Discourse and innovation journeys: the case of low energy housing in the UK

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Abstract

The paper examines the role of discourse in innovation journeys, using the example of low energy housing in the UK. Discourse is shown to be influential within innovation journeys in two main ways: first, discourse unites often disparate people involved in innovation, and thereby gives structure and direction to the innovation journey; second, discourse has the power to retrospectively 'reframe' the course of an innovation journey, leaving out inconsistent parts and ignoring twists and turns, so past innovation journeys are in effect reconstructed in the present. This discursive remapping of innovation journeys has implications for current and future pathways of innovation. Further, there is a two-way relationship between discourse and technology development. It is discussed how pioneering low energy housing developments have themselves become a significant part of low carbon housing discourse, acting as powerful 'storylines'.

Keywords

Discourse coalitions; innovation journeys; low energy housing; climate change; framing; storylines

Introduction

The main objective of the paper is to assess the key processes, mechanisms and patterns in an innovation journey from a discourse analysis perspective, using the case of low energy housing in the UK. Discourse analysis incorporates a large literature (see Dryzek 1997; Sharp and Richardson 2001 for an overview), and for this reason the paper focuses on two key discursive processes within the UK low energy housing innovation journey: first, the emergence of a network of actors united by language about climate change, a low carbon housing discourse coalition (Hajer 1995); and second, the framing and reframing of innovations as solutions to different policy problems (Laws and Rein 2003; Rein and Schon 1993). It is shown how discourse is particularly important during the developmental stage of an innovation journey because once prototypes have been built and innovations are in the public arena and have a visible material presence, it becomes possible for organisations not involved in the initiation stage of an innovation journey to try to claim ownership of the innovation through discursively reframing it to meet their objectives.

The role of discourse in innovation journeys has not been examined in detail, which is surprising because the notion of an innovation journey concerns ideas, people and relationships, thereby has significant overlap with discourse analysis, which concentrates on similar themes (Dryzek 1997; Flyvbjerg 1998; Hastings 1999; Rydin 1999; Sharp and Richardson 2001). An innovation journey is defined by Van de Ven

et. al. as "new *ideas* that are developed and implemented to achieve desired *outcomes* by *people* who engage in *transactions* (relationships) with others in changing institutional and organizational *contexts*" (1999: 6, emphasis in original). It is argued here that the politics and power struggles highlighted through a focus on discourse are integral to the innovation process, and deserve more attention. Discourse both constrains and enables innovations, in particular through its role in simplifying the messiness of innovation journeys.

An objective of the paper is therefore to broaden van de Ven's original approach to innovation journeys, which focused on corporations and discrete products (Van De Ven et al. 1999), in order to consider the influence of broader policy and political factors on sustainable innovation journeys. In other words, the author seeks to expand the notion of an innovation journey beyond a specific technology to consider a broader pathway of socio-technical change, comprising a complex mix of technologies, policies, organisations and discourse. The empirical focus of the paper is on the changing policy and socio-technical context within which a diverse group of technical and administrative low energy housing innovations developed in the UK from the 1970s to 2006-07, including photovoltaic panels, solar design, insulation, wind turbines, micro-CHP plants, self build housing, and new models of planning and designing housing. It is not the author's intention to examine in detail the journey of each specific innovation. Rather, analysis concentrates on the influence of discourse on low energy housing innovations as a whole, as well as the effect of the low energy housing innovations themselves on discourse and policy. The paper explores how low energy housing innovations were initially developed and trialled in the UK within the sustainable housing movement during the 1970s. Sustainable housing - originally designed to meet a number of broadly defined environmental and social objectives - became reframed more narrowly as 'low carbon housing' by a loosely associated group of policy actors – a discourse coalition – in the late 1990s as climate change rose up the UK policy agenda. This process of low carbon reframing has significantly remapped the historical innovation journey, and this has had a bearing on the contemporary pathway of low energy housing technologies.

The analysis is based on a combination of interview and documentary evidence collated through a UK Economic and Social Research Council (ESRC) funded doctorate (2001-2005), and Postdoctoral Fellowship (2005-07). Approximately fifty in-depth semi-structured interviews were conducted with a range of people involved in sustainable housing, climate change policy and low carbon technology innovation in the UK. Organisations interviewed included local and national government, sustainable housing groups, consultancies, Registered Social Landlords, non-governmental organisations, regional government agencies, architects, renewable energy firms, and private sector house builders. The interviews were transcribed and

coded in order to identify key discourses. In addition, documentary evidence was compiled and analysed from a range of sources including government policy documents, housing and energy industry trade magazines, and the national press.

The paper is structured as follows. First, the role of discourse in innovation journeys is assessed, and theories about discourse coalitions and discursive framing are introduced. Second, the UK low energy housing innovation journey is explored using a discourse analysis approach, from its early origins in the sustainable housing movement of the 1970s, to the later dominance of a low carbon housing discourse coalition centred on the problem of climate change. It is discussed how the low carbon discourse coalition has used ecologically modern discourse to promote the benefits of low energy housing. Ecological modernisation is the idea that there is no conflict between economic growth and protecting the environment because 'smart' green technologies can fulfil both objectives (Mol and Spaargaren 2000; Murphy 2000; Young 2000). The metaphors or 'storylines' (after Hajer 1995) used by the low carbon discourse coalition to help explain and define their work hence have a strong technology focus. In conclusion, the author reflects on the strengths and limitations of discourse analysis to the innovation journey concept.

The relationship between discourse and innovation journeys

As mentioned, discourse has not been explored in the context of innovation journeys (see Van De Ven et al. 1999), so the key objective here is to highlight in what ways it might be relevant. It is argued that discourse is important in innovation journeys for two main reasons. First, it unites disparate actors involved in innovation, and thereby gives coherence to otherwise loosely co-ordinated, messy pathways of change: discourse gives structure to the innovation journey. Second, and related, discourse has the power to retrospectively change the course of innovation journeys; to 'reframe' the journey, simplifying it, reshaping or forgetting its origins, and ignoring twists and turns. As is shown to be the case with low energy housing, this retrospective remapping of past innovation journeys can affect the contemporary trajectory of innovations. These ideas are discussed with reference to two political science theories about discourse: discourse coalitions, and discursive framing.

There is a long tradition in political science of theorising policy change as driven by networks of actors – termed policy networks – mixed groups of people involved in the policy process from government, corporations, the media and non-governmental organisations (Marsh and Rhodes 1992; Sabatier 1999). Policy networks are an important influence on the direction and pace of innovation journeys because it is through these networks that decisions are made on issues such as the regulatory environment, grant funding and consumer markets for new innovations; factors all

identified as critical to innovation journeys (Van De Ven et al. 1999). The policy network literature is large, and it is not my intention to discuss it in full here. Rather, I wish to concentrate on one particular type of policy network – the discourse coalition – and illustrate how discourse coalitions give structure to the messiness of innovation journeys.

