

**Developing a critical model to evaluate the
appropriateness of local body climate protection
policies: the case of Freiburg**

by

Ray Galvin

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DEVELOPING A CRITICAL MODEL TO EVALUATE THE APPROPRIATENESS OF LOCAL BODY CLIMATE PROTECTION POLICIES: THE CASE OF FREIBURG

RAY GALVIN

SCHOOL OF ENVIRONMENTAL SCIENCE, UNIVERSITY OF EAST ANGLIA
r.galvin@uea.ac.uk
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Abstract

Sub-national governments are now seen as having an important role to play in climate protection. Initial research in this area sought to identify their initiatives in climate change mitigation and theorize their role in relation to national and international climate protection policies. Because of the wide variations of constitutional arrangements that restrict and enable these bodies, it has been difficult to compare their efforts, particularly across national boundaries. However Bulkeley and Kern offer a conceptual framework of four 'modes of governing' that are common to local authorities, enabling their efforts to be compared more meaningfully. This schema is used in an empirical study of Freiburg's climate protection program. The schema facilitates identification of the full range of Freiburg's climate initiatives, but is not designed to account for the inappropriateness and counter-productiveness of some of the city's key climate policies. It is therefore extended in two ways. First, using Hajer's 'argumentative discourse' approach, the dominant discourses that drive Freiburg's climate policies are examined, together with how these are held in place cognitively and institutionally. Secondly, a rationale is offered for examining the 'descriptive elements' of environmental discourse in terms of their correspondence to the way the world is. This approach enables a close critique of these discourses, which provides an explanation as to why Freiburg's climate protection strategy has led to disappointing results. This model is offered for research on other sub-national bodies' climate programmes, and as a means of helping policymakers adopt a more self-critical approach.

Key words: Municipalities, Climate Protection, Discourse, Freiburg

Introduction

There is increasing motivation in OECD countries to reduce greenhouse gas (GHG) emissions, due to the twin concerns of climate change and energy security. International agreements, such as the Kyoto Protocol and the EU's '20 20 by 2020' plan (COM, 2008), are seen as unlikely to achieve GHG reductions quickly and deeply enough to significantly reduce the probability of dangerous climate change (Anderson and Bows, 2008; Hansen, et al., 2008).

However, many sub-national governments (states, counties, municipalities, etc.) have developed their own GHG reduction aims and programmes. Some, such as in the US and Canada, have done so despite their national government's indifference or opposition to international GHG reduction agreements (Kates and Torrie, 1998; Rabe, 2004). GHG reduction targets of such bodies in the US, if combined, would go further than the US's (unratified) Kyoto target (Lutsey and Sperling, 2008). Other sub-national bodies, such as in Germany and the UK, are partially integrated into national GHG reduction efforts, but many have adopted ambitious targets of their own (Collier, 1997; Collier and Löffstedt, 1997). Thousands of such bodies are now linked worldwide via resourcing networks such as Cities for Climate Protection (Lindseth, 2004) and Climate Alliance (Jansen, 2007, and see <http://www.klimabuendnis.org/>).

Hence it is increasingly accepted that sub-national governments have a crucial role to play in GHG reduction, and the factors associated with their motivation for this endeavour have been closely examined (e.g. Rabe, 2004; Bulkeley and Betsill, 2003).

It has therefore become important to ask how we can evaluate a given sub-national authority's initiatives and achievements at GHG reduction. A complicating factor is that, because these bodies do not have the sovereignty of a national government, their powers to effect GHG reductions are limited by whatever constitutional arrangements happen to be in place for their particular level of government in their particular country. This makes it difficult to compare their efforts and to see whether they could do more.

Bulkeley and Kern (2006) have provided a useful framework that shifts the emphasis somewhat away from the constitutional powers and limitations of a sub-national government, to their 'modes of governing'. This enables research to focus more fully on what these bodies actually do and are potentially able to do, and to make comparisons between them despite constitutional differences. Here Bulkeley and Kern use the word 'governing' in a non-legalistic, general sense, along the lines of leading, initiating or managing.

Their work in this field chiefly concerns German and UK municipalities, and among these they identify four distinct modes of governing: governing by *authority*; governing by *provision*; *self-governing*; and governing through *enabling*. They argue that, due to developments at national and EU levels, local bodies are less and less able to govern by authority and provision, and are increasingly restricted to self-governing and enabling modes. But because local bodies are large institutions, with many staff, copious assets, and well-established connections throughout their local communities, there is often very great scope for them to exert their influence through these 'softer' modes, of self-governing and enabling.

Bulkeley and Kern use this schema to explore and compare the GHG reduction endeavours of six cities which have shown significant leadership in climate protection: Heidelberg, Munich, and Frankfurt am Main in Germany; and Leicester, Kirklees, and Southampton in Britain.

In the present study the GHG reduction endeavours of Freiburg im Breisgau¹, Germany, are explored. The schema of the four governing modes proved useful in relating specific climate protection initiatives to the powers, resources and limitations of the municipality's government and administrative apparatus. As such it fulfilled its purpose. It was found, however, that more needed to be said, which went beyond an institutional or structural analysis of how the city goes about attempting to reduce GHG emissions. There needed to be a component for critiquing the city's claimed GHG reduction achievements and evaluating them in terms of their wider effects on the sum total of the world's GHG emission reductions. The 'modes of governing' approach certainly identified GHG reduction efforts and strategies, but some of these appeared successful when in fact they were highly questionable in terms of their stated aim of furthering the cause of climate protection through GHG reduction.

