionary standards that supplement national, mandatory regulations. We found further evidence, consistent with previous studies (see Section 3c), that a significant proportion of stakeholders have serious concerns about whether the Code effectively balances the various economic, environmental and social criteria requiring consideration. Yet, in principle, the need for a non-mandatory Code to supplement mandatory regulations as a driver of further innovation was widely accepted across the sector. Variation in housing markets, skill bases and supply chains, some emphasised, meant that there was an important potential role for local authorities, exercising discretion, to adopt standards above the national regulatory minimum. Consequently, the

¹⁷ See Section 3a above.

question of withdrawing the Code most divided opinion amongst our interviewees. This cleavage did not clearly align with their types of expertise or occupation. Various stakeholders emphasise that achieving Code certification involves significant administrative costs, although the Code provides a common industry language and **audit process** for addressing energy and sustainability that is widely viewed as having promoted learning and embedded change. Removal of the Code, some point out, can be justified as 'streamlining,' with energy and water efficiency building regulations having been strengthened.¹⁸ However, various experts expressed concern that, after the proposed withdrawal of the Code, policy will no longer cover other sustainability criteria, notably ecology and the sustainability of materials.

Reflecting wide support for 'fabric first,' often supplemented by a preference, especially amongst developers, for funding off-site CO₂ mitigation measures or 'allowable solutions,' stakeholders often challenge the Code approach of assigning points for installing on-site technologies and facilities within homes. The Code, particularly levels 5 and 6, they argue, encourages installations of facilities such as water recycling systems, cycle storage and home office space simply to 'tick the box,' without sufficient consideration of how technologies are used in practice, their costs, or even whether they are used at all. This point is emphasised not only by developers concerned about costs but also by designers and other industry experts strongly committed to high environmental standards. These criticisms often reflect more fundamental reservations that the LZC homes agenda was too focused on technology, with a need for a closer focus on the social dimension of technology installation and use, as critics of EM emphasise. Some stakeholders regret the absence of other social dimensions of sustainable development from the Code, such as public engagement, food growing, training, skills and apprenticeships, as well as criteria such as

¹⁸ The FEES level proposed by the Hub, which is viewed as broadly similar to Code Level 4 for energy, was set to be incorporated in the 2016 zero carbon target. The water standard in building regulations of 125 litres/ person/ day is a stronger standard than that proposed by the Environment Agency (2009).r,

transport accessibility and local amenities which had been included in BRE's previous Ecohomes standard¹⁹. Several interviewees, including developers and designers, expressed concern about the accountability of the process for maintaining the Code. Also in an interesting juxtaposition to the 'smart regulation' emphasis upon the flexibility and responsiveness of industry-defined voluntary tools, these stakeholders expressed regret at the lack of development of the Code. They queried whether BRE were using their revenues for this purpose, though this also reflected a lack of government funding.

The predominance of the Code amongst industry LZC home standards, due to its 'quasi mandatory' status, raises the question of which LZC home standards might replace it as a driver of higher standards beyond the regulatory minimum. The most widely recognised alternative is Passivhaus, based on a very highly regarded design approach and modelling tool PassiveHaus Planning Package (PHPP) for achieving comfortable, energy efficient homes. Yet, the suitability of Passivhaus as a mass-market housing standard is widely questioned. PHPP is demanding in terms of the skills required and the Passivhaus standard does not incorporate other sustainability criteria. The BRE's new standard, the Home Quality Mark (HQM), aims to foster consumer engagement through a focus on criteria such as health and well-being which LZC homes can potentially promote. However, restrictions on local authority powers to set standards as planning conditions and industry fatigue regarding codes and standards suggest that uptake of the HQM is likely to be very limited compared with the Code. As there is no one clear replacement for the Code, it seems that, somewhat paradoxically, the Housing Standards Review, with its goal of 'streamlining,' could lead to a variety of different voluntary standards being adopted across the country. There is a danger that this could create more confusion and uncertainty for industry of the kind the Review aimed to prevent.