Members of discourse coalitions do not necessarily share the same values, rather they are driven by a variety of different aims and beliefs, and united instead by their shared use of language (Hajer 1995). The 'glue' that binds these actors is discourse – the way they talk about an issue and the metaphors or 'storylines' that they use. Storylines are defined as "*the essential discursive cement* that creates communicative networks among actors with different or at best overlapping perceptions and understandings. " (ibid. 1995: 63, emphasis added). Discourse coalitions are loose, fluid networks and it is storylines that facilitate understanding between network members who do not otherwise have much in common.

Discourse coalition theory was originally developed in relation to public policy debates, rather than private sector innovation (Flyvbjerg 1998; Sharp and Richardson 2001). There are hence some limitations in translating the concept to innovation journeys. But, the concept of a discourse coalition was always designed to embrace a wide range of actors – including the private sector and non-governmental actors – not just government (Bulkeley 2000; Hajer 1995; Owens and Cowell 2002). It is a broader, more inclusive concept than an industrial lobby, for example, and therefore more appropriate to the empirical case of low energy housing. In this paper it is shown how the innovation journey of low energy housing has been closely connected with government and public policy as climate change has risen up the UK policy agenda, so the public policy origins of discourse coalition theory has relevance.

Discursive framing concerns how new ideas are presented, and in particular how problems and solutions are simplified in order to make them understandable and amenable to debate, it is defined as: "... a way of selecting, organising, interpreting and *making sense of a complex reality* to provide guideposts for knowing, analysing, persuading and acting." (Rein and Schon 1993: 146, emphasis added), or "a particular way of representing knowledge, and … the reliance on *schemas that bound and order a chaotic situation,* facilitate interpretation and provide a guide for doing and acting' (Laws and Rein 2003: 173, emphasis added). Discursive frames are hence a critical influence on innovation journeys because of their role in neatening and simplifying individual innovation pathways, retrospectively making it appear that there only ever was one predefined journey, when in reality there were multiple often overlapping innovation trajectories (Van De Ven et al. 1999). Framing sets the boundaries around

an issue, or technology, and allows ownership of it by certain actors. It is thereby closely connected to the concept of a discourse coalition. There has been extensive academic debate about the relationship between discourse coalitions, frames and storylines, which is not appropriate to enter in detail here (see Rein and Schon 1993). For this analysis I assume that framing is technique used by discourse coalitions to help define their boundaries of activity and lend coherence to their message. For example, it is discussed below how the low carbon housing discourse coalition draws on an ecologically modern discursive frame.

Framing is usually discussed in terms of framing an emerging situation or issue as a problem, as follows:

"A frame is a perspective from which an amorphous, ill-defined, *problematic situation* can be made sense of and acted on."

(Rein and Schon 1993: 146, emphasis added);

However, framing of *solutions* can also occur, and this is what happened with UK sustainable housing: existing technologies were retrospectively framed as a solution to new policy problems that emerged during the course of the innovation journey, most notably climate change. This type of reframing occurs most readily when an innovation is disseminated within the public domain – i.e. once it has a material presence - and thus is recognised and adopted by different organisations.

In sum, considering ideas about discourse coalitions and discursive framing and reframing helps us to better recognise and acknowledge the non-linearity or 'messiness' of innovation journeys. Discourse acts to filter out and simplify seemingly irrelevant issues, technologies and ideas in order to create an effective, understandable message, thereby simplifying innovation journeys retrospectively. Analysts of innovation journeys must therefore play close attention to how discourse operates, especially to reinstating some of the complex dynamics of innovation journeys; a task turned to below.

The UK low energy housing innovation journey

This section is structured as follows. First, the origins of the low energy housing innovation journey in the 1970s are discussed, and a period of policy flux during the late 1990s is explored when policy makers became interested in sustainable housing as a solution to a number of persistent policy problems. Second, the process of 'low

carbon' reframing of existing low energy housing innovations is assessed: the low carbon discourse coalition is described, and it is shown how the coalition has simplified and remapped the past innovation journey of low energy housing through use of ecologically modern discourse. 'Storylines' used by the discourse coalition about innovative housing developments – in particular two UK developments called BedZed and Hockerton - are critically assessed. These technology-based storylines have helped inspire further innovation and action, thereby speeding up and facilitating the innovation journey. However, there have been some problems arising from the low carbon discourse coalition's simplification and remapping of the low energy housing innovation journey, especially the way in which it has largely ignored the social context in which the low energy housing innovations were originally developed.

The 1970s: the early origins of UK sustainable housing

A general pattern identified in the innovation journey of low energy housing is a shift from early stage innovation in the 1970s being dominated by a single close-knit network of people with shared environmental and social values (an 'advocacy coalition', see Sabatier and Jenkins Smith 1993), to looser multiple networks of actors united by shared language – discourse coalitions - emerging during the 1990s. The case of low energy housing thus has parallels with other research regarding the professionalisation of environmental groups over time as new types of mainstream actor become involved once sustainable innovations are established (Lounsbury et al. 2003; Smith 2007). The sustainable housing movement emerged in the early 1970s in the UK (Barton 2000; Chappells and Shove 2000; Smith et al. 1998), concurrent with an increased public awareness of environmental issues, and an upsurge in radical deep green environmentalism (Dryzek 1997; Porter and Brown 1996). Examples of sustainable housing developments from this period include the Centre for Alternative Technology in Wales and the Findhorn Ecovillage in Scotland (CAT 1995; Findhorn Ecovillage 2003). Housing developments were typically broadly designed as a solution to a number of environmental and social problems, ranging from water pollution to fuel poverty (CAT 1995; Wood 1990). Innovation was not located within private companies but rather dispersed across a range of largely informal organisations and individuals, including community groups, non-governmental organisations, green architects and social entrepreneurs (see Chappells and Shove 2000; Lovell 2004; Smith 2004). Table One gives some examples of key organisations involved in sustainable housing during this early stage of innovation.

Name of Actor	Brief Description
Centre for Alternative Technology (CAT), Machynlleth, Wales 1973+	A community development in an old quarry site in rural Wales, established in 1973. It is a self built autonomous development (energy and water self sufficient). It also operates as a sustainable housing education and resource centre, and runs residential courses (see Centre for Alternative Technology 1995). CAT also publishes a quarterly sustainability magazine called 'Clean Slate'.
Findhorn Ecovillage, Scotland 1962+	A self built community in rural Scotland. It was established in 1962, and building on site started in the early 1970s. As with CAT, there is an education centre and residential courses (see Findhorn Ecovillage 2003).
Communes Network and Diggers and Dreamers 1968+	The Communes Network started as the Communes Movement in 1968, founded by the Selene Community in Wales. Amongst other activities it produced a bi-monthly magazine 'The Communes Journal', which had a print run of 3000 copies. In 1975 it became the 'Communes Network', a more loosely connected organisation, which still operates informally today. Some members of the Communes Network have formed 'Diggers and Dreamers' – a self build community organisation which aims to help self builders to network, and to access information on self build housing (Dawling 1992).
Undercurrents magazine 1972 - early 1980s	Undercurrents was a radical environmental magazine published in the 1970s and early 1980s (commenced in 1972), and was regarded as the alternative movement's journal during this period. Its subtitle was 'the magazine of radical science and people's technology'. It focused in particular on sustainable housing communities active during the 1970s.
Robert and Brenda Vale 1970s+	The Vales' both studied architecture at Cambridge University in the early 1970s, and in 1975 published 'The Autonomous House', an influential text for the sustainable housing movement. They subsequently built their own autonomous house in the village of Southwell in the East Midlands, UK, and were then the architects for nearby the Hockerton Housing Development. They remain active in the field of sustainble and low energy housing.

