The challenge of policy coordination for sustainable sociotechnical transitions: the case of the zero-carbon homes agenda in England

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This is an electronic final author-formatted version of an article published in Environment and Planning C: Government and Policy 30 (1). pp. 162-179, 2012.

The definitive version is available online at:

http://dx.doi.org/10.1068/c1146

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July 2011

This paper is forthcoming in *Environment and Planning C: Government and Policy* (2012)

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Abstract

Emerging in recent research on socio-technical transitions towards a low carbon economy is the question of the extent to which such transitions require centralised, intentional coordination by government. Drawing from F.A.Hayek's conceptualisation of coordination, this paper evaluates the effectiveness of policy for low and zero carbon homes in England. A detailed analysis is presented of how policy makers address complex choices and trade-offs, as well as significant uncertainty. Particular attention is given to those policy decisions which are widely agreed by stakeholders to cause distortive effects. The focus here on the impacts of policy definition and delivery in terms of multiple evaluative criteria can complement and enrich the more process-orientated cross-sector and multi-level analyses that predominate in existing research on policy coordination. Furthermore, the coordination problems identified yield further insights into the actual and potential effectiveness of policy processes in shaping complex socio-technical transitions.

Contents

1. Introduction

Research on socio-technical transitions in general, including the growing literature on transitions to a low carbon economy (Elzen et al., 2004), offers important insights into how technological innovations are shaped by their wider social, economic and political contexts. In this literature, states are understood to have a potentially coordinative role in facilitating transitions (Kemp et al., 2007). An emerging question is the extent to which such coordination needs to involve centralised, intentional decision-making and planning (Smith et al., 2005; Walker and Shove, 2007, p. 1492). 'Transition management' theorists emphasise the need for coordination at the national, as well as regional and local levels (Kemp et al., 2007; Rotmans et al., 1999). Yet their understanding of coordination has been criticised as being 'teleological' in character, not capturing the plurality of different ways in which transition goals might be achieved (Berkhout et al., 2004).

This paper focuses upon this emerging issue of the effectiveness of governance and policy in facilitating coordination during processes of transition in the face of complexity and uncertainty. This issue is explored through a case study of the U.K. zero carbon homes agenda in England. The analytical approach applied here draws particularly from F.A. Hayek's conceptualisation of coordination problems as essentially epistemological in character. It is argued that Hayek's work formulates important questions about the capacity of governments to address problems of coordination, a closer focus on which can complement and enrich current approaches in transitions research. By applying this approach, several effects of policy for low and zero carbon homes are identified which are widely agreed to be 'distortive.' However, the conclusion drawn is that, contrary to the Hayekian thesis, there are

strong grounds for supposing that the cause of these problems are institution-specific and that there is significant scope for political and policy processes to address the coordinative challenges involved in the governance of transitions towards sustainable development.

The analytical approach applied here for evaluating the effectiveness of policy, as further explained in section 2 below, includes detailed analysis of stakeholder framings of policy and its impacts. The case study is introduced in Section 3, with the detailed findings, including several examples of problems of policy coordination, being presented in section 4. Section 5 briefly sets out insights yielded by this research into some of the causes of these problems.

2. The Problem of Coordination

The transitions literature is primarily concerned with understanding the range of social factors that shape processes of innovation. There is a particular interest in understanding the interactions between innovation across the three different 'levels' defined by Rip and Kemp (1998) in their multi-level model as: (i) socio-technical 'regimes,' (consisting of production practices embedded in particular institutions and infrastructures), (ii) the 'landscape' within which these regimes emerge (structural trends such as cultural norms and socio-economic developments) and (iii) technological 'niches' (defined as micro level spaces). The literature also includes reflection on how to facilitate coordination in the governance of transitions. There is a focus on the approach of transition management theorists who developed the multi-level model and whose proposals have been adopted by the Dutch government. On their view, it is the role of government to facilitate the development of "guiding visions" containing the long-term objectives for a transition and the formulation of interim objectives for moving towards achieving this. Another key element of the approach is 'strategic niche management' (Kemp et al., 1998), in which governments provide some initial protection for

emerging ‘niche’ technologies to enable them to be tested and become established to some degree.

Transition management theorists highlight the complexity and uncertainty involved in defining and achieving transition objectives and emphasise the importance of drawing from the perspectives of a wide variety of actors. Yet the approach has been criticised for having a teleological character (p.53), underestimating the plurality of ways in which transitions can be achieved (Berkhout et al., 2004). This critique also highlights the uncertainty and difficulties involved in establishing the viability and desirability of these visions. Rather than being dominated by rational action, it is suggested that transitions involve technological choices which are inevitably value-laden and hence open to political contestation. This, it is suggested creates problems for such attempts at steering transitions (Berkhout et al., 2004, pp. 57-59).

The concepts of policy “integration” and coordination have been a more explicit subject of inquiry in some research on governance for sustainable development (Jordan and Lenschow, 2010; Lafferty and Hovden, 2003). This research agenda is, in significant part, a response to the stated EU commitment to ‘Environmental Policy Integration’ (EPI). The focus is primarily on ‘vertical’ integration (the implementation of policy objectives across different tiers of responsibility within a particular policy sector) and ‘horizontal’ forms integration (the extent to which a cross-sectoral policy strategy has been developed (e.g. Lafferty and Hovden, 2003). Discussions of the concept of EPI refer to the early definition of Underdal (1980) for whom EPI entails a need to consider a comprehensive range of potential policy outcomes. However, the focus of research has been on process-orientated criteria for assessing horizontal and vertical coordination (e.g. Jordan and Schout, 2006; Lenschow, 2002; Nilsson and Persson, 2003). There is much less of a focus on the substantive impacts of

policy decisions in terms of the various evaluative criteria requiring consideration, as is the focus here.