A modified version of this schema was therefore developed, to move the issue from description and comparison, toward evaluation. This involved insights from policy discourse theory, sharpened up somewhat using the logic of critical realism and actor-network theory.

Part One of this paper introduces Freiburg, outlines the research strategy and methods, and shows how Freiburg appears to have a strong and effective climate protection programme when looked at through the schema of the four governing modes. Part Two identifies

¹ Freiburg im Breisgau lies near the Swiss and French borders, on the southern edge of the Black Forest, in the German state of Baden-Württemberg. The city's full title is given here to avoid confusion with Freiburg, near Dresden, and the Swiss city, Freiburg. Hereinafter I will use the shorter form, Freiburg.

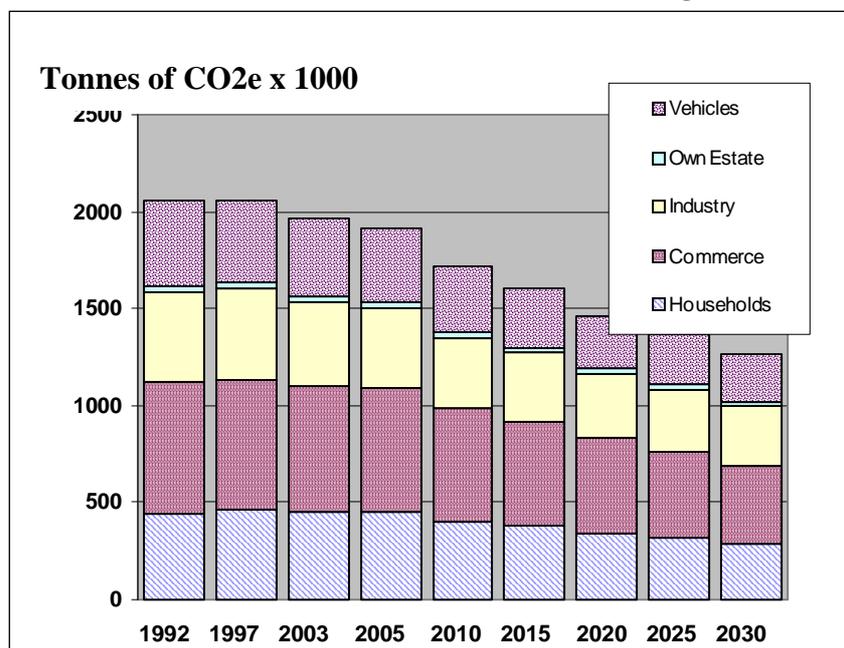
aspects of Freiburg’s climate protection programme that are promoted by the city as successful but are not, on closer analysis, particularly productive of climate protection aims. Part Three develops a modified schema which is offered as one way researchers can identify these anomalies in climate protection programmes, and Part Four gives examples of discourse found in this study, using this schema. A concluding section suggests implications for these findings, and avenues for further study and research.

PART ONE: FREIBURG AND THE FOUR GOVERNING MODES

Freiburg has a reputation and self-image as a leader in environmental and climate protection. After successful protests against a planned nuclear power station in the 1970s, the city became a central influence in the formation of the West German Green Party (Gänzle 2004) and a cultural home for many ecologically committed individuals and a host of green organisations and enterprises. In the 1990s Social Democrat mayor Rolf Bohme initiated a string of environmental reforms that have since been deepened and broadened under the current Green Party mayor, Dr Dieter Salomon, elected in 2000.² In 1996 the city council formally adopted an ambitious *Klimaschutz* (climate protection) programme.

Surprisingly, GHG reduction in Freiburg has been modest. A recent study by the *Institut für angewandte Ökologie*³ revealed that CO₂e emission levels in 2006 were just 5% below 1992 levels, though this equates to a reduction of nearly 10% per capita, as the city has been growing (Timpe and Seebach 2007). These figures disappointed the City Council, which responded by committing to 40% cuts by 2030, backed up by yet more vigorous action (Freiburg 2007, and see Chart 1 and Table 1).

Chart 1. CO₂e achievements and aims in Freiburg



Source: Timpe & Seebach, 2007: 46.

² The mayor is directly elected. The current makeup of the city council is: Green Party 13; Young Freiburg (youth greens) 2; CDU (conservatives) 13; SPD (social democrats) 8; *Unabhängige Liste* (Left Party and other leftist groups) 6; *FreieWähler* (free voters) 4; *Freiheitliche Partei Deutschland* (Free Liberals – FDP) 2. The Greens govern in coalition with the CDU. The SPD sees itself as the main opposition party.

³ Institute for Applied Ecology. Hereinafter referred to by its common name, Öko-Institut.

Table 1. Freiburg's CO₂e achievements and aims

	1992	1997	2003	2005	2010	2015	2020	2025	2030
CO ₂ e reductions →	x1000t/yr								
Households	447	458	457	449	406	378	344	317	290
Commerce	672	674	641	640	581	542	492	448	401
Industry	461	468	435	415	362	352	331	319	307
Council estate	37	36	33	32	29	28	26	24	23
Vehicles	442	422	399	381	336	300	270	257	244
Totals	2059	2058	1965	1917	1714	1600	1463	1365	1265
% reductions of 1992	0.0	0.0	4.6	6.9	16.8	22.3	28.9	33.7	38.6

Source: Timpe & Seebach, 2007: 46.