Table One – Principle organisations involved in the UK sustainable housing movement in the 1970s.

The sustainable housing movement believed radical societal changes were necessary in order to achieve sustainable development, such as governance via small-scale self-sufficient communities (Dobson 2000). Crucially, those involved perceived themselves as a social movement united by deep green environmental and social values (Lovell 2004; Smith 2003; 2004). Somewhat paradoxically for this analysis, therefore, the 'deep green' beliefs that united these early innovators centred on a rejection of a technical fix to environmental problems, instead advocating a fundamental shift in attitudes and consciousness (Dobson 2000). Prototype household-level renewable energy technologies such as micro-hydro, wind turbines, wall and roof insulation etc, were adopted primarily because they enabled this network of early innovators to fulfill their desire for autonomy from modern society (Wood 1990). But, as explained in an assessment of the history of the CAT development in Wales, there were a mix of views in the early sustainable housing movement about their role as innovators – the situation was not clear cut:

"There was always a tension [at CAT] between those who wanted to raise a drawbridge to the outside world and those who believed that what they were doing was primarily to serve others."
(Richard St George, co-founder of CAT, quoted in CAT 1995: 9)

Nevertheless, despite this internal tension, these actors played an important role in the early development and testing of new low energy housing technologies (see BRECSU 1996; Centre for Alternative Technology 1995; Wood 1990).

Two issues about the relationship between discourse and innovation journeys are worth emphasising here. First, that the original context in which low energy housing innovations were developed and experimented with is very different to how they are used and promoted currently in the early 21st century. Those using low energy innovations at the household and community scale in the 1970s were part of a radical 'alternative' social movement, united by strong values and a desire to be self-sufficient (Chappells and Shove 2000; Dobson 2000; Lovell 2004; Smith 2004). The example of low energy housing illustrates the messiness and unpredictability of an innovation journey: those organisations and individuals involved at the early stages have not been a long-term feature of the innovation journey. Second, and related, the policy context in which these low energy housing innovations developed was very different to the contemporary situation. Energy efficiency and renewable energy were issues on the government's policy agenda in the 1970s, but not because of climate change – which had yet to become widely recognised in policy circles – but largely because of fuel shortages and the OPEC oil crisis (see Toke 2000). So a low carbon - or even a low energy - innovation journey was not planned from the outset, those involved at the time could not envisage where their activities might lead: the final destination of the innovation journey was unknown. Innovations centred initially on a wide range of environmental and social issues, and it was only subsequently that low energy innovations were prioritised by other more mainstream organisations, as discussed below.

The late 1990s: the reframing of sustainable housing
During the late 1990s and turn of the century there was a growing interest in sustainable housing from mainstream organisations, in particular the UK government. There emerged during this period multiple discourse coalitions who framed sustainable housing as a solution to a number of policy problems, ranging from modernisation of the construction industry, to meeting the demand for new housing (see Table Two).

Policy problem sustainable housing was framed as a solution to	Organisations involved in framing	Examples of policies, housing developments and technologies
Meeting the demand for new housing	UK government; private sector house builders; local authority planners; the Town & Country Planning Association; WWF.	Policies: The 2003 Sustainable Communities Plan; The Millennium Communities Programme; WWF One Million Sustainable Homes campaign. Housing Developments: 'Zed squared' zero energy, zero waste development in the Thames Gateway; the West Stevenage development; Ashton Green, Leicester. Technologies: prefabricated housing components, high density design, community-level provision of utility systems (water, energy, waste).
Lack of innovation in the construction industry	UK government; government-funded housing innovation organisations (Rethinking Construction and the Housing Forum).	Policies: Speech by Construction Minister Brian Wilson April 2003 – green housing and housing sector modernisation (DTI 2003); The Housing Forum 2001 Off Site Manufacture report – 'Homing in on Excellence'. Housing Developments: Greenwich Millennium Village, London; INTEGER housing projects at Maidenhead & Sandwell. Technologies: prefabricated housing components, 'smart' metering, household renewable energy technologies, eg PV roof tiles.
Poor quality of existing housing stock	UK government; social housing organisations; local authorities.	Policies: The Sustainable Communities 'Pathfinder' Regeneration Areas; The 2003 Decent Homes policy; Urban Regeneration Companies Housing Developments: inner city Tower Block refurbishment – e.g. Glastonbury House, Pimlico, London. Technologies: low 'e' insulated windows, solar hot water systems, wall and roof insulation.
Fuel poverty	Local authorities; government-funded energy efficiency advice centres; energy utilities; campaign organisations	Policies: The 2001 Fuel Poverty strategy; The 2003 Energy White Paper; The 2000 Home Energy Conservation Act. Housing Developments: Boughton Energy Village, Newark and Sherwood District Council, East Midlands; Ravenscliffe, Bradford, North British Housing Association (1999), 64 low energy timber frame houses. Technologies: low 'e' insulated windows, solar hot water systems, wall and roof insulation, community and micro-CHP.
Traffic congestion	UK government; local authority planners; campaign organisations, e.g. Transport 2000.	Policies: The UK Transport 10 Year Plan (2000). Housing Developments: Slateford Green, Edinburgh; BedZed, south London. Technologies: community electric car share schemes, high-density design, no car parking spaces for residents.
Meeting renewable energy generation targets	Energy utilities; UK Government; renewable energy companies.	Policies: The 'Clear Skies' community and household grant programme; the social housing Generating Solar Homes Programme.

		Housing Developments: North Nines, Edmonton, London; Sherwood Energy Village, East Midlands. Technologies: solar hot water systems, PV panels, small wind turbines, community and micro-CHP.
Climate Change mitigation ('low carbon')	Energy utilities; UK government; local authorities; Private sector house builders; social housing organisations; green architects; WWF.	Policies: The 2003 Energy White Paper; 'Energy - The Changing Climate'. The UK Royal Commission on Environmental Pollution's 22nd Report. Housing Developments: The Vales' Autonomous House; Hockerton Housing Development, Notts.; BedZed, south London; Greenwich Millennium Village. Technologies: low 'e' insulated windows, solar hot water systems, wall and roof insulation, PV panels, small wind turbines, community and micro-CHP.

Table Two - The framing of sustainable housing as a solution to different UK policy problems (adapted from Lovell (2004)).