Although widely known, the Hayekian thesis, and indeed the Austrian tradition in political economy from which it emerged, receives relatively little attention in the literature on governance for sustainable development in general and socio-technical transitions in particular[1]. Hayek conceptualises the problem of coordination as an essentially epistemological one of ensuring that individuals are able to act on the basis of information about the technical and economic possibilities open to them, whilst taking into account the preferences and actions of others (Kirzner, 2000, p. 136). Hayek emphasises that markets facilitate coordination in this sense through a decentralised process involving continual innovation.[2] His work anticipates recent debates about transitions management, including a critique of centralised, instrumentalist approaches to planning. There is even a sense in which, by emphasising that choices between technologies are shaped by socially-determined perceptions, norms and purposes and involve significant uncertainty, his work anticipates the recent postpositivist turn in the social sciences (this author, 2010). He stresses the inextricable connection between the plurality of individual purposes, norms, or 'ends' and the most suitable technological means for achieving those ends. These choices are, therefore, essentially 'economic' in character (Hayek, 1948, pp. 77-86; 121-123). Again reflecting the Austrian economics tradition, he recognises that the different ends motivating individuals are not reducible to monetary measurement (Hayek, 1944, p. 69). Hence Hayek can be taken to understand 'economic' choices in a broader sense that can incorporate non-monetary values and criteria (this author 2006). Economic complexity, for Hayek, is also shaped by the variegated, spatially dispersed and subjective character of knowledge concerning complex

[1] A contribution to the debate by John Meadowcroft is a significant exception (Meadowcroft, 1999)
[2] Hayek's thesis is developed through his debates with socialists on economic calculation (Hayek, 1948) and further elaborated in his subsequent famous works (Hayek, 1944; Hayek, 1960; Hayek, 1982a).

economic choices and trade-offs (Hayek, 1948, p. 77). Economic knowledge is also emphasised to be characterised by continual change, being shaped by ongoing processes of innovation in technologies and consumer goods (Hayek, 1935; Hayek, 1949, p. 82).

Markets are, Hayek argues, an indispensable mechanism for facilitating coordination in the face of complexity because they perform two closely related, yet conceptually distinct, coordinative functions (this author 2007b). Firstly, the prices generated by markets *encapsulate*, in a simple numerical form, highly complex, indispensable information about demand and supply in the economy (See Hayek, 1982b, pp. 116-118). This information, he notes, is often locally situated and can be difficult to formally define. Hence, he argues, the decentralised, distributed nature of markets means that they are especially well suited to capturing this. Prices also serve as a guide enabling producers and consumers to *discover* new economic knowledge in the face of continually changing economic circumstances and associated uncertainty (Hayek, 1978). Hayek acknowledges that markets do not reach optimal outcomes (Hayek, 1948, p. 101). His point is that they are able to fulfil coordinative functions in a way that cannot be achieved by centralised planning.

Hayek's critique of government planning is directed not only to non-market central planning systems such as that of Soviet Russia but also to social democratic proposals for a mixed economy in which governments seek to intervene in markets in order to secure particular economic outcomes. Hayek's objection to such proposals is that government intervention will inevitably fail to capture important information about the productive potential and impacts of different technologies, especially when considered in terms of the 'ends' of different individuals and groups across society. Hence, from a Hayekian perspective, the problems of 'unintended consequences,' which have since been the subject of much discussion in policy analysis, are an inevitable result of such a mixed model of political economy (Hayek, 1944, p. 31).

Yet, even Hayekian proposals for market-based solutions to externality problems such as environmental pollution and degradation, as forwarded more recently by 'free market environmentalists,' entail a significant role for the state in defining the scope of markets. Defining property rights in a way that is conducive to ecological protection involves complex political choices, especially in the face of issues of such a profound scale and cross-cutting character as climate change (Meadowcroft, 1999); this author, 2007). Hence, the question that emerges from reflection on the Hayekian pro-market thesis is the same as has emerged in the transitions literature: what should be the nature and scope of the role of the state in facilitating coordination?

Hayek's work has been criticised for neglecting the significant potential of the political sphere to address problems of coordination (Gamble, 1996; Meadowcroft, 1999). Non-market forms of coordination are possible, such as through dialogue amongst policy-makers and the insights provided by various kinds of experts (this author 2010). Assessment methods designed to take into account non-monetary criteria (this author 2008), some of which are measured by social and bio-physical indices, also perform a coordinative function by encapsulating complex information. Nonetheless, Hayek's work raises the interesting question of the capacity of non-market, political processes to fulfil the dual coordinative functions of knowledge encapsulation and discovery (this author 2010; 2011).

Of course, the potential epistemological problems which Hayek particularly emphasises, are not the only ones facing the political sphere in seeking to facilitate transitions towards more sustainable forms of development. A further challenge is to create the incentives for policy actors which encourage a coordinated approach. And not all problems arising in the political sphere can be understood as problems of coordination, as there might be significant, perhaps irreconcilable, differences between the values of stakeholders. In the case of low and zero carbon housing, for example, the priorities of an environmental organisation such as WWF

can be expected to differ markedly from those of most housing developers. Nonetheless, as the Hayekian perspective suggests, the process of forming goals and assessing and discovering concrete means of translating them into practice are closely intertwined. Hence, analysis of coordination problems as conceptualised by Hayek offers the promise of yielding new kinds of insights into the nature and scope of the plurality of normative ends across society.