Freiburg was chosen as a case study because of the overwhelming strength and continuity of its commitment to climate protection, the skills of its staff to implement such policies, the presence in the city of many relevant experts in the field, and the city's promotional self-image as a climate protection leader. For the researcher this has the effect of eliminating variables of inadequate commitment and expertise, which would count against a successful GHG reduction programme. It enables the researcher to ask, how good is a research model in the near-ideal setting where common restrictive variables do not apply?

Research included document analysis, semi-structured interviews, attendance at technical briefings, and observations. Documents examined included key minutes of council meetings, a technical assessment of Freiburg's GHG performance by an independent institution (Timpe and Seebach, 2007), and the city's public information and promotional material. Interviews were conducted with leading city councillors from the Council's two major political groupings (PG1 and PS1⁴); Council administrative and engineering staff (A1a, A1b, A2); a company administrator of Freiburg's part-owned energy supplier, 'badenova' (E1); and two engineers in different branches of photovoltaic (PV) research and development (R1 and R2). Technical briefings covered Freiburg's transport policy (B1), climate protection strategy (B2), and thermal refit technology (B3). There were also informal conversations with other relevant actors, many of whom took opposing views to those dominant in the city council, plus follow-up correspondence. All interviews were conducted in German and transcribed verbatim, to ensure accurate comparison of key phrases and narratives between various players, and between written documents and the spoken word.

Governing for Climate Protection in Freiburg

Governing by *authority* is most clearly seen in Freiburg's thorough enforcement of national regulatory frameworks for energy standards. Having a 'supportive national framework', said one administrator (A1b), 'solves a big problem for us, because here is, quite simply, a set of rules.' Where the municipality considers Federal standards too lax, it finds ways to enforce its own rules. An example is in the current Federal Building Standard for home space heating. New homes must be insulated sufficiently to consume no more than around 100 kilowatt hours of heating fuel energy per square metre of floor area per year (100kWh/m²a), but Freiburg prefers the stricter, 'low energy home' standard, of 65kWh/m²a, and the 'passive house' standard of 15kWh/m²a where possible⁵. Local authorities have no power to

⁴ See 'Key to the actor aliases' at the end of this article. Although interviewees gave permission for their names to be published with their responses, I have withheld these so that my criticisms of Freiburg's climate protection efforts cannot be seen to be directed at anyone personally.

⁵ The value varies according to the volume and shape of the building. The formula is given in 'Tabelle 1' of the Energieeinsparverordnung (EnEV), available at <http://www.enev-online.de/>. The standards were raised in 2004, so figures in this paper vary according to both building dimensions and time of renovations.

enforce these stricter standards, but Freiburg has developed a stealth approach to doing so. When the Council sells land for home building, it may, as vendor, set conditions of sale that include the stricter building standards. Where it does not own the land, and a developer wishes to build a number of homes, the city can set the tighter standards in its district plan. Hence the less strict Federal standards are used only where an individual buys a single section of land privately and builds her own dwelling.

Council publications, and all Council interviewees, spoke of the success of this approach in the development of two large new subdivisions, Vauban and Rieselfeld. Here all 7,000 homes are built to at least the low energy home standard. As we will see, however, in the case of Vauban this does not necessarily achieve the city's stated climate protection goals, and may in fact serve to subvert them.

Further, the municipality lobbies Federal government to progressively tighten energy standards for both new home building and renovation of existing homes. While this may appear to further the goals of climate protection, we will see that it, too, can be counter-productive.

The second mode, governing by *provision*, includes waste management, public transport, cycle-ways, energy supply and social housing. Freiburg has progressively developed a comprehensive, integrated public transport system based on trams, buses and regional trains. Use of public transport within the municipal boundaries has risen from 11% of journeys in 1982 to 20% today, while private car journeys fell from 38% to 28% (B1). However, Council engineers were not able to answer the question as to whether Freiburg's public transport system encourages or discourages car journeys to feeder stations outside the municipal boundaries (B1).

Freiburg has built up a 'cycle path network' of 410km. Cycle journeys now account for 28% of journeys, compared to 15% in 1982. The city centre offers 5,725 cycle parks, up from 2,200 in 1987, and there are free, lockable, covered cycle parks at commuter railway stations.

CO₂e emissions from vehicles within the municipal boundaries fell by 6.9% from 1992 to 2005 (Timpe and Seebach, 2007). However a good portion of this is due to stricter Federal standards for vehicle emissions (A1b).

Waste management represents a further successful provision of GHG reducing services. 57% of waste is recycled, an increase from 25% in 1991. The rest is incinerated in a combined heat and power (CHP) generator (PG1). The tonnage requiring incineration fell from 58,000 to 39,000 from 1992 to 2005 (Freiburg 2005c:19).

Freiburg has been able to maintain some influence over energy provision, through local CHP plants and by retaining a stake in its privatised energy supply company, 'badenova'. Badenova offers a choice of 3 electricity products, with varying mixes of mainstream and renewable power. Surcharges on the greenest power earn badenova €600,000 per year, which it invests in the development of more renewable electricity generation. This has financed the building of 25 small-scale hydroelectric plants, 6 biomass plants, and well over 1300 PV installations (E1).

Freiburg also provides social housing, and is reducing CO₂e emissions from its stock of 8,000 homes through an ongoing programme of thermal refits. Recently the Council decided on a 'demonstration project', to renovate an ageing multi-storey apartment block to the 'passive house' standard of 15kWh/m²a (A2), far stricter than the Federal standard of 150kWh/m²a for refits of existing buildings. As we will see, however, this turns out to be counterproductive of the municipality's goal of reducing CO₂e emissions deeply and quickly.