¹⁹ The Ecohomes tool was superseded by the Code as the BRE tool for assessing the sustainability of homes.

Some interviewees suggested that local planning policies might cover the sustainability criteria previously only addressed by the Code. However, several industry stakeholders commented that local planning authorities lack the required expertise and resources to effectively deliver local LZC homes policies. Local authorities have frequently been criticised for setting high Code requirements or on-site renewables targets without having been in the position to assess fully their viability or feasibility²⁰. The need for local authorities to review their plans following the winding down of the Code and the requirement for viability testing entails additional costs that will further stretch their resources.²¹ Yet, local authority capacity and expertise, it is recognised, varies significantly. Some are pro-active, for example, Cambridge and Brighton have initiated their own sustainability checklists and tools. There remains significant scope for local authorities to support LZC housing developments even in the context of reduced discretion in the use of standards. They can have a key role in promoting infrastructure such as district heating networks, acting as client for housing projects on public land and promoting development of local construction skills²². However, wide support for national policy consistency suggests that this potential role of local authority discretion in promoting innovation is, like that of voluntary standards, best viewed as a supplement to strong, mandatory national regulations.

²⁰ 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)

²¹ 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. It is notable that the 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. Hence, the Environmental Audit Committee commented: “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” (H.M. Parliament, 2013).

²² For example, through the inclusion of apprenticeships as part of Section 102 agreements.

5. Discussion

This study of the LZC homes policy agenda finds wide agreement concerning the need for strong national regulations as a core driver of higher standards and innovation, especially in markets with weak consumer drivers, such as the English housing market.²³ Non-mandatory, industry-defined standards of the kind advocated by 'smart regulation' are widely viewed as having an important potential supplementary role in driving innovation and fostering consumer engagement, especially in those localities and markets most receptive to environmental sustainability concerns. Yet, there are mixed views about the effectiveness of the definition and balance between the mandatory and non-mandatory tools developed for the LZC homes agenda in England. Since their introduction by the Labour government in 2006, the zero carbon target and the most widely used non-mandatory standard, the Code for Sustainable Homes, were criticised by experts for their strong emphasis on on-site LZC and other technologies, which, it was argued, often lacked cost effectiveness and did not necessarily lead to more sustainable outcomes²⁴. Indeed, the policy agenda in general, including both building regulations and the Code, was criticised for focusing on the technological specification of design standards to the relative neglect of the challenges of how LZC homes perform in practice²⁵. Standards, critics argued, should focus more strongly

²³ The widespread view that consumer drivers are weak is supported by primary evidence gathered by NHBC (2012). Energy Performance Certificates (EPCs) had been introduced in 2004 with the aim of informing homebuyers about the energy efficiency of buildings. However, implementation weaknesses meant they had relatively little impact in fostering consumer drivers (Watts et al., 2011). 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, 2012).

²⁴ These criticisms had been made in the early years of the Code (name, 2012). 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). Prior studies cited above also refer to the technology focus of the Code e.g. Lowe and Oreszczyn (2008), Reid and Houston (2012).

²⁵ These challenges were brought to prominence across industry by the work of the Zero Carbon Hub (Zero Carbon Hub, 2014, 2015).

on 'fabric first' and consider the broad range of home occupant behaviours and practices that shape energy efficiency outcomes and demand²⁶.

The deregulation agenda introduced in this context by the Conservative-led Coalition government from 2010, although expressly concerned with avoiding unforeseen negative consequences of regulation, is widely viewed as having, in some key respects, exacerbated the challenges for industry in delivering LZC homes. There is significant concern in housing and related sectors that the Coalition had not established a sufficiently strong, clear trajectory for national, mandatory regulations as a core driver of high performing LZC new homes.²⁷ The Code had a key role in promoting innovation and driving down costs²⁸.