Such an analytical focus demands careful attention to the substantive content of policy and its impacts, as well as the process-orientated focus of existing literature on socio-technical transitions and policy integration. Here, the effectiveness of policy in facilitating coordination is assessed through a comparative analysis of how different stakeholders frame the issue. The starting point for the analysis, following the recent 'postpostivist' turn in science and technology studies, is a recognition of the contestable, often normatively-laden character of these 'framings.' As Smith and Stirling (2007) argue in their discussion of low carbon transitions, such a starting point does not in itself exclude the possibility of evaluating these perspectives. They allude to the possibility of a reflexive awareness of multiple perspectives being combined with an "objectification" or "fixing" of knowledge concerning socio-technical systems (Smith and Stirling, 2007, pp. 369-370). Such a process can be taken, as it will here, to provide a degree of objectivity on which to base such evaluative analysis.

In the analysis below, policy decisions are considered to have given rise to coordination problems if, according to the views of a significant proportion of stakeholders: (i) they have failed to capture significant information about 'economic' dimensions of complexity (understood in the broad sense introduced above that incorporates non-monetary criteria) and (ii) as a result, policy does not effectively reflect overall policy priorities as stated by leading policy-makers. In other words, to borrow a phrase from economists, they consider policy to have a 'distortive' effect on the decisions of practitioners. In order to ensure that such

distortive effects are captured by the research, the analysis undertaken includes a detailed focus on how stakeholder framings understand and address the potentially complex economic dimensions of choice involved in the transition to a low carbon economy. Identifying these 'distortive effects' will enable subsequent reflection on their causes and exploration of the Hayekian thesis that problems of coordination are an inevitable outcome of governmental intervention in the market.

3. Introducing a case study of policy for low and zero carbon homes

In December 2006 the U.K. Labour government established the ambitious, 'world leading' target (ARUP, 2009) for England that, by 2016, all newly built homes will be 'zero carbon.'[3] This was an important example of government seeking to substantively shape market outcomes in the face of profound market externality problems, particularly that of climate change. Yet the Labour government also emphasised that this ambition would be addressed in a way consistent with maintaining economic competitiveness (DCLG, 2006, p. 32). The 2016 target represented a significant policy shift, with the under-ambitious character of previous policy having been the subject of comment in previous research (Lovell, 2007; Raman and Shove, 2000; Smith, 2007). Sustainable homes in England had previously taken the form of 'niche' developments (Smith, 2007). As ministers now recognised, achieving the 2016 target entailed a need for these niche developments to inform the 'mainstreaming' of the delivery of sustainable homes.

The previous research in the social sciences referred to above highlights the contested, technologically complex character of this policy issue. There is particular emphasis on the importance of the social purposes and locational contexts for the use of technology in

[3] Note also that the 2016 zero carbon target is applicable only to England owing to devolution of power to Northern Ireland, Scotland and Wales and it is beyond the scope of this study to cover the policies adopted by these three devolved regions.

understanding and evaluating processes of technological innovation (Lovell, 2004; Shove, 1993; Smith, 2007). The significance of these factors, these authors argue, has been under-estimated by government. The value-laden, often politicised nature of technological choices is emphasised (Lovell, 2007, p. 2505; Raman and Shove, 2000). However, the question of the effectiveness of policy for facilitating the transition sought in the house building industry is only briefly touched upon (e.g.Lovell, 2004, p. 43; Smith, 2007, p. 439). Some more recent research by economists and engineers does provide useful insights into the views of stakeholders about the zero carbon homes agenda (McManus et al., 2010; Osmani and O'Reilly, 2009). However, while this research highlights some key criticisms of current policy, the question of the lessons to be drawn from these criticisms for the design of governance and policy is not addressed.

There are a range of different types of policy and assessment tool which might be used to facilitate the transition to zero carbon, including a carbon tax or emissions trading. However, CO2 emissions are just one of multiple criteria that require consideration in designing sustainable homes. Several of these, such as conserving scarce natural resources, biodiversity protection and aesthetic appearance, take the form of market externalities. Given this multi-faceted nature of the policy problem, it can be questioned whether a single policy such as a carbon tax can, on its own be the solution. Indeed, in the case of a carbon tax, there are significant problems of implementation and enforcement, as well as the political challenge of gaining acceptance for the policy (Johansson, 2006; Victor, 2004, p. 86). Hence there is a need to evaluate regulatory strategies of the kind being developed by U.K. government, as a potential part of the solution.

The analysis here considers how a wide cross-section of stakeholders frame this area of regulatory policy, including: central government, particularly the Departments of Communities and Local Government (CLG) and Energy and Climate Change (DECC); non-

governmental organisations, notably WWF who have an active interest in this policy area; industry groups, e.g. U.K. Green Building Council (UKGBC), Sustainable Building Association (AECB), Good Homes Alliance (GHA) and private sector firms, including architects, engineers and sustainability consultancies. The sources for this research have been a wide range of policy documents and reports produced by stakeholders, professional and trade journals, supplemented by 38 semi-structured interviews conducted between March 2009 and October 2010. The research focuses on the development of policy under Labour between December 2006 and the May 2010 election, with nine of the interviews being conducted after this period, between June and October 2010. The focus of the interviews was on identifying stakeholder views about the strengths and weaknesses of policy, including where they thought policy was having distortive effects.

Policy background

The UK government policy for the transition to low and zero carbon homes in the new build sector is widely agreed to have galvanised the building industry, encouraging the development of new technologies. However, since it was introduced in 2006 and subsequently developed, policy has been the subject of some significant, widespread criticism from practitioners. Many argue that current policy inhibits, rather than facilitates, their efforts to take what they consider to be the most sustainable design decisions. This has prompted much debate across the industry. With stakeholders on all sides of this debate showing a strong commitment to tackling climate change, it is evident that their framings of policy goals are crucially shaped by their views about the contested means for achieving them.