In the third mode, *self-governing*, Freiburg is seeking to reduce GHG emissions from its administration buildings, schools, kindergartens, vehicles and recreation facilities, which produced 1.7% of the city's total CO₂e emissions in 2005 (Timpe and Seebach, 2007:55). Results are evident in a pilot project at Staudinger Comprehensive School, which the Council outsourced to the renewable energy company Eco-Watt. Eco-Watt raised investment money from staff and parents, identified physical features where big energy savings could be made for minimal investment, and engaged staff and students in energy-saving strategies. This achieved an annual saving of €80,000, and reduced energy usage by 20-30% and water usage by 70%, despite an increase in the student roll (ERF 2007; Eco-Watt 2008, Eco-Watt 2008a.)

In the final governing mode, *enabling*, Freiburg offers online advice for reducing CO₂e emissions, and part-finances a home thermal refit advice centre. It offers financial incentives for home thermal refits and renewable energy installations, supplementing incentives offered by badenova and by the state and Federal governments.

It also has a strong tradition of consultation, with business groups, NGOs and citizens' groups. Councillors and administrators consult regularly with 'Roundtables', comprising leading figures in the main enterprises in the city: transport, energy, building, and commerce. This extends the influence of the city council but also serves to dilute it (A1a). At least one interviewee felt the Roundtables had more power than the City Council (R2).

By far the most visible expression of governing by enabling is in the massive presence of photovoltaics (PV) in the city. PV panels are on every conceivable surface: the roofs of schools, churches, factories, supermarkets, hotels, office blocks, sports centres, the football stadium, council buildings, homes and hen-houses, plus entire walls of multi-storey buildings.

Although most PV units are owned by private organisations and individuals, the city council promotes PV as a central feature of its character, in much the same way that Florence promotes its ancient works of art. Special buses offer tours of the creations of 'solar' architect Rolf Disch, including the 'Heliotrop', a building that rotates to keep its PV panels facing the sun. The Tourist Information Centre offers free publications on the Freiburg PV phenomenon (Freiburg 2005a, Freiburg 2005b, Freiburg 2004a) and a DVD, *Solar City Freiburg*, is available for €15 (Freiburg 2006b). One of Freiburg's key promotional publications on climate protection policy, *Freiburg Green City: Weg zur Nachhaltigkeit* (The Road to Sustainability) (Freiburg 2008a), describes PV as 'the new leading energy' (p3). The huge number of PV installations, it says, points to Freiburg's 'success in economy and ecology' (p.5). The title 'SolarRegion Freiburg' denotes a city where research and production of PV technology are reinforced through a confluence of cutting edge institutions (p.6).

The city now produces about 3 times as much electrical energy through PV as the national average. Again, however, as we shall see, it is highly questionable whether this project and emphasis have served to further the city's stated climate goals.

PART TWO: LIMITATIONS OF THE FOUR GOVERNING MODES

Freiburg exploits each of the four governing modes vigorously. However a closer examination indicates that there are deep flaws in its approach to the reduction of CO₂e emissions. The following section explores three main aspects of this: low energy housing development, thermal renovation of existing homes, and the promotion of PV.

Low energy housing developments

Freiburg's low energy housing development in Vauban is world-renowned as an example of eco-friendly housing. This new suburb of over 2,000 eco-homes, with school, kindergarten, shops, district heating and transport links, has been built on the site of a former military barracks. Erected in 1935, the site was commandeered by French occupation forces in 1945 and returned to the German government in 1992. A group of students suggested to Freiburg's city council that the buildings be renovated modestly to provide student accommodation, as there was a shortage of affordable housing in the city. This group formed itself into a *Verein* (charitable trust) with the acronym 'SUSI'⁶ (*Selbstorganisierte Unabhängige Siedlungs Initiativ* - Self-organised independent residential development initiative). It exists to this day as a protest group *against* the Vauban development.

After the students' suggestion, other interest groups joined the discussion. The concept that prevailed was to demolish all but a few of the buildings to make way for cutting-edge eco-housing in a 'green' suburb that would attract well-educated, environmentally conscious people to the city. The Council bought the site from the government and, as it was both land vendor and district plan maker, was able to require all developers to conform to energy efficiency standards well in excess of the Federal standard.

Most of those who came to live in Vauban were well-educated professionals from out of town (A2). All the blocks but two were demolished to make way for the new homes. One of these was renovated to a modest thermal standard and offered for student accommodation. There were conflicts over what to do with the last remaining block, with SUSI leading a sit-in protest to prevent it being demolished. The police were called in to remove the demonstrators and the block was demolished to make way for the final stage of homebuilding.

The prevailing discourse on Vauban frames it as a 'demonstration project' that saves thousands of tonnes of CO₂e per year. But this does not take account of the 'embedded' CO₂e in new buildings. Large quantities of CO₂e are produced in the extraction, transport and processing of raw materials for new homes, plus the transport of finished materials and the construction process. It is difficult to establish a precise figure per home. However, calculations by the Empty Homes Agency (EHA, 2008), using data from Bath University's Inventory of Carbon and Energy⁷ indicate that this normally amounts to around 50 tonnes of CO₂e per dwelling. By contrast, an existing home can be renovated inexpensively to a moderate thermal standard, producing very little CO₂e in the renovation process, and thereby reduce its annual home heating CO₂e emissions by one or two tonnes. So a new 'carbon-neutral' home actually takes 25-50 years before its CO₂e savings draw level with those of a moderately renovated existing home.