The empirical material in Table Two illustrates how there were multiple possible innovation pathways at this point, centred on different innovations used in sustainable housing developments, ranging from factory-based housing technologies (a solution within the 'innovation in the construction industry' discourse, see The Housing Forum 2001), to car sharing initiatives and housing without car parking (innovations adopted by the 'traffic congestion' discourse coalition, see DEFRA 2000). In other words, there were a number of different directions the innovation journey could take, with a high degree of uncertainty and messiness. It is not my intention to imply here that none of these pathways were subsequently followed: in the early 21st century sustainable housing continues to be framed as a solution to a number of policy problems in the UK, in particular construction industry modernisation and meeting the demand for new housing (see Barker 2004; ODPM 2003b). The situation is thus in keeping with the notion of a non-linear, contested innovation journey with multiple pathways. However, as climate change rose up the UK political agenda, it was the low energy innovations that became the dominant focus of attention. Other pathways have subsequently been selectively 'edited out' by low carbon discourse coalition, as explored below, because a clear uniting message was required to unite the low carbon discourse coalition, and any 'messiness' in the story of low energy housing was unhelpful in this regard. The low carbon discourse coalition endeavoured to simplify existing sustainable housing developments so the message was solely about energy and climate change, ignoring other social and environmental innovations therein.

A critical influence on the low energy housing innovation journey during this period was that a reasonably large amount of sustainable housing already existed in the UK:

the innovations had a material presence. Once an innovation has undergone the initiation stage of an innovation journey and is within the public domain it is more readily able to be discursively reframed in this way. Thus the material presence of the UK sustainable housing developments rendered them liable to 'capture' and discursive reframing (Lovell 2004). The developmental stage of an innovation journey – when working prototypes are within the public domain – is hence a critical period from a discourse analysis perspective because multiple future pathways for the innovations become possible as ownership of the technology is wrested from those actors originally involved in its initiation. The prior material existence of innovations makes it appear that rapid progress has been made on an issue, and thus is particularly appealing in policy areas where there is a gap between government targets and actual policy achievements. The material presence of innovations also helps demonstrate that the new technologies work, and thus reduces risk for more mainstream institutions who wish to use them. Furthermore, it helps to ground rhetoric or discourse about a particular problem and thus lends the discourse coalition credibility.

The reframing of sustainable housing as a solution to climate change

The remainder of the paper concentrates on how one particular discourse coalition active during the late 1990s – the low carbon discourse coalition – has come to dominate policy debate since the turn of the century (Turnpenny et al. 2005; Vidal 2006). Low energy housing innovations such as solar hot water heating systems, self build community schemes and passive solar design - initially developed and tested by the sustainable housing movement prior to the problem of climate change rising up the UK's policy agenda – have become reframed as 'low carbon'.

The current UK climate change policy framework is briefly introduced, followed by a discussion of how the discourse coalition has conducted low carbon framing using ecologically modern discourse. Technologies are an integral part of this discourse, and it is shown how certain sustainable housing developments have themselves become important low carbon 'storylines' (after Hajer 1995). The implications of the emergence of a UK low carbon discourse coalition for the innovation journey of low energy housing are considered. It is shown how the framing of sustainable housing as low carbon has speeded up the innovation journey of low energy household technologies. However, the narrowing of debate to focus on the energy aspects of sustainable housing has been contested, and the inconsistencies and difficulties in maintaining a coherent low carbon discourse are discussed.

Climate change policy in the UK: an introduction

Climate change has become an important policy problem within the UK and other industrialised countries since it first captured widespread public attention at the Rio

1992 Earth Summit (Bulkeley and Betsill 2003; Newell 2000). Since the turn of the century in particular climate change has risen dramatically up the UK's policy agenda (House of Commons 2006; Stern 2006; Vidal 2006). Through the international Kyoto Protocol the UK Government is committed to reducing greenhouse gas emissions by twelve and a half percent by the year 2010, and it also has a long-term legally binding goal to lower carbon emissions by sixty percent by 2050 through the 2006 Climate Change and Sustainable Energy Act (HM Government 2006). It has been suggested that discourse structuration (after Hajer 1995: 60-61) has occurred with the issue of climate change in the UK, defined as when a certain way of discussing an issue dominates policy discourse, such that those not using particular phrases or storylines risk loosing credibility (see Turnpenny et al. 2005).

Although the 2003 UK Energy White Paper reframed energy policy around the issue of climate change, in particular concentrating on the action required in the residential sector (DTI 2003), the government has since faced mounting criticism for its failure to make significant progress in curbing emissions. For example, the government's sustainability advisor, the Sustainable Development Commission, suggested that "…current methods of dealing with climate change are incompatible with the task at hand." (SDC 2006a: 6). In response to this criticism, and with growing evidence of the detrimental effects of climate change (IPCC 2007; NCAR 2006), the government introduced a raft of new climate change policies in 2005-07, including a number of significant initiatives to encourage the development of low carbon homes, such as relief from stamp duty (house sales tax) for zero carbon homes (HM Revenue & Customs 2007), a new national code for the sustainable design and construction of housing (the Code for Sustainable Homes), a pledge for all new housing in England and Wales to be zero carbon by the year 2016, and mandatory energy performance certificates for homes when they are sold (Communities and Local Government 2006; Kelly 2006).

Yet, despite the development of UK climate change policy, there remains a shortage of politically acceptable solutions to the problem, thus leaving the government open to challenges of engaging in policy rhetoric rather than action. In other words, there is a gap between the UK government climate change targets, and the policies in place (RCEP 2000; SDC 2003). Thus there is a strong political drive for solutions: 'ready made' solutions such as sustainable housing are ideal, and the low carbon discourse coalition has been adept at framing low energy housing innovations in a way designed to appeal to policy makers.

The low carbon housing discourse coalition

The UK low carbon housing discourse coalition comprises a loosely connected group of organisations and individuals united through their use of shared language and ideas

about solutions to climate change in the housing sector. There are some inherent difficulties in mapping members of the discourse coalition, because of its fluid membership, but in general terms the low carbon coalition comprises three main types of organisation, those involved in domestic energy efficiency, renewable energy, and construction industry modernisation (see Table Three).

Core focus of innovation activities	**Examples of discourse coalition member organisations**
Domestic energy efficiency	local authorities; the Building Research Establishment (BRE); Housing Associations and The Housing Corporation; the Energy Saving Trust (EST); energy utilities; Energy Efficiency Advice Centres; Department for Environment Food and Rural Affairs (DEFRA); Association for the Conservation of Energy (ACE); Office of Communities and Local Government.
Renewable energy	renewable energy companies (e.g. Solar Century), Department for Trade and Industry (DTI); Regional Development Authorities (RDAs); energy utilities; BRE; the Carbon Trust; DEFRA; the Renewable Power Association.
Construction industry modernisation	Rethinking Construction (the Housing Forum); Office of Communities and Local Government.; large private sector house builders (e.g. Countryside Properties, Laing); small private sector house builders (e.g. Greenfield Way, Gusto Construction); BRE; English Partnerships (the Millennium Communities Programme); Housing Associations and The Housing Corporation.

Table Three – Members of the UK low carbon housing discourse coalition

The discursive ‘frame’ used by the low carbon discourse coalition – its way of describing and seeing the world that helps delineate its boundaries – is ecological modernisation, defined as "the discourse that recognises the structural character of the environmental problematique, but none the less assumes that existing political, economic, and social institutions can internalise the care for the environment.” (Hajer 1995: 25). A central assertion of an ecologically modern approach is that economic growth is not incompatible with protecting the environment, a ‘win-win’ scenario (Mol and Spaargaren 2000; Murphy 2000); there is also a strong focus on technology-based solutions to environmental problems (Christoff 2000). As Table Four demonstrates, the low carbon housing discourse coalition has drawn heavily on these ecologically modern ideas.