The focus here is on policy for reducing CO2 emissions in new domestic buildings. Hence the focus is on reforms to the Energy section (Part L) of the building regulations and the related matter of the 'zero carbon' definition. The research has also extended to cover reforms to the Standard Assessment Procedure (SAP), which is the methodology for

assessing the energy performance of domestic buildings as required for the building regulations. Also analysed are the energy and water sections of the Code for Sustainable Homes, a non-mandatory assessment tool launched just after the announcement of the 2016 target, which assesses homes in terms of nine different categories of sustainability criteria. Homes are ranked according to one of six levels, each of which includes minimum energy and water efficiency standards. Many local planning authorities have used powers they were granted by Government to set target Code levels for social housing.

The process through which the policy framework for sustainable housing has been developed is in several ways characteristic of the shift to 'governance,' much discussed in political science (Stoker, 1998). Various types of stakeholder organisation, including industry groups, quasi and non-governmental organisations, offer insights for government officials and ministers into the implications of different policy measures. These industry experts and representatives take part in a range of advisory groups organised by the Department for Communities and Local Government (DCLG), advising on the reforms of building regulations, the definition of zero carbon and the development of the Code. The Code and SAP, a tool for assessing the energy efficiency of new homes, have been developed and managed, under the direction of DCLG, by the now private company BRE, formerly the Government-funded research body known as the Building Research Establishment (BRE).

In Part L of the building regulations, calculation of the minimum energy efficiency for a particular building, known as the 'target emissions rate' (TER), is based on the performance of a hypothetical 'notional' building of the same size and shape as the building being assessed. Part L requires that the estimated performance of the actual building, known as the Dwelling Emissions Rate (DER), is no higher than the TER. Both the TER and DER are calculated using the SAP model, which includes a number of assumptions about variables such as the climate, performance of particular building and energy technologies and the

number of occupants per dwelling. Because of this approach in Part L of measuring building energy efficiency relative to a target, the zero carbon target was also defined in relative terms, as a reduction in CO2 emissions relative to the 2006 TER used as a benchmark. The requirement was for net carbon emissions in the home over a year to be zero (DCLG, 2007a, p. 9), meaning that all energy used should be compensated for by the generation of energy from renewable sources. In addition to energy uses covered by the building regulations (heating etc), it was agreed, following the DCLG consultation on zero carbon, that energy use caused by cooking and appliances (referred to as 'unregulated emissions') would be included in this calculation, which made the zero carbon target an especially ambitious one.

As part of the requirements for achieving zero carbon, as depicted in the zero carbon pyramid (see Figure 1 below), the Government proposed that minimum standards would be set for both the energy efficiency of the building and the proportion of the zero carbon target to be met by renewable energy sources situated on the site of the building itself (or connected by a private wire). Emissions reductions beyond this carbon compliance standard, as represented by the top layer of the pyramid, could be achieved through a range of 'allowable solutions', including 'off site' measures. Examples of such allowable solutions, as outlined in the zero carbon consultation, include the use of, or investment in, renewable energy technologies which are not on-site, such as large scale wind or tidal energy sources, community heating, or the installation of energy efficient appliances and advanced energy control systems for buildings that encourage energy efficiency.

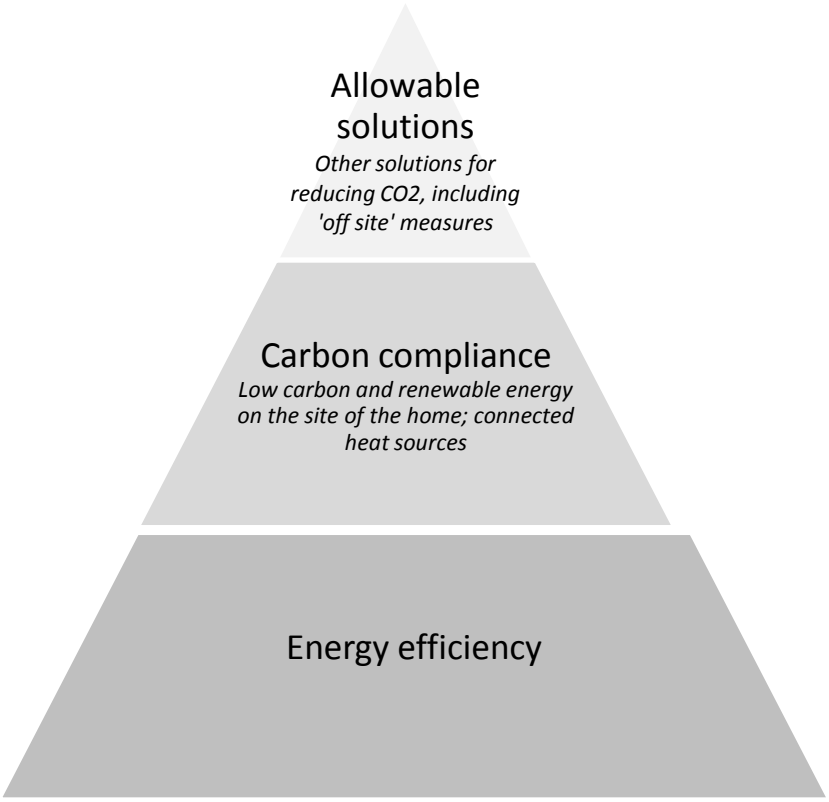

Figure 1: Defining zero carbon

In order to indicate the trajectory and timescale of changes to the building regulations, the government defined two intermediate steps towards achieving zero carbon. The three stages defined correspond to minimum energy efficiency standards for achieving Code for Sustainable Homes Levels Three, Four and Six respectively.