Demolishing homes to build new ones is thereby counter-productive of Freiburg's goal of achieving 40% CO₂e reductions by 2030. But it has more serious consequences. There is widespread agreement that ambient CO₂e levels need to be reduced sooner, rather than later, to achieve early stabilisation of GHG levels. There is no consensus on what this stabilisation level should be, but no climate scientist is advocating we wait 25-50 years before attempting reductions. Further, recent publications tend to see the situation as more, rather than less, urgent (e.g. HEAC, 2007; Anderson and Bows, 2008; Hansen et al., 2008).

Clearly, where new homes have to be built, it is more environmentally sound to build to the highest standards of space heating energy efficiency, as Freiburg does. But demolishing existing buildings to make way for new homes is counterproductive to the goal of climate protection.

⁶ The story of Vauban, from SUSI's perspective, is told on their website, <http://www.susi-projekt.de/>

⁷ Available online at <http://people.bath.ac.uk/cj219/>

Thermal renovation of existing homes

There are also problems with Freiburg's approach to thermal renovation of existing homes. The prevailing discourse is that the best renovations are those carried out to the highest thermal standards, as this will save the most CO₂e per home or building renovated.

There are two difficulties with this approach. One concerns its *cost threshold*, and the other its *cost effectiveness*.

'Cost threshold'⁸ is the minimum amount you have to pay to do anything at all. To insulate an apartment block to the standard of 120kWh/m²a, you might have to pay, say, €20,000 per apartment. However if building standards are tightened to 65kWh/m²a, the costs per apartment may rise to €100,000 (Galvin, 2009). But if you can only budget a maximum of, say, €25,000, the stricter building standard *prevents you doing anything at all*. You will save *no* CO₂e emissions. The 'cost threshold' has been set too high for your budget. Conversely, if the building standards were lower than 120kWh/m²a, the cost threshold would be lower than €20,000 and you could insulate even if your budget was much less than €20,000. Hence you would save *some* CO₂e emissions, rather than *no* CO₂e emissions.

This raises questions of the prevailing view that urges progressive tightening of the Federal standards for thermal renovation. Even though this would ensure greater CO₂e savings in cases where homes are renovated, it would exclude others from reaching the required threshold, prevent them getting renovated, and therefore limit the possibilities for the reduction of CO₂e emissions. Empirical studies would be needed, to estimate the effects of a range of standards on the total amount of CO₂e emission reduction achieved. There is growing evidence that raising the statutory thermal renovation standards either deters homeowners from renovating, or leads them to flout the regulations and make up their own standards (Galvin, 2009).

The other measure, 'cost effectiveness', can be defined as the amount of CO₂e saved per euro invested. This is an important concept because if a municipality or landlord has limited funds to invest in CO₂e reduction but a great number of dwellings to renovate, a greater amount of CO₂e will be saved by renovating in the most cost effective way.

This issue is particularly relevant to Freiburg's renovation of a multi-storey apartment block to passive house standard – i.e. to 15kWh/m²a, rather than the minimum standard, for this size and shape of building, of around 120kWh/m²a (also framed as a 'demonstration project'). This might seem an 8-fold improvement, but that would be a misreading of the mathematics. The pre-renovation space heating energy use is around 300kWh/m²a,⁹ so renovation to the minimum standard would reduce emissions by 60%, while renovations to the passive house standard would result in a 95% reduction, i.e. about 1 ½ times as much CO₂e saved. However, renovating to passive house standard will cost *far more than 1 ½ times as much* as renovating to the minimum standard. Hence this approach will be *less* cost effective in terms of tonnes of CO₂e saved per euro invested.

This is a subset of a wider phenomenon, that energy-saving cost-effectiveness generally falls, as the absolute effectiveness of energy saving technology rises. Jaffe et al. (1999) have investigated this phenomenon extensively in the United States, and call it the 'energy-efficiency gap'. They distinguish between the 'technologist's optimum', in which the greatest possible energy efficiency is achieved in a given project (as in Freiburg's project), and the 'social optimum', where the highest energy efficiency per unit expenditure is achieved.

⁸ This is an original concept with respect to housing renovation. There does not appear to be any literature on it.

⁹ A comprehensive analysis of space heating consumption patterns in old buildings in Germany is offered in Schuler, et al. (2000).

Empirical studies of thermal renovations of apartment blocks in Germany and Switzerland serve to illustrate this point. Enseling and Hinz (2006) examined the outcome of a large thermal renovation project in Ludwigshafen, undertaken from 2000 to 2003. A 1930s subdivision of 850 apartments was gutted and renovated to produce ‘minimum’¹⁰, 70kWh/m²a, 40kWh/m²a, and 30kWh/m²a standard homes. After reoccupation, 150 sensors were used to monitor the performance of the apartments, measuring temperature, humidity, air quality, and fuel consumption. Each home’s energy performance was compared with the costs of thermal renovations specific to that home, and the annualised costs and savings for each standard were calculated, assuming a 25-year lifespan for the efficacy of the renovations. A summary of the results is set out in Table 2.

Table 2. Annualised cost of thermal renovations for 4 standards of thermal upgrade of homes in Ludwigshafen, expressed as €/kWh and kWh/€.

Standard	Annualised cost of thermal renovations expressed as €s invested per kWh saved	Annualised achievement of energy savings expressed as kWh saved per € invested
Minimum	.0299	33.44
70kWh/m ²	.0420	23.38
40kWh/m ²	.0567	17.64
30kWh/m ²	.0906	11.04

Source: Translated from Enseling and Hinz (2006: 11).