'Win-win': no incompatibility between economic growth and environmental protection	**Technology-based solutions**
"Government is seeking a partnership in the way we "de-carbonise" our building stock, involving all of the players in delivering greener, better buildings faster." (DTI 2003). extract from a speech by the Construction Minister, Brian Wilson, at the 2003 Buildings Awards	"We try to promote passive [technologies], so that householders don't even need to know that they're making an environmental saving." (Interview, sustainability manager in the social housing sector, June 2002).
"the houses are more expensive because they are more popular, because it is a super place to live, well designed very attractive, low energy..… There will be a premium on the house prices so the [local] authority will get some of that back through each house that is sold off. So ultimately it will be self financing" (Interview, A local authority manger responsible for planning a large low carbon housing development, December 2002).	"So what we're trying to do on our [housing] developments is, its all in there, you buy the house and its there, you don't have to think about it, you're not even aware of it… And all the technologies are put in in a way that you would be nuts to want to replace them with something else." (Interview, Sustainable housing manager at an environmental charity, June 2002).
"our overriding concern was to ....encourage those yet to embrace the [sustainability] agenda that sustainable construction can be low or no-cost." (The Housing Forum 2002: 2).	"[we're] trying to come up with a lifestyle that makes it easier and more convenient to live a lower impact existence, than by using conventional alternatives. So what we're saying is that if you're prepared to work with the infrastructure we've provided, you can achieve really quite astonishing things. Its possible to live [at BedZed] and be pretty close to carbon neutrality." (Bill Dunster, Chief Architect of BedZed housing development, quoted in (Lowenstein 2001 emphasis added))

Table Four – Examples of ecologically modern discourse used by the UK low carbon housing discourse coalition.

The ecologically modern discursive frame has been important to the innovation journey of low energy housing in a number of different ways. First, ecologically modern discourse has had strong appeal to policy makers because, as the examples in Table Four demonstrate, it has presented low energy housing technologies as capable of mitigating climate change with no negative economic implications. This has helped speed up the innovation journey via a number of government grants and policy initiatives (see for example DTI 2007; Energy Saving Trust 2007; HM Revenue & Customs 2007). Second, and related, the ecologically modern framing of low carbon discourse has been used partly as a way of distancing low energy housing technologies from the social and institutional context in which they were initially developed. The approach and language of the low carbon discourse coalition stands in strong contrast to the deep green values and beliefs of the original 1970s

sustainable housing movement. In effect the socially 'alternative' origins of these technologies have been placed outside of the ecologically modern discursive frame, as part of an attempt to reorientate the past trajectory of the low energy housing innovation journey. Thus, for instance, the project developers of the UK BedZed housing development comment how "BedZed is a long way from the hairshirt living that bedevils green living" (2001). It is notable though how BedZed's architect also describes the development as having origins in the 1970s socially-alternative bioregionalism movement (Lowenstein 2001b); the ecologically modern framing is not without tension and dispute.

The key point here is about the power of discourse to retrospectively change the course of innovation journeys by mapping out different pathways and selectively editing the reasons for, and context of, original innovations. For instance, an ex-local authority energy manager in the East Midlands, UK, describes shifts in discourse from energy conservation to climate change mitigation as follows:

> "10 or 15 years ago [the local authority energy mangers'] jobs were to save energy, to save money. Over the past few years *they have concentrated on saving carbon*, it still saves energy, it still saves money, *so they just package things differently*." (Interview, December 2002).

Similarly, another local authority energy manager in the East Midlands, who has been working on energy issues within local government for the last twenty-five years, explains his strategy for accessing funding through using different discourses:

> "what happened then was that the government came back from Rio ….and they said we'll do a green house program in council housing. *So we took our strategy and shoved it through the word processor*…. So we developed this technique, *as flavour of the month changes, we took the same strategy and just reordered the priorities.* So I secured about £2 million extra money through competitive bidding." (Interview, August 2002).

People involved in sustainable housing innovation have strategically reframed their activities using discourse as new policy issues rise up the government's agenda during the course of an innovation journey. These interview extracts also illustrate dominance of ecologically modern ideas within the low carbon discourse coalition, with no perceived incompatibility between economic growth and environmental protection.

Sustainable housing developments as low carbon storylines

The low carbon discourse coalition has used a number of 'storylines' to convey its ecologically modern message about solutions to climate change in the housing sector, including about smart housing and housing 'lifecycles' (see Lovell 2004). The most relevant storyline to this discussion, because of its clear technology-focus, is about existing sustainable housing developments which have been reframed as 'low carbon' by the discourse coalition. Analysis here concentrates on two especially high-profile developments - the BedZed development in south London (BedZed 2001; BRECSU 2002), and the Hockerton Housing Project in the East Midlands, UK (BRECSU 2000; Vale 2001), which have become metaphors - short-hand discursive techniques - used by the low carbon discourse coalition to convey key elements of the discourse. It is examined here how these storylines have influenced the innovation journey of UK low energy housing in terms of both technology and policy development.

Plate One- The BedZed housing development, London

Plate Two- Hockerton Housing Project, Hockerton

The sustainable housing developments of BedZed and Hockerton have had extensive coverage in specialist and general media, facilitated by their unusual, eye catching appearance (see Plates One and Two). These two developments in particular have acquired almost a celebrity status, with much publicity in mainstream media, not just industry journals (Lovell 2007). The Beddington Zero Energy Development, or 'BedZed', is a housing development in south London; the outcome of a joint initiative between the architect Bill Dunster, the Peabody Trust (a Registered Social Landlord), and the environmental consultancy BioRegional Development Group (BRECSU 2002; Lowenstein 2001a). It comprises eighty-two homes; nearly half of which have been sold on the private market, and the remainder are social or low-income housing. BedZed comprises a number of sustainable innovations including an on-site combined heat and power plant, an electric car pool, rainwater tanks, and sedum grass roofs (BRECSU 2002). Hockerton is an earth-sheltered housing development near Newark in the East Midlands. The five terraced homes have no need for central heating: large conservatories collect heat from the sun, and the walls are very well-insulated. Electricity is provided by photovoltaic panels and a wind turbine, and all wastewater is treated on-site in a reed bed (BRECSU 2000). Both Hockerton and BedZed comprise a number of social or administrative innovations, ranging from the community leasehold at Hockerton to the electric car share scheme at BedZed. However, it is their technical energy innovations that have been prioritised by the low carbon discourse coalition, a point returned to below.

BedZed and Hockerton have acted as a focal point for policy makers, uniting otherwise disparate actors, and thereby have created further opportunities for innovation. Table Five gives examples of UK policy documents citing BedZed. Notably, the policy documents neglect to mention how BedZed emerged in the absence of significant direct government support. The government has nevertheless attempted to associate itself with BedZed and claim ownership through frequent references to the development in policy discourse, and through site visits, including the launch of new policies there. For example, Patricia Hewitt, the then UK Secretary for Trade and Industry, used BedZed as a location to announce a new government solar power initiative (DTI 2002). Similarly, the Liberal Democrat party leader visited because he "was making an environment announcement later that day and wanted a photo to go with any publicity" (BioRegional Communications Officer 2004, pers.comm.).