Table 1: Towards the zero carbon target

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

4. Coordination problems and the zero carbon agenda

The Government's original definition of 'zero carbon' was a very general one leaving open several questions which became the subject of significant debate across the building industry. As discussed below, there were some specific issues where stakeholders disagreed with the policy approach of Government. Unless stated otherwise, the views of stakeholders reported below are drawn from the interviews undertaken and seminars attended for this project.

Stakeholder views about the zero carbon agenda point to areas where greater horizontal and vertical coordination are needed. Regarding 'vertical integration' and policy implementation, concerns were expressed about the need for more support and training for building control officers responsible for ensuring compliance with Part L, as well as training for construction workers to address the 'skills gap' which has been highlighted in relation to the challenge of delivering sustainable buildings (Royal Academy of Engineering, 2010).

The views of stakeholders also provide significant cause for questioning whether sufficient 'horizontal coordination' between the policy for new homes and other related policy sectors has been achieved. These concerned two different types of horizontal coordination. The first was whether policies in different policy sectors were implemented in a mutually consistent way. For example, some housing developers interviewed complained that they had been refused planning permission for the installation of on-site technologies such as solar thermal and photovoltaic panels. They had expected permission in these cases to be granted, given that such technologies were in their view of key importance for enabling them to meet renewable targets set by the local planning authority, including target Code levels, as well as being of integral importance for achieving carbon compliance standards within the zero carbon definition.

Secondly, stakeholders frequently questioned whether objectives in each policy sector appropriately reflected the overall Government objectives of encouraging a transition to a low carbon economy in a way that maintains economic competitiveness. For example, a frequently made point during Labour's third term was that, in contrast with the high ambition of the 2016 target, the need to tackle CO2 emissions of the existing housing stock had been relatively neglected. It was often argued that there was a need to redress this balance because energy efficiency measures for the existing stock were a more cost effective way of achieving emissions reductions than the installation of on-site technologies. Equivalent arguments were also made about the potential CO2 savings that could be achieved by strategies for encouraging more sustainable patterns of consumer behaviour in sectors such as food and transport.[4]

[4] This perspective is evident, for example, in the 'One Planet Living' approach of the developer Bioregional Quintain (Desai and King, 2006).

However, a further set of concerns arose that do not all fall straightforwardly into categories of 'horizontal' or 'vertical' coordination between different levels or tiers of decision-making. As further discussed below, these concerns were about the way in which policies seek to achieve a balance between different evaluative criteria *within* as well as between particular areas of policy.

Defining zero carbon

The views of stakeholders suggest that several decisions concerning the definition of zero carbon have had distortive effects. Firstly, many stakeholders disagreed with decisions made concerning the chosen level for the first two layers of the zero carbon pyramid, especially relating to the carbon compliance level. This was a matter of considerable debate and sometimes controversy across the housing industry.[5] Secondly, problems have arisen concerning whether to vary these standards for different types of dwelling. Thirdly, some stakeholders considered the way CO2 emissions of dwellings were measured as having further distortive effects. As is now discussed in more detail, the arguments expressed in these debates reflect different perspectives regarding the course on which to steer the market in order to achieve targets for reducing greenhouse gas emissions. These opinions reflect different views about the potential performance of different low and zero carbon energy and building technologies, often in the face of significant uncertainty, and how to balance emissions reductions targets with other sustainability criteria.

[5] Note that discussions about the definition of the top layer of the zero carbon pyramid, known as 'allowable solutions,' are not discussed here as no decision had been reached on this matter by May 2010.

Specifying minimum standards for zero carbon

The level of carbon compliance

The subject of the most widespread controversy across the industry was the question of the minimum level of on-site renewables for new homes, or the 'carbon compliance' level as it came to be referred to. This issue was first addressed by Government in early 2007 when the Treasury (2007) published a zero carbon definition for the purposes of giving tax relief to zero carbon homes. This Treasury definition stipulated that only on-site renewables, or off-site renewable solutions connected to the development by a private wire, would count towards achieving zero carbon. This equated to a carbon compliance level of '100% on site,' as advocated at the time by some key stakeholders including leading representatives of the U.K. Green Building Council, WWF and the architect Bill Dunster who designed the well-known BedZed eco-housing development in Surrey, Southern England. These stakeholders emphasised the need for a tough regulatory standard to encourage innovation in on-site technologies.

The goal of encouraging innovation needed to be balanced with feasibility and here different judgments were made about potential innovation in on-site renewables. As a previous government report had acknowledged (DCLG, 2007), generating all of the energy required in a home from such 'on-site' renewables involves significant difficulties and costs, especially on sites such as urban infill where the space required for installing these technologies is often lacking. Interviewees with close involvement in the policy process explained that the '100% on site' definition was questioned and criticised by some industry advisers to Government before it was adopted by Housing Minister Yvette Cooper. They emphasised that off-site measures tend to be more cost-effective and suggested that a requirement for '100% on site'

would distort the choices of designers, steering industry away from the most promising technological paths for reducing emissions. As a 2008 U.K. Green Building Council report showed, this was a view that most house builders shared (UKGBC, 2008b, p. 31).

The UKGBC report provided evidence that 80% of sites could not achieve '100% on-site' zero carbon because of the costs and practical difficulties of on-site renewables, particularly on small developments. As a result, the UKGBC departed from their previous position which supported 100% on-site. Their report concluded that "non private wire, near-site solutions" should count alongside on-site renewables towards achieving carbon compliance (UKGBC, 2008a, p. 31). In December 2008, the government then launched a public consultation on the definition of zero carbon. Responses to the consultation were broadly favourable to the idea of including "allowable solutions" within the zero carbon definition. Only 11% of respondents supported a requirement of carbon compliance achieving 100% of CO2 emissions reductions, with 43% of respondents favouring a 44% target and 46% favouring 70% (UKGBC, 2008b, p. 11).