Clearly the ‘minimum’ standard is by far the best performer in terms of kilowatt hours of energy saved per euro invested (the right and centre columns are reciprocals of each other). Since CO₂e emissions are directly proportional to kilowatt hours of energy used, the ‘cost effectiveness’ of each standard, in terms of tonnes of CO₂e saved per euro invested, follows the same proportions. The minimum standard is *more than three times* as cost effective as the 30kWh/m²a standard. None of these homes were renovated to the even higher ‘passive house’ standard (15kWh/m²a), but Jacob (2006: 183, Table 3) found that marginal costs of energy saving for such homes are about twice those for homes renovated to the 30kWh/m²a standard. We can conclude, then, that the minimum standard is up to six times as cost effective as the passive house standard.

One justification of the higher standard is that it might save more money, in the long term, than the minimum standard, if fuel prices rise significantly within the refit’s 25-year lifetime (B3). However a price sensitivity analysis using Enseling and Hinz’s data showed that energy prices would have to average 70 eurocents per kWh over the next 25 years, for the financial benefits of the 30kWh/m² standard to surpass those of the lower standards. This is more than 10 times the mid-2008 price, a most unlikely scenario.

Jacob (2006) made a comprehensive survey of residential building stock in Switzerland, bringing together the actual costs of a large representative sample of thermal renovations of existing homes during 1993-2003. In contrast to Enseling and Hinz (2006), who monitored the actual thermal performance of dwellings post-renovation, Jacob estimated performance using standardised U-values for the various standards of thermal renovation.

¹⁰ Prior to 2004 standards were 40% less strict than those at the time of the Freiburg study. In the LUWOGÉ renovations the measured energy end-use of ‘minimum’ standard buildings was 193kWh/m²a, somewhat higher than the aim of 150kWh/m²a. This difference has been taken into account here in the calculations for kWh saved per € invested.

Jacob compared the average costs and benefits of renovating to standards ranging from 300 MJ/m²a (equal to 83 kWh/m²a), to the Swiss *Minergie* standard, which consumes 50 MJ/m²a (14 kWh/m²a), the equivalent of the German passive house. He found that none would pay back the money invested over the expected lifetime of the refits, but that the lowest standard was most cost effective. He also noted that the marginal costs of energy saving, per Swiss Franc invested, rose steadily with the increase in the standard of refit.

The theoretical concept of the 'energy efficiency gap' is confirmed in both these studies¹¹. Freiburg's decision to renovate a large apartment block to passive house standard does not further its stated goal of reducing CO₂e emissions deeply and rapidly. Far more CO₂e could be saved – perhaps up to 6 times as much - for the same amount of money, if more of its apartments were renovated but only to the minimum standard.

The promotion of photovoltaics

PV produces very little electrical energy per euro invested. The most economical modern units cost 5 euros per Wp¹², and produce around 0.9kWh¹³ per WP per year in German sunshine. Hence a PV unit that lasts 20 years will produce 18kWh for each Wp installed, at the cost of 28 eurocents per kWh. Electricity sells on the German spot-market for less than 7 eurocents per kWh. So the very best PV panels are still four times as expensive as conventional power, and far more expensive than the newest wind turbines, at around 8 eurocents per kWh.

The cutting edge of Freiburg's PV technology is the FLATCON-Concentrix, in which lenses amplify sunlight up to 450 times onto germanium-based crystals. The manufacturers claim the cost per Wp is 2.38 euros in the optimum conditions of southern Spain, and should fall to 1.5 euros by 2015 (Lerchenmüller et al. 2005). This is still nearly twice the current price of wind power, which should also gain in efficiency within that time period.

Since PV is so uneconomic, the Federal *Erneuerbare Energien Gesetz* (EEG - Renewable Energy Law) provides it with a generous subsidy (a 'feed-in tariff', or 'FIT') of around 50 eurocents per kWh (EEG 2004). Spain now has a similar law, and is the main market of Freiburg's PV manufacturers.

The German subsidies are paid to individual PV owners but are added to the power bills of all users, evenly distributed throughout the country. So all Germans pay more for their power for each PV unit connected to the grid.

Frondel *et al.* (2008) developed a model based on modestly increasing sales of PV units in Germany and a steadily increasing spot-price of wholesale power. They calculated that the total subsidy for PV would amount to over 30 billion euros, if the FIT were to be phased out from 2010. If not, estimates made by the Rhein-Westfalen Economic Institute run to at least 120 billion euros (cited in Waldermann 2008). Current subsidies amount to about 200 million euros per month, enough to thermally renovate some 10,000 apartments to a modest standard each month.

PV, then, is not an economically efficient way to reduce CO₂e. The four modest sized, outmoded wind turbines on the hills northeast of Freiburg produce 30% more energy each year than all the city's PV (PG1). In the words of a city administrator, 'PV is not very efficient.

¹¹ Nevertheless the authors of the studies do not stress this point. Their concern, in both cases, is to explore under what circumstances the most stringent standards could conceivably become economical.

¹² Wp (Watts peak) is the maximum power a unit can produce, in Watts, under ideal conditions.

¹³ kWh (kilowatt hours) is the quantity of electrical energy produced or consumed, in kilowatts, over a period of an hour.

But it's a symbol' (B2). The discourse of PV as symbolic of a green future was frequently found enmeshed with praise of it as a 'demonstration project.'