Important parts of building regulations, including on energy, were strengthened, catching up with the Code, hence creating some duplication and scope for 'streamlining' standards, a key, stated aim of the deregulation agenda. However, the proposed winding down of the Code raised concerns about some important sustainability criteria being lost from policy and the lack of a well-established, alternative non-mandatory standard that developers and local authorities might adopt to promote future innovation beyond the regulatory minimum.

Deregulation was combined with a reduction in the support that many in industry felt they needed to promote research and skills development across the range of professions²⁹ and local planning authorities involved in delivering LZC homes.

²⁶ The Local Housing Delivery Group (Local Housing Delivery Group, 2012) provide a similar critique of other parts of the Code, commenting that "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/ CO2 requirement of the Code for Sustainable Homes". Grant (2008) provided a similar, earlier critique of the water sections of the Code.

²⁷ This finding mirrors that of Morgan et al (2015) and was evident in the 2013-14 Consultation on the zero carbon definition (DCLG, 2014).

²⁸ This view, widely held amongst our interviewees, reflects prior detailed studies of costs which highlight significant falls since 2006 in costs, notably for photovoltaic panels and key elements of improving fabric energy performance (Zero Carbon Hub and Sweett group, 2014). This is reflected in significant falls in the cost of achieving Code levels 5 and 6 (in the region of 40-50%), compared with Part L (Element Energy, 2013).

²⁹ Our interview findings highlight the importance of professional codes and training for surveyors and valuers, supporting the prior findings of Heffernan et al (2015).

6. Conclusion and policy implications

Addressing the need for research evaluating policy mixes in the face of complex policy challenges, this study of the LZC homes agenda in England finds significant supportive evidence for a blend of mandatory and non-mandatory tools of the kind broadly advocated by 'smart regulation.' Yet, while the smart regulation approach reflects some welcome advancements upon traditional 'command and control' regulation, there is a danger of it ceding too much to the market liberal critique of state-led regulation. Although smart regulation does include a continued regulatory role for the state, our study suggests that this is under-stated, especially in the context of markets such as housing in England where consumer drivers towards higher environmental standards are weak. There is a much discussed need for government to more actively support industry in developing the tools and skills required in housing and related sectors. Smart regulation highlights the need and scope for public-private collaboration in defining regulations and standards. Yet the literature lacks detailed attention to the challenges of aligning the substantive definitions of mandatory and non-mandatory standards with the outcomes sought and the most appropriate scale of governance for different policies to be specified and adopted. In this study, the marked differences between the roadmaps to zero carbon offered by proposed changes to mandatory regulations and the Code as an industry-led non-mandatory tool, compounded by uncertainty about the future trajectory and role of these tools, meant that industry stakeholders widely felt that the required, clear regulatory trajectory towards LZC homes was lacking. **The notion of 'smartness' needs to accommodate a continued role for state steering as a central feature of governance for promoting leading edge innovation, the delivery of and consumer engagement with the potential benefits of higher environmental standards.**