Following this consultation, in July 2009, the Government proposed that the carbon compliance level be set at 70% of regulated energy use. Yet debate on the issue continued. Some practitioners with a role in policy discussions emphasised the lack of an evidence base to inform this policy decision. Developers and some consultants argued that 70%, in their experience, was still too challenging as a minimum standard on many sites, where off-site measures are more feasible and cost effective. Furthermore, this revision to the zero carbon target raised a further issue of coordination with the Code, given that Code Levels Five and Six continued to include a requirement for 100% carbon compliance[6]. The Code had originally been established as a tool that would anticipate and inform future regulatory

[6] Code level Five requires 100% reduction in regulated emissions, while level Six requires 100% reduction in both regulated and unregulated emissions.

standards. Some stakeholders therefore questioned whether a requirement for 100% on-site remained appropriate or desirable, given that there was now no prospect of this becoming incorporated into building regulations.

The minimum energy efficiency standard

The issue of balancing feasibility and innovation in the face of uncertainty also arose in debates about the fabric energy efficiency standard (FEES), the first layer of the zero carbon pyramid. To encourage innovation in building fabric products and design, the Hub working group on FEES sought to set the standard at a challenging level yet in a way that could be achieved by a variety of different technical solutions.[7] One contested issue within the working group was whether FEES should be set so that to achieve the required level of air tightness would require installation of mechanical ventilation and heat recovery (MVHR) systems to provide sufficient ventilation. Negotiation on this issue, in the words of one interviewee, involved a "compromise" between advocates on the one hand of a tougher FEES standard and those who were sceptical about MVHR technologies and prefer natural ventilation. Advocates of a tougher standard included AECB who draw inspiration from the Passivhaus approach to building design, which originated in Germany and emphasises the importance of maximising the energy efficiency of the building fabric as a cornerstone for achieving CO2 emissions reductions. MVHR is a standard feature of Passivhaus buildings. By contrast, representatives of house builders within the task group highlighted what they saw as the dangers of a requirement to install MVHR. The home buying public, they argued, would not adequately understand such a system. As a result, they might not use the system properly, for example leaving windows open which interferes with the working of MVHR and can lead to a net increase in energy use in the home.

[7] Their report refers to their goal of striking this balance (Zero Carbon Hub, 2009, p. 11).

Measuring progress towards zero carbon

A further issue that needed to be addressed by the Zero Carbon Hub working groups was whether to switch away from the current approach of measuring performance relative to the 2006 Part L benchmark and to adopt an absolute measure of energy use. Some organisations with a close involvement in the policy process, such as the GHA and AECB, had long advocated a switch to the absolute approach. With the relative approach, they argued, it was more difficult for designers to keep track of the actual emissions of the building. With the focus being on achieving a specific TER as measured by SAP, there was, in their view, a danger of designers losing sight of actual building performance measured in terms of actual energy use. Where the SAP model was inaccurate, the relative approach was prone to creating distortive effects. An important case in point was the discovery that significant heat loss can occur through a 'party wall' (a wall which divides two adjacent dwellings) (Lowe et al., 2007). SAP 2005 had assumed party wall heat loss to be zero. The significance of this issue meant that, if the 2006 building regulations minimum standard were to continue to be used as a benchmark for specifying emissions reductions in subsequent part L updates, it would have to be adjusted to take account of this issue. This, in turn, would compound the problem of understanding the standards, which were already viewed as being difficult to interpret.

The general preference amongst experts for an absolute approach was reflected in the recommendation of the Zero Carbon Hub that FEES be expressed in terms of an absolute metric (Zero Carbon Hub, 2009). By this stage, Government had experienced the considerable problems involved in accommodating the discovery of the party wall issue within the current Part L framework and decided to adopt the Hub's recommendation. Some stakeholders felt that this switch to an absolute approach was long overdue. Yet it was suggested that the decision had not been taken sooner due to Government not wanting to be

seen to have changed direction. One civil servant interviewed highlighted the perceived difficulties that would have been involved in changing course, at an earlier stage, arguing that a switch to the absolute approach at the time the Code was introduced would have been a major change that could have caused the government to "lose" industry at a time when it was vital to gain their support for the transition to low and zero carbon housing.

Varying emissions by dwelling type?

A 'flat' or 'aggregate' approach?

A further issue involved in specifying minimum standards for new homes concerns whether or not these could vary by dwelling type. The objective of this 2010 update to achieve 25% CO2 emissions reductions led to the question of whether to treat the 25% emissions reductions target for 2010 as an 'aggregate' target, allowing the TER to vary by dwelling type, or whether to set a 'flat' 25% target for all dwelling types (DCLG, 2009). A decision was made to adopt the flat approach, even though the aggregate approach was favoured by a significant majority of advisers to government. The aggregate approach, they argued, promised a more cost effective approach to reducing emissions, given that the costs of improving the energy efficiency of different types of dwelling can vary significantly. For example, the marginal cost of reducing the emissions from a large, detached house will tend to be lower than for an apartment in a large block where there is much less exposed wall area where efficiency improvements could be made. The 'flat' approach, they pointed out, could therefore distort the choice of dwelling types that are built, creating an incentive to build detached houses rather than apartment blocks, even though apartments are an inherently more energy efficient form.

In defence of his decision, the Housing Minister John Healey, interviewees for this project explained, argued that the flat approach would be more easily comprehensible for industry.

Government support for the flat approach appears to have influenced opinion amongst respondents to the consultation on the 2010 revisions to Part L, as a small majority favoured the flat approach. However, in response to this government view, expert advisers to Government argued that the additional complexity of the varying TER in the aggregate approach could be hidden from designers because it could automatically be calculated for them in design software. This argument did not sway the minister, whose decision was a significant cause of frustration to these advisors. With the Government having adopted the aggregate approach for non-domestic buildings, these critics also emphasised the need for more consistency in the zero carbon definition for domestic and non-domestic buildings, especially given that mixed use developments were becoming increasingly common.