PART THREE: THE MODIFIED SCHEMA

The schema of the four governing modes enables us to look critically at how well a local body is utilising its governing powers in the service of GHG emission reduction. If, for example, municipalities in a particular country have authority over public transport, we may look in that domain to see how committed they are to GHG emission reduction. For municipalities with very limited constitutional authority, a relatively modest joint scheme with local businesses might indicate a very high level of commitment. The strength of this approach is that it enables us to compare efforts at GHG emission reduction across very uneven playing fields.

However, there is a need to take the further step of evaluating the effectiveness of a municipality's GHG reduction measures. What looks successful from the perspective of the municipality might not be so on critical examination. For example, Munich (one of the cities explored by Bulkeley and Kern) saves GHG emissions by means of its public transport system. This brings people from as far away as Tutzing, on Lake Starnberg, into the city centre, thereby saving car exhaust emissions. However it also encourages people from beyond Tutzing, who would not otherwise travel to the city centre, to drive to the Tutzing station and take the train from there. The same is the case for over 100 other outlying centres along the extremities of Munich's 16 'S-Bahn' (rapid rail) feeders¹⁴, which each extend some 50 km from the city centre. The question is: should the GHG emissions from these car journeys be included in Munich's total?

Whether or not they are will depend on how the city's leading players frame the issue, i.e. how they have agreed to talk about it, and how this standardised way of talking about it has become embedded in assumptions used in calculating GHG emissions, and in the city's transport policy. There may or may not be a written account of this. For many issues of this type, the standardised way of talking solidifies by default, and may depend on factors that have nothing to do with official policy.

To find out, then, whether these 12 S-Bahn feeders really are saving GHG emissions, the researcher would need to be attentive to this 'standardised way of talking'. However, this may be difficult because, once a 'standardised way of talking' has solidified, it might only rarely be articulated. Its consequences may be built into policy but it might remain unspoken unless challenged by a question such as 'Do you count the GHG emissions of the people who drive to the Tutzing Station?'

This 'standardised way of talking' can also be called a 'discourse.' Postmodernist scholars such as Michel Foucault (1972) have offered useful insights into how 'discourse' functions. Foucault's notion of discourse may be expressed as 'systems of thoughts composed of ideas, attitudes, courses of action, beliefs and practices that systematically construct the subjects and the worlds of which they speak' (Lessa, 2006). Foucault was aware of the extreme potency of discourse. Discourse is not simply a dispassionate description of the world. Rather, for the interlocutors, discourse makes the world into something that it would otherwise not have been. Suppose that, from the point of view of Munich's public transport officials, car journeys to Tutzing do not add to the city's GHG emissions, while from the point of view of some NGO members, they most certainly do. Two different discourses 'construct'

¹⁴ Munich has 8 S-Bahn lines, each of which extends out beyond the city in 2 directions. There are also 6 U-Bahn (underground) lines, most of which also extend beyond the city. See map at http://www.mvv-muenchen.de/web4archiv/objects/download/1/schnellbahn_2009_english.pdf

two different worlds. We may debate the precise meaning of 'construct' in this context, but the important point is that the researcher needs to know which world the municipal actors are referring to, when they set out their GHG reduction achievements.

Hajer (1995) examined the role of discourse in environmental policymaking. He noted that discourse in the policy domain is strongly 'argumentative.' He draws upon the social construction theorising of Harré (1993) and Billig (1987) to explore how people seek to win others to their point of view through various devices of rhetoric. This involves fierce argument in the policy community, with proponents using rhetorical devices to demolish credentials and win followers. Environmental politics '... becomes an *argumentative* struggle in which actors not only try to make others see problems according to their views, but also seek to position other actors in a specific way' (Hajer, 1995:53). This includes discrediting others' arguments on the basis of where they stand in relation to institutional structures, as in the retort: 'You *have* to say that because you're a Conservative party member.'

Hence policy development does not normally proceed as an orderly discussion based on well-grounded facts. Hajer notes that often 'seemingly technical positions conceal normative commitments' (p.54).

Hajer then examines how this argumentative process can lead to policy change. There are two aspects to this. Firstly, when a new or emerging discourse (ensemble of ideas, concepts and categories) reaches a certain level of appeal within a policy domain, the actors within that policy domain have to adopt it to remain credible. Hajer calls this 'structuration,' reflecting the notion that the discourse's story line becomes embedded in, and modifies, the social rules which people follow when arguing a case. Secondly, if this discourse gets translated into policy and institutional arrangements, it has achieved 'institutionalization.' A discourse that has achieved both structuration and institutionalization is now 'hegemonic in a given domain' (Hajer, 1995:59). The key players have adopted it as their view of the world, and have devised laws, regulations, bureaucracies and enforcement agencies to put it into practice. In our Tutzing example, this would refer to a set of transport decisions based on the view that exhaust emissions of car journeys from satellite towns to new S-Bahn stations do not (or do, depending on which discourse has become hegemonic) add to a city's GHG emissions.

But why does a particular discourse become hegemonic while another does not? Firstly, explains Hajer, a discourse must win *cognitive* acceptance. It must appear to fit the facts, hold together as a consistent 'story-line,' and appeal intellectually to a 'coalition' of supporters who might be coming at the issue from different perspectives. This does not necessarily mean it must be 'true' by any outside, 'objective' standard; rather, it must fit comfortably with the views people hold about the world. Secondly, it must be *positionally* acceptable. It must offer its potential proponents tangible advantages in the physical world, such as money, prestige and influence.