Policy document	Reference to BedZed
Speech by Energy Minister Brian Wilson, Feb 2002 (DTI, 2003b).	"Demonstrations such as the developments .. at BedZed …prove that the technologies are available to deliver practical systems."
Royal Commission on Environmental Pollution 22nd Report: "Energy – Our Changing Climate"	Has a case study box devoted to BedZed and describes it as: "the most ambitious low energy housing development in the UK to date.." (RCEP, 2000: 105).
Government Energy Efficiency Best Practice Programme – General Information Report no. 89	"…BedZed represent[s] state-of-the-art for sustainable housing in the UK." (BRECSU, 2002: 3).
UK 2003: the Official Yearbook of the United Kingdom of Great Britain and Northern Ireland (The Stationery Office, 2003).	Double page picture spread (pp.298-299).
Environment Agency report – 'Our Urban Future' September 2002 (www.environment-agency.gov.uk)	BedZed is cited as an example of a solution to climate change.
The Housing Corporation (2004).	It is used as a model case study for Registered Social Landlords "… to show how sustainable development can be achieved."

Table Five - Examples of UK policy documents citing BedZed

The storylines about these two housing developments have promoted further low energy housing innovation, and thereby helped speed up the innovation journey, because their material existence has acted to convince others – government, business and householders - of the economic and technical feasibility of low carbon housing. As the project manager of the Hockerton housing project succinctly summarises:

"The most effective tool is the place and the fact that we are living in it." (Interview, Hockerton Project Manager, March 2003).

In other words, the innovative dwellings literally lend substance to the discourse coalition's arguments, and have helped sustainable housing to be viewed as a credible solution to climate change. Similarly, the authors of the Government-commissioned report about BedZed stress how the development represents:

"… a powerful argument for the feasibility of a zero-carbon target for all new build." (BRECSU 2002);

and a housing policy officer at a non-governmental organisation involved in sustainable housing describes how they have used BedZed to influence key decision makers in government:

"I think [exemplar projects] are invaluable for showing people what might be done. It is really great when we want to talk to people about sustainable housing - important people - we take them to BedZed… *and to actually see it in action I think is very inspiring, rather than just talking about what it might look like."*
(Interview, sustainable homes co-ordinator at a national environmental NGO, May 2003).

These technology-focused storylines thereby constitute a key element of the ecologically modern low carbon discourse used by the coalition. The interview extracts also illustrate how, with the rise of low carbon discourse in the UK housing sector (Lovell 2004; Toke 2000), it has become increasingly important not just to participate in the discourse, but to have actual material evidence of low carbon *practice* in order to promote new ideas and gain support. A small number of policy theorists have considered the impact of seeing new policy ideas and innovations in practice (see Guy and Osborn 2001; Owens and Rayner 1999). Hajer, for example, discusses the key role of policy actors' excursions to certain sites of interest, in particular when visiting forests in Scandinavia damaged by acid rain:

"A striking finding… concerned the role of meetings and excursions in the process of persuasion... these practices... can… be identified as an essential moment in the process of proliferation and utilization of knowledge, and… policy change..."
(Hajer 1995: 271).

Thus actually seeing the damaged trees helped catalyse shifts in policy. Applied to the idea of an innovation journey, it reminds us of the agency of technologies and materials within their own innovation journey. In particular, there is a stage when the physical presence of innovations, and publicity about them, acts to speed up the innovation journey and simultaneously opens up a number of different pathways for future development and growth. Thus there is a two-way process of interaction between innovations and discourse; it is not just that publicity, discourse and the policy context influence the innovation journey, but also that the innovations themselves influence policy and discourse. For instance, both Hockerton and BedZed are cited in policy documents recommending changes to the UK energy building regulations because of climate change (ODPM 2000; 2003a). In addition, new policies have been forthcoming at a local government level, based on the experience of BedZed and Hockerton. Sutton Borough Council, where BedZed is located, set an important new precedent in planning procedure by awarding the development contract

to the BedZed team, despite not being the highest bidder (BRECSU 2002). Experience with BedZed has subsequently helped inform the Unitary Development Plan produced by Merton Borough Council – the neighbouring local authority – which now requires new developments over a certain size to source ten percent of their energy from renewable resources (Forum for the Future 2004). The ten percent renewable energy requirement, which became known as 'the Merton Rule', was subsequently incorporated into a national government planning guidance (Merton Borough Council 2008).

In sum, there have been a number of important implications of the rise in low carbon discourse for the innovation journey of low energy housing. One effect has been to speed up the innovation journey: the low energy housing sector has experienced rapid growth. Surveys have identified over four hundred low energy housing developments or single houses in the UK (White 2002), with nearly two hundred built or planned since the late-1990s (Sustainable Homes 2003). This increase in the pace of the innovation journey has partly been achieved through greater publicity of low energy housing innovations, which has encouraged consumer demand (see Lovell 2005b), but also through a number of new government grant programmes for low energy technologies, such as the Low Carbon Buildings Programme (DTI 2007; see also Energy Saving Trust 2007). A second effect of the spread of low carbon discourse has been to prioritise the development of certain types of low energy innovation over others, notably technical innovations over administrative ones. This relates to the ecologically modern discourse adopted by the low carbon discourse coalitions, which has tended to prioritise technical solutions to environmental problems over institutional or social reform. Thus, for example, highly visible renewable energy technologies such as photovoltaic panels and small wind turbines have been prioritised in government funding programmes such as the Low Carbon Buildings Programme, whereas administrative innovations such as planning reforms, or integrating sustainable decision making within private sector housebuilders - although an active part of the government's agenda - have been relatively overlooked (House of Commons Environmental Audit Committee 2006).

There have also been negative effects on the low energy housing innovation journey arising from how the boundaries of the low carbon discourse coalition have been narrowly defined in ways that ignore issues that contradict its core ecologically modern ideology. The discourse has been uncritically adopted by members of the coalition, including government, which has inhibited learning. The ecologically modern framing, with its focus on profitable low carbon technologies rather than administrative or social innovations, has resulted in some important behavioural and social issues arising from occupied low energy housing developments being overlooked. For instance, at BedZed problems have occurred with residents using

blinds over the windows – in an effort to gain some privacy – but which block sunlight and hence the solar heating effect, which is required to maintain comfortable indoor temperatures (Bioregional 2003). Similarly at Hockerton some of the houses have experienced low winter temperatures below 18 degrees centigrade and residents have had to compensate by wearing extra clothing or in some cases using portable heating devices such as oil radiators and wood stoves (BRECSU 2000). As these examples demonstrate, it is not the case that residents can become low carbon by simply living in these developments – an idea that the ecologically modern discourse promotes, but rather that some degree of active householder participation and involvement is required. Experience from BedZed and Hockerton suggests that these 'softer' social or administrative innovations are a necessary part of their successful functioning. The second main strand of ecologically modern discourse – about the financial benefits of being green, the 'win-win' scenario – has also acted to exclude important contradictory evidence about the difficulty of making low carbon housing development financially viable. BedZed, for example, is said to have overrun its budget by £5 million (Clark and Smit 2004; Lovell 2005a), and Hockerton's average construction cost was achieved in large part through use of unpaid labour (Energy Saving Trust 2003).