Defining the target for 'off gas' dwellings.

It is more expensive for homes without access to the gas grid to achieve CO2 emissions reductions. A decision was therefore made to relax (i.e. increase) the TER for properties with electric heating, through the introduction of a 'fuel factor' in Part L. This made it easier for them to achieve their target than it would otherwise be, although still more difficult than for dwellings with gas heating. A consequence of this was that, given that calculations for the energy section of the Code are also based on the DER/ TER methodology, dwellings that *do* have access to the gas grid find it easier to achieve Code level 3 or 4 using electric rather than gas heating. Currently, the carbon intensity of the electric heating is higher than for gas and consequently it is possible for Code Three and Four homes to have higher CO2 emissions than homes not achieving this standard (May and Warm, 2008). (This became known as the 'Code Four loophole'). One motivation behind this adjustment to the fuel factor for the Code was to provide some protection for the manufacturers of electric heating systems, an important industry within the UK. However, the loophole is widely viewed as an anomaly by stakeholders, undermining the key policy objective of encouraging lower emissions.

Assessing the climate change impact of fuels

Manufacturers of products and systems using electricity, such as electric heat pumps, mechanical ventilation systems and air-conditioning units were also influential in the choice of methodology for the calculation of the 'emissions factors' in SAP which are intended to express the CO2 emissions caused by different fuels. This was another decision that required judgement about the future potential for technologies to achieve emissions reductions. For, as well as taking into account available data about direct and indirect emissions involved in the production and consumption of different fuels, the methodology includes a forecast of the likely carbon intensity of fuels in the coming five years.

In discussions about whether to update this methodology for the 2009 version of SAP, these lobbyists argued strongly that the methodology chosen would need to take account of the potential for a future 'greening of the grid,' through the increased use of low carbon sources of energy such as renewable technologies. However, as some interviewees point out, this goal of decarbonisation had been a longstanding one and with only limited progress having been made so far there are grounds for scepticism about how soon it will be achieved.

The emissions factors for all fuels shown in the 2009 consultation were based on a revised version of the methodology used for SAP 2005 (Pout, 2009). This revised 2009 version took other greenhouse gases into account, such as nitrous oxide and methane, measured as CO2 equivalents and incorporated a more consistent approach to calculating emissions, including 'indirect' emissions.[8] Using this 2009 methodology, the emissions factor for electricity was calculated to be 0.591kgCO2/kWh, compared with 0.422 kgCO2/kWh using SAP 2005. The main reason for this difference was that, since 2005, an increased proportion of electricity had

[8] A brief outline of the previous methodology is provided in (Pout, 2005)

been generated by burning coal due to an increase in the price of gas. A secondary factor was that a rapid decarbonisation of the grid projected in 2005 did not materialise.

A majority of respondents to the SAP 2009 consultation expressed their support for the proposed 2009 revisions (BRE, 2009). However, electric heating industry interests were concerned that the increased emissions factor for electricity could potentially mean that electrical products would be significantly less attractive for designers in terms of their calculated CO2 emissions.[9] Given that DECC's Chief Scientists encourage heat pump technology (MacKay, 2009), it is assumed that DECC would be concerned about the impact on heat pumps of higher carbon factors for electricity. This seems to have been the case as the DECC website indicates that the 2005 methodology has been used to inform SAP 2009 (DECC, 2010).[10]

Interactions between climate change mitigation and other sustainability criteria

The analysis so far has concentrated on the distortive effects of the balance struck by policy between different ways of reducing CO2 emissions. However, stakeholders also expressed some significant concerns about how policy had addressed trade-offs between emissions reductions and other sustainability objectives. Again, these are not straightforwardly matters of horizontal coordination because they relate to trade-offs within specific policy sectors.

This case study has not sought to give a complete analysis of these interactions between various sustainability criteria for housing. To give an illustrative case in point, the treatment of the inter-relationship between water and energy efficiency in the Code for Sustainable Homes has been the subject of considerable discussion. The Code provides credits for the

[9] The TER and DER methodology within Part L, which allows for variation in the fuel factor for electricity over time, meant that the impact of the higher emissions factor, from the point of view of achieving compliance with the building regulations, is nullified (Hughes, 2009). This could change, however, if there was a move away from the notional building approach to measuring energy efficiency towards an absolute approach.
[10] The factor for electricity in SAP 2009 is given as 0.517 kgCO2/kWh (BRE, 2010)

installation of grey water and rainwater recycling systems. However, a number of experts have argued that the energy cost of these systems can be higher than mains water (Grant, 2008). Their opinion has received support from an Environment Agency report which found that most water recycling systems currently on the market entail higher energy use than mains water (Environment Agency, 2010). Stakeholders often emphasise that, in localities where there is no water scarcity, saving energy should take priority over water efficiency and in this respect the Code is having a 'distortive effect'.

As well as depending on scientific findings, such as those of the Environment Agency, establishing whether policy impacts are 'distortive' can also depend on the acceptability of technologies and their use by home occupants. Here, again, the effectiveness of water saving technologies and appliances is an important case in point. The Code also provides credits for the installation of water efficient appliances such as low flow taps and showers. However, some buyers of homes, particularly those of Code Level Three and above, have been reported as dissatisfied some of these appliances, replacing these appliances with much less efficient ones, such as 'power showers' (Watters, 2010). Information about such post-occupancy behaviour is not captured by Code assessments which only take place at the time of purchase.