Appendix 1: Interviewee information

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7. References

- Ayres, I., Braithwaite, J., 1992. *Responsive regulation : transcending the deregulation debate*, New ed. ed. Oxford University Press, New York ; Oxford.
- Baba, A., Mahdjoubi, L., Olomolaiye, P., Booth, C., 2012. Insights of architects' knowledge of the Code for Sustainable Homes (CSH) in relation to low carbon housing design and delivery in the UK. *Structural Survey* 30, 443-459.
- Baldwin, R., Black, J., 2008. Really Responsive Regulation. *The Modern Law Review* 71, 59-94.
- Ball, M., 1999. Chasing a Snail: Innovation and Housebuilding Firms' Strategies. *Housing Studies* 14, 9-22.
- Barlow, J., 1999. From Craft Production to Mass Customisation. *Innovation Requirements for the UK Housebuilding Industry. Housing Studies* 14, 23-42.
- Barry, J., Paterson, M., 2004. Globalisation, Ecological Modernisation and New Labour. *Political Studies* 52, 767-784.
- Black, J., 2012. *Calling Regulators to Account: Challenges, Capacities and Prospects*. London School of Economics Working Papers, London.
- Christoff, P., 2000. Ecological modernisation, ecological modernities, in: Young, S. (Ed.), *The Emergence of Ecological Modernisation: Integrating the Environment and the Economy?* Routledge, London, pp. 209-232.
- DCLG, 2008a. *Definition of Zero Carbon Homes and Non-Domestic Buildings - Consultation*. H.M. Government, London.
- DCLG, 2008b. *Definition of Zero Carbon Homes, Impact Assessment* HM Government, London.
- DCLG, 2014. *Next steps to zero carbon homes – Allowable Solutions: Government response and summary of responses to the consultation*, in: Government, D.f.C.a.L. (Ed.). H.M. Government, London.
- Dodds, A., 2006. The Core Executive's Approach to Regulation: From 'Better Regulation' to 'Risk-Tolerant Deregulation'. *Social Policy & Administration* 40, 526-542.
- Dryzek, J., 1987. *Rational ecology : the political economy of environmental choice*. Basil Blackwell, Oxford.
- Element Energy, 2013. *Costs of building to the Code for Sustainable Homes - final report*.
- Enevoldsen, M., 2005. *The theory of environmental agreements and taxes : CO₂ policy performance in comparative perspective*. E. Elgar, Northampton, MA.
- Environment Agency, 2009. *Water resources in England and Wales - current state and future pressures*.
- European Union, 2010. *DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings (recast)*, Brussels.
- Fischer, J., Guy, S., 2009. Re-interpreting Regulations: Architects as Intermediaries for Low-carbon Buildings. *Urban Studies* 46, 2577-2594.
- Frieden, B.J., 1979. *The environmental protection hustle*. M.I.T. Press, Cambridge, Mass. ; London.

Gibbs, D., O'Neill, K., 2015. Building a green economy? Sustainability transitions in the UK building sector. *Geoforum* 59, 133-141.

Goodchild, B., Walshaw, A., 2011. Towards Zero Carbon Homes in England? From Inception to Partial Implementation. *Housing Studies* 26, 933-949.

Grant, N., 2008. A Critique of the CSH Water Efficiency Requirements Good Homes Alliance.

Gunningham, N., Grabosky, P., Sinclair, D., 1998. *Smart Regulation: Designing Environmental Policy*. Oxford University Press, Oxford.

H.M. Parliament, 2013. Code for Sustainable Homes and the Housing Standards Review - Environmental Audit Committee. H.M. Parliament, London.

Hajer, M., 1993. *The Politics of Environmental Discourse : a Study of the Acid Rain Controversy in Great Britain and the Netherlands*. . Oxford University Press, Oxford.

Hampton, P., 2006. Reducing administrative burdens : the consumer and tradinf standards agency. summary of responses to the consultation. DTI, London.

HBF, 2009. Consultation response: Definition of zero carbon homes and non-domestic buildings, London.

Heffernan, E., Pan, W., Liang, X., de Wilde, P., 2015. Zero carbon homes: Perceptions from the UK construction industry. *Energy Policy* 79, 23-36.

Helm, D., 2006. Regulatory Reform, Capture, and the Regulatory Burden. *Oxford Review of Economic Policy* 22, 169-185.

Jansen, A.-I., Osland, O., Hanf, K., 1998. Environmental challenges and institutional changes. An interpretation of the development of environmental policy in Western Europe., in: Jansen, A.-I., Hanf, K. (Eds.), *Governance and Environment in Western Europe: Politics, Policy and Administration*. Addison Wesley Longman, New York.

Jordan, A., Wurzel, R.K.W., Zito, A.R., 2013. Still the century of 'new' environmental policy instruments? Exploring patterns of innovation and continuity. *Environmental Politics* 22, 155-173.

Lemprière, M., 2016. Using ecological modernisation theory to account for the evolution of the zero-carbon homes agenda in England. *Environmental Politics* 25, 690-708.