Therefore a first step in extending the framework of four governing modes is to consider what relevant discourses are structured, institutionalized, and therefore driving a local body's policies. The researcher needs to be attentive to such discourse during field research, whenever an apparently successful GHG reduction policy or practice is observed.

But a second modification is needed. Hajer's understanding of discourse, based on the weakly realist philosophy of Rom Harré¹⁵, tends to skirt around the question of the *veracity* of the *descriptive elements* of discourse¹⁶. While Hajer acknowledges that a discourse has to

¹⁵ Hajer leaned very heavily on Harré's 1993 work, *Social Being*. Harré's later work reflected a position more akin to critical realism. See, e.g. Harré, 2002.

¹⁶ I am indebted to Latour (2005) for the notion of descriptive elements of discourse.

win 'cognitive acceptance', this only means that people have to *think* it is correct, not that its claims about the world have been rigorously tested and found to fit the way the world is. Hajer sees discourse argumentation primarily as a clash of ideas, world-views, concepts and categorizations. Clearly this does not go far enough, as almost every environmental statement includes a descriptive element – a claim about the way the world is. And this element needs to be checked for its veracity, since the environment can be unforgiving of mistakes.

This idea may clash with sociological analyses in the tradition of Durkheim (1966; and see Latour, 2005:13-15), in which the researcher's interest is confined to the social factors that lead people to adopt this or that discourse. In some such social constructionist approaches there is agnosticism as to whether anyone can ever say anything certain about the things that are the subjects of the discourse (see discussion in Pels, et al., 2002). However, the 'critical realism' of Bhaskar (1989) and Sayer (2000) provide sound arguments for the view that, while all knowledge is socially constructed, the objects it seeks to represent are sufficiently real as to be able to hit back painfully at those who act in accordance with discourse that constructs them incorrectly.

Advocates of actor-network theory (ANT), too, take issue with views of discourse that avoid conceptualizing this descriptive, or 'ontological' element (Latour, 2005:102-111). Debates about housing, for example, may take place within the medium of socially constructed discourse, but if we see only the discourse and fail to see the houses, we are missing their point (p.105).

Nevertheless, we need not even go as far as critical realism or ANT to accept the need to check out the descriptive elements of discourse. A pragmatic approach, in the tradition of Rorty (1991), will suffice, since if we have already agreed to reduce GHG emissions we will be concerned about what works, even if we find categories of truth or falsity problematic. If, for example, we are setting out to reduce global GHG emissions and our new S-Bahn line results in more car-kilometers than there were before, we can confidently say it has not worked, whatever our philosophical position with respect to 'truth' and 'falsity'. The point at issue is: does the discourse fit with the way the world is?

The modified schema is shown diagrammatically in Figure 1. Consider a researcher who is evaluating a municipality's GHG reduction endeavours within the framework of the four modes of governing (left of diagram). The researcher is attentive to the language used by key actors and/or found in documents (bottom right), for common threads that indicate shared constructions of the realities that matter to the actors. The researcher is also checking (top right) the veracity of the descriptive elements of this discourse, in terms of how well it corresponds with the way the world is. In a further check (top two arrows), the researcher is independently checking the facts and figures that make up the claimed successes of the GHG reduction policies.

This requires the researcher to be well versed in practical and engineering matters, which are the daily bread of local body politics. Further, it requires skill in listening to language and identifying common elements of discourse that come up repeatedly among different actors. It also requires the researcher to do independent critical examination of claims that appear problematic through this kind of analysis.

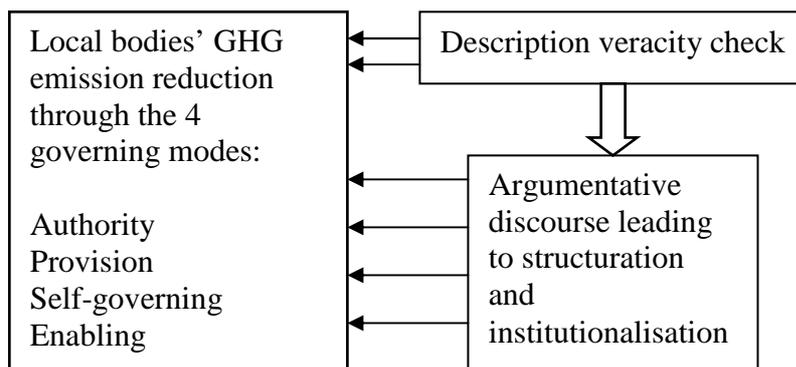


Figure 1. The modified schema for examining municipalities' GHG reduction programmes.

Hence, attending to discourse will flag up areas that need to be more closely examined. Then, using a robust ontology such as that provided by critical realism, or using a sound 'pragmatic' approach, a researcher can check whether these discourses really do describe environmental successes in the physical world, or serve other purposes such as reinforcing vested interests.

PART FOUR: EXAMPLES OF PROBLEMATIC DISCOURSE

The three problematic policy areas discussed in Part Two are domains of very strong discourse. In each case, the dominant discourse among politicians and city administrators is the one that corresponds to current policy. There are indeed alternative discourses in Freiburg that contrast with the dominant discourses, but these are 'marginalised', in the sense that they do not penetrate or engage with the dominant discourses.¹⁷

There are two common strands running through these discourses. The first is the very high value placed on cutting edge technology. PV, a newly built 'passive house', and thermal refits at passive house standard all embody the most advanced technology in their fields. The discourse that argues for and institutionalises this approach as the solution to environmental problems is a version of what has been termed 'weak ecological modernization' (Young, 2000, Chapter 1; compare