Reflections on the effectiveness of policy in the face of complexity

While stakeholders might take different views about the urgency and scale of the CO2 emissions reductions required, much of the frustration about policy felt by many of them focuses on the various kinds of coordination problem discussed here. One interviewee criticised how policy is "not linking together different, complex trade-offs." Another called for a fundamental reassessment of policy, echoing the calls across the industry for a more "holistic" approach. A third commented on the lack of integration between what is described as a "disparate" array of different policies.

Practitioners will of course typically have to comply with regulations, even where they view them as an obstacle to developing the designs they consider to be most sustainable. Some stakeholders regretfully comment that the design process can become a "tick box" exercise, particularly in achieving higher Code levels but potentially also in working to Part L requirements as they become increasingly stringent. By this they mean that a focus on achieving regulatory and Code requirements at the minimum cost can be at the expense of using professional judgement to consider the potential and actual impacts of their designs. Having said this, some stakeholders welcome the use of indicators such as those within the Code, as a way of encouraging designers to consider a wide range of sustainability criteria. Views about such indicators will of course depend on their perceived effectiveness in capturing progress towards the sustainability outcomes that are generally agreed to be sought, e.g. actual reductions in water and energy consumption. This is an issue which can involve both significant technical complexity as well as uncertainty about how technologies will be used by home occupants in practice. In this context, some stakeholders, such as AECB and the GHA express scepticism about the potential effectiveness of attempts to define targets. They instead favour a set of minimum energy and water standards and the AECB have developed their own set of such standards, which seek to be less prescriptive than the Code about the particular technologies and appliances that designers are required to install. Their standards assess building performance in absolute terms and are intended to avoid assumptions about occupant behaviour, as made by the Code water calculator (AECB, 2009) and the unintended consequences which these organisations see as arising from a target-based approach. The presence and use of non-mandatory assessment tools can of course influence policy development and the fact that AECB and PassivHaus standards already used an absolute measure of energy use could only have strengthened the case for adopting this approach for FEES.

5. Inevitable distortion?

As argued above, Hayek's formulation of the coordination problem as essentially epistemological provides a useful analytical focus for research on governance and policy. However, identification of the distortive effects arising from coordination problems does not in itself support the Hayekian thesis that such effects are an inevitable result of governmental interventions in complex modern economies. It is beyond the scope of this paper to reflect in detail on the relative significance of the various causes of the problems with policy discussed here. However, we can note that the views of many stakeholders do suggest the significance of some causes which are specific to the U.K. institutional context within which these policies were developed. These include the following:

- The lack of a strong evidence base on the performance of low and zero carbon technologies to support the design and delivery of policy.

- The informal nature of the processes through which assessment tools such as SAP are updated and the limited scope of the information made publically available by BRE on which these updates are based. A couple of interviewees commented wryly that by far the most effective way of achieving a required change to SAP is to phone Brian Anderson, the head of the SAP team at BRE.

- Some experts and industry representatives have reported favourably on how their views are listened to and appreciated by civil servants in both briefing and committee meetings. However, others felt that, on occasions, their concerns about policy impacts were "brushed aside" by civil servants. It was suggested that this was sometimes due to these officials lacking technical knowledge of the policy area, or lacking the incentive to report the issues to ministers.

- The policy decisions discussed above were each ultimately made at ministerial level. Several interviewees suggested that ministers lacked technical understanding, some commenting on this problem being exacerbated by the relatively short term nature of ministerial appointments (there were five Labour housing ministers from December 2006). [11] As examples of ministers not responding appropriately to expert advice, interviewees with a direct involvement in the policy process referred to two key decisions: firstly, Yvette Cooper's 2007 decision to define zero carbon as 100% on-site and John Healey's 2010 decision to adopt the aggregate approach for Part L (see Section 3 above).

- Participants from industry on policy committees generally valued their opportunity to help shape policy. However, some commented that the discussion, particularly on policy strategy committees, involved a great deal of "lobbying" for particular industry interests, which could hinder attempts to make balanced assessments of evidence and its implications for policy. Participants in the Zero Carbon Hub working group meetings, which had an independent chair and on which Government only sat as observers, welcomed this as a different type of forum. They commented on how the wide range of parties involved had a shared interest in reaching a compromise set of recommendations as a way of making it less likely that Government will impose their own solution. Indeed the recommendations reached by the Hub on FEES reflected the widely held preferences for the standard to be measured in terms of absolute energy use and to vary according to the dwelling type.

[11] This issue is also highlighted by previous research by Government on the policy process. See (Cabinet Office, 1999, p. Section 4.2)

6. Conclusion

Previous research on transitions towards a low carbon economy alludes to the problem of policy coordination facing governance systems but there is a need for an analytical approach giving a more explicit, detailed consideration of this challenge. As highlighted by the Hayekian thesis discussed here, the problem of policy coordination involves ensuring that the definition of policy reflects the balance of macro-level objectives being sought. Balance is required not just between policy sectors and tiers of responsibility (as highlighted by notions of horizontal and vertical integration) but also within specific policy areas where different sustainability criteria need to be balanced.

This problem of the coordination of transitions involves complex trade-offs and choices, which are characterised by subjective judgment and significant uncertainty. Yet, although a quantitative survey of opinion has not been conducted here, this research suggests significant agreement about some key policy decisions having had distortive effects. The identification of such effects here, through a focus on the substantive content and perceived impacts of policy, prompts the further question of the causal factors which explain how these problems arose. In the case of the zero carbon agenda, industry experts and advisers to Government have played a significant role in highlighting key dimensions of coordinative challenges yet these have not, in the examples discussed here, been captured by policy, or at least not captured as quickly as some stakeholders think they might have been. This suggests a greater potential for the state to adopt a coordinative role in facilitating transitions through a regulatory strategy in the face of complexity than the Hayekian pro-market thesis posits.

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