These kind of technical and financial issues – the 'twists and turns' of a typical innovation journey - do not fit well with the ecologically modern discourse used by the low carbon discourse coalition, and hence have not been widely reported (see for example Bioregional 2003; BRECSU 2000; 2002; Minton 2002). Media coverage of BedZed and Hockerton has almost exclusively been positive: ninety-nine percent of the articles written about BedZed have been complimentary, as have all but two articles or programmes about Hockerton (Lovell 2005a). A lack of honesty about problems with existing low energy housing technologies can lead to insufficient learning, and therefore hamper their innovation journey because there is a risk of the technologies being used in a more widespread manner without the problems being corrected. Rose (1991) has suggested that honest accounts of policies or projects are not necessary for learning, because the main impact of demonstration projects is to generate 'inspirational learning', thereby motivating others to adopt similar approaches; an outcome that can be seen in the case of low energy housing. However, Rose's focus is more on learning about social issues than technical ones: there are perhaps greater limitations to inspirational learning if significant technical problems are replicated.

Conclusions

The case of UK low energy housing illustrates the influence of discourse on an innovation journey, showing, for example, how discourse smooths out the dynamic

twists and turns of an innovation journey through retrospectively retelling and simplifying the journey using a particular discursive frame, in this instance ecological modernisation. It has been discussed how discourse may speed up an innovation journey by creating cohesion amongst actors, and through presenting technologies in a way designed to appeal to policy makers. But the narrow framing of innovation may create problems because key issues and facts are left out. Learning can be inhibited because of a reluctance to engage with the complex, often contradictory dynamics inherent to an innovation journey. Discourse is evidently an important factor in innovation journeys, and more research is needed to explore whether the patterns and processes identified here might be applicable to other cases.

A discourse analysis perspective also raises some critical challenges for notion of an innovation journey. A key methodological challenge arises from considering the implications of the power of discourse to retrospectively remap an innovation journey. It suggests the need for researchers to pay sharp attention to how interviewees might 'tell the story' of an innovation journey – neatening and simplifying it within a particular discursive frame – and thereby missing out important contradictory issues and events. Indeed, research has shown that theories about innovation have been used by practitioners as a type of policy discourse, where events have been portrayed in line with certain popular theoretical innovation frameworks, such as transitions theory (Smith and Kern 2007). Methodological rigour is therefore needed to triangulate interviews with other data, and perhaps for political and social scientists to engage with the data-intensive mapping of all possible relevant events to in an innovation journey in a manner advocated by Van de Ven et al. (1999). The paper highlights the value of an interdisciplinary approach to innovation journeys: discourse analysis approach focuses attention on the important patterns and dynamics of the broader policy, political and cultural context within which an innovation journey takes place, and hence adds significant insight.

References

Barker K 2004 Review of Housing Supply - Securing our Future Housing Needs - Final Report (HMSO, London)

Barton H, Ed. 2000 *Sustainable Communities: the potential for eco-neighbourhoods*. (Earthscan, London)

BedZed, 2001 *About BedZed - what is BedZed?* , http://www.bedzed.org.uk/about.htm

Bioregional 2003 Technical Tour of BedZed Housing Development. H.LovellSutton, South London)

BioRegional Communications Officer 2004 Email correspondence: Jennie Organ, Communications Officer - BioRegional Development Group. H.LovellLondon)

BRECSU 1996 General Information Report 53: Building a sustainable future - homes for an autonomous community (Building Research Establishment (BRE), UK, Watford)
BRECSU 2000 New Practice Profile 119: The Hockerton Housing Project - design lessons for developers and clients (Building Research Establishment (BRE), Watford, UK)
BRECSU 2002 General Information Report 89: BedZED - Beddington Zero Energy Development, Sutton (Building Research Establishment (BRE), Watford, UK)
Bulkeley H, 2000, "Discourse coalitions and the Australian climate change policy network" *Environment and Planning C* **18** 727-748
Bulkeley H and Betsill M, 2003 *Cities and climate change: urban sustainability and global environmental governance*. (Routledge, London & New York)
CAT 1995 Crazy Idealists? The CAT story (The Centre for Alternative Technology (CAT), Machynlleth)
Centre for Alternative Technology 1995 Crazy Idealists? The CAT story (The Centre for Alternative Technology, Machynlleth)
Chappells H and Shove E, 2000, "Sustainable Homes and Integration" in *Domestic Consumption Utility Services and the Environment (DOMUS)*. Eds H. Chappells, M. Klintman, A.-L. Lindenet al (Universities of Lancaster, Wageningen and Lund, Wageningen) pp 105-128
Christoff P, 2000, "Ecological Modernisation, Ecological Modernities" *Environmental Politics* **5** 476-500
Clark P and Smit J 2004 Dream Over. *Building*) 1-3
Communities and Local Government 2006 Building a Greener Future: Towards Zero Carbon Development - Consultation (HMSO, London)
DEFRA 2000 Transport 2010 - the Ten Year Plan (Department for the Environment Food and Rural Affairs (DEFRA), London)
Dobson A, 2000 *Green Political Thought*. (Routledge, London and New York)
Dryzek J, 1997 *The politics of the Earth: environmental discourses*. (Oxford University Press, Oxford)
DTI 2002 First stage of major PV Demonstration Programme launched. *New Review*) 52 1
DTI 2003 Energy White Paper 'Our Energy Future - creating a low carbon economy' (HMSO, London)
DTI, 2007 *Low Carbon Buildings Programme Phase 2*, http://www.lowcarbonbuildingsphase2.org.uk/
Energy Saving Trust, 2003 *Sustainable Construction: Hockerton Housing Project*, www.practicalhelp.org.uk
Energy Saving Trust, 2007 *Housing and Buildings Funding Database*, http://www.energysavingtrust.org.uk/housingbuildings/funding/database/
Findhorn Ecovillage, 2003 *Findhorn - an Introduction*, http://www.ecovillagefindhorn.com/.
Flyvbjerg B, 1998 *Rationality and Power: Democracy in Practice*. (University of Chicago Press, London)
Forum for the Future, 2004 *Merton Borough Council - a radical planning decision to promote renewable energy*, http://www.regionalfutures.org.uk/newsdigest/mertonboroughcouncil_page2181.aspx

Guy S and Osborn S, 2001, "Contesting Environmental Design: the Hybrid Green Building" in *Infrastructure in transition: urban networks, buildings, plans*. Eds S. Guy, S. Marvin and T. Moss (Earthscan, London) pp 87-102

Hajer M A, 1995 *The politics of environmental discourse: ecological modernisation and the policy process*. (Clarendon Press, Oxford)

Hastings A, 1999, "Analysing Power Relations in Partnerships: is there a role for discourse analysis?" *Urban Studies* **36** 91-106

HM Government, 2006 *Climate Change and Sustainable Energy Act 2006*, http://www.opsi.gov.uk/ACTS/acts2006/ukpga_20060019_en.pdf