Local Housing Delivery Group, 2012. *A Review of Local Standards for the Delivery of New Homes*, London.

Lowe, R., Oreszczyn, T., 2008. Regulatory standards and barriers to improved performance for housing. *Energy Policy* 36, 4475-4481.

McLeod, R.S., Hopfe, C.J., Rezgui, Y., 2012. An investigation into recent proposals for a revised definition of zero carbon homes in the UK. *Energy Policy* 46, 25-35.

McManus, A., Gaterell, M.R., Coates, L.E., 2010. The potential of the Code for Sustainable Homes to deliver genuine 'sustainable energy' in the UK social housing sector. *Energy Policy* 38, 2013-2019.

Morgan, J., Bowles, G., Leishman, C., Williams, C., Peacock, A., Sosenko, F., 2015. *Building Sustainable Homes*. Joseph Rowntree Foundation, York.

NHBC, 2012. *Today's attitudes to low and zero carbon homes: views of occupiers, house builders and housing associations*. NHBC Foundation, Milton Keynes.

O'Neill, J., Spash, C., 2000. Conceptions of value in environmental decision-making. *Environmental Values* 9, 521-536.

Osmani, M., O'Reilly, A., 2009. Feasibility of zero carbon homes in England by 2016: A house builder's perspective. *Building and Environment* 44, 1917-1924.

Parker, D., 2002. Economic Regulation: a review of issues. *Annals of Public and Cooperative Economics* 73, 493-519.

Radaelli, C.M., Meuwese, A.C.M., 2009. BETTER REGULATION IN EUROPE: BETWEEN PUBLIC MANAGEMENT AND REGULATORY REFORM. *Public Administration* 87, 639-654.

Reid, L.A., Houston, D., 2012. Low Carbon Housing: A 'Green' Wolf in Sheep's Clothing? *Housing Studies* 28, 1-9.

Reid, L.A., Houston, D., 2013. Low Carbon Housing: A 'Green' Wolf in Sheep's Clothing? *Housing Studies* 28, 1-9.

Revell, A., 2005. Ecological modernization in the UK: rhetoric or reality? *European Environment* 15, 344-361.

Sanstad, A.H., Howarth, R.B., 1994. 'Normal' markets, market imperfections and energy efficiency. *Energy Policy* 22, 811-818.

Schweber, L., Lees, T., Torriti, J., 2015. Framing evidence: policy design for the zero-carbon home. *Building Research & Information* 43, 420-434.

Shen, L., He, B., Jiao, L., Song, X., Zhang, X., 2016. Research on the development of main policy instruments for improving building energy-efficiency. *Journal of Cleaner Production* 112, Part 2, 1789-1803.

Slaughter, J., 2013. Housing Standards Review Consultation - Response Form. HBF, London.

Smith, A., 2007. Translating Sustainabilities between Green Niches and Socio-Technical Regimes. *Technology Analysis & Strategic Management* 19, 427 - 450.

Taylor, C., Pollard, S., Rocks, S., Angus, A., 2012. Selecting Policy Instruments for Better Environmental Regulation: a Critique and Future Research Agenda. *Environmental Policy and Governance* 22, 268-292.

TCPA, 2016. A Crisis of Place: Are We Delivering Sustainable Development through Local Plans? Town and Country Planning Association, London.

Tombs, S., 2016. Making better regulation, making regulation better? *Policy Studies* 37, 332-349.

Watts, C., Jentsch, M.F., James, P.A., 2011. Evaluation of domestic Energy Performance Certificates in use. *Building Services Engineering Research and Technology* 32, 361-376.

Williams, J., 2012. Zero-carbon homes : a road-map. EarthScan, Abingdon.

Zero Carbon Hub, 2014. Closing the gap between design and as-built performance: end of term report, London.

Zero Carbon Hub, 2015. Overheating in homes: the big picture, London.

Zero Carbon Hub, Sweett group, 2014. Cost analysis: meeting the zero carbon standard, London.