HM Revenue & Customs, 2007 *Stamp duty land tax relief for new zero-carbon homes*, http://www.hmrc.gov.uk/ria/9-zero-carbon-homes.pdf

House of Commons, 2006 *Climate Change and Sustainable Energy Bill*, http://www.publications.parliament.uk/pa/cm200506/cmbills/017/2006017.pdf

House of Commons Environmental Audit Committee 2006 Sustainable Housing: a follow-up report (HMSO, London) 275

IPCC 2007 Climate Change 2007: The Physical Science Basis - Summary for Policymakers (Intergovernmental Panel on Climate Change (IPCC), Paris)

Kelly R, 2006 *Shaping a low carbon future - our environmental vision*, http://www.communities.gov.uk/index.asp?id=1505202

Laws D and Rein M, 2003, "Reframing practice" in *Deliberative Policy Analysis: understanding governance in the network society*. Eds M. A. Hajer and H. Wagenaar (Cambridge University Press, Cambridge) pp 172-206

Lounsbury M, Ventresca M J, et al., 2003, "Social movements, field frames and industry emergence: a cultural-political perspective on US recycling" *Socio-Economic Review* **1** 71-104

Lovell H, 2004, "Framing sustainable housing as a solution to climate change" *Journal of Environmental Policy and Planning* **6** 35-56

Lovell H 2005a The governance of emerging socio-technical systems: the case of low energy housing in the UK. *Department of Geography* (Cambridge University, Cambridge)

Lovell H, 2005b, "Supply and demand for low energy housing in the UK: insights from a science and technology studies approach" *Housing Studies* **20** 815-829

Lovell H, 2007, "The governance of innovation in socio-technical systems: the difficulties of strategic niche management in practice" *Science and Public Policy* **34** 35-44

Lowenstein O 2001a From BedZed to eternity. *Building for a Future*) 11 16-21

Lowenstein O 2001b Zero energy homes come to the United Kingdom. *Building for a Future*) 11 8-14

Marsh D and Rhodes R A W, Eds. 1992 *Policy Networks in British Government*. (Clarendon Press, Oxford)

Merton Borough Council, 2008 *The 10% Renewable Energy Policy*, http://www.merton.gov.uk/living/planning/plansandprojects/10percentpolicy.htm;

Minton A 2002 Eco experiments. *Estates Gazette*) 62-63

Mol A P J and Spaargaren G, 2000, "Ecological Modernisation Theory in Debate: a review" in *Ecological Modernisation around the World: Perspectives and Critical Debates*. Eds A. P. J. Mol and D. A. Sonnenfeld (Frank Cass, London and Portland) pp 17-49

Murphy J, 2000, "Editorial - Ecological Modernisation" *Geoforum* **31** 1-8
NCAR, 2006 *Abrupt Ice Retreat Could Produce Ice-Free Arctic Summers by 2040*
Newell P, 2000 *Climate for Change: non-state actors and the global politics of the greenhouse*. (Cambridge University Press, Cambridge)
ODPM, 2000 *Current thinking on possible future amendments of energy efficiency provisions*, http://www.odpm.gov.uk/stellent/groups/odpm_buildreg/documents/page/odpm_breg_600333.hcsp
ODPM, 2003a *Industry Advisory Group (Working Party 4) Low and Zero Carbon Energy Systems Meeting Minutes - 16th October 2003*, www.odpm.gov.uk
ODPM 2003b Sustainable Communities: building for the future (HMSO, London)
Owens S and Rayner T, 1999, "When knowledge matters: the role and influence of the Royal Commission on Environmental Pollution" *Journal of Environmental Policy and Planning* **1** 7-24
Owens S E and Cowell R, 2002 *Land and Limits: interpreting sustainability in the planning process*. (Routledge, London)
Porter G and Brown J W, 1996 *Global Environmental Politics*. (Westview Press Inc., Boulder)
RCEP 2000 Energy - The Changing Climate, 22nd Report (HMSO, London)
Rein M and Schon D, 1993, "Reframing Policy Discourse" in *The Argumentative Turn in Policy Analysis and Planning*. Eds F. Fischer and J. Forester (UCL Press Ltd, London) pp 145-166
Rose R, 1991, "What is lesson drawing" *Journal of Public Policy* **11** 3-30
Rydin Y, 1999, "Can we talk ourselves into sustainability? The role of discourse in the environmental policy process" *Environmental Values* **8** 467-484
Sabatier P A, 1999 *Theories of the Policy Process: theoretical lenses on public policy*. (Westview Press, Boulder)
Sabatier P A and Jenkins Smith H C, Eds. 1993 *Policy change and learning: an advocacy coalition approach*. (Westview Press, Boulder)
SDC 2003 Policy audit of United Kingdom Climate Change Policies and Programmes (Sustainable Development Commission (SDC); The Edinburgh Centre for Carbon Management Ltd, London)
Sharp L and Richardson T, 2001, "Reflections on Foucauldian Discourse Analysis in Planning and Environmental Policy Research" *Journal of Environmental Policy and Planning* **3** 193-209
Smith A, 2003, "Transforming Technological Regimes for Sustainable Development: a role for Alternative Technology niches?" *Science and Public Policy* **30** 127-135
Smith A, 2004, "Governance lessons from green niches: the case of eco-housing" in ESRC Sustainable Technologies Programme workshop on Governance, Technology and Sustainability, Open University, Milton Keynes
Smith A, 2007, "Translating sustainabilities between green niches and socio-technical regimes" *Technology Analysis & Strategic Management* **in press**
Smith A and Kern F 2007 The transitions discourse in the ecological modernisation of the Netherlands (SPRU Working Paper no.160) (SPRU, University of Sussex, Brighton)
Smith M, Whitelegg J, et al., 1998 *Greening the Built Environment*. (Earthscan, London)

Stern S N 2006 The Stern Review on the economics of climate change (HM Treasury, London)
Sustainable Homes, 2003 *Sustainable Homes Ecodatabase*, http://www.sustainablehomes.co.uk/
The Housing Forum 2001 Homing in on excellence: a commentary on the use of offsite fabrication methods for the United Kingdom house building industry (The Housing Forum, London)
Toke D, 2000, "Policy network creation: the case of energy efficiency" *Public Administration* **78** 835-854
Turnpenny J, Haxeltine A, et al., 2005, "Mapping actors involved in climate change policy networks in the UK" *Tyndall Centre Working Paper no.66* January 2005
Vale R 2001 Hockerton Housing Project - Case Study 7.7b (Australian Greenhouse Office, Institute for Sustainable Futures, Canberra) 1-6
Van De Ven A H, Polley D E, et al., 1999 *The Innovation Journey*. (Oxford University Press, New York & Oxford)
The Guardian 2006, "The year the world woke up" 20th December 2006, page
White N 2002 Sustainable Housing Schemes in the United Kingdom (Hockerton Housing Project, Hockerton)
Wood A, 1990 *History and overview of communal living*, http://www.diggersanddreamers.org.uk/Articles/199001.htm.
Young S C, 2000, "Introduction: the origins and evolving nature of ecological modernisation" in *The emergence of ecological modernisation: integrating the environment and the economy?* Eds S. C. Young (Routledge, London) pp 1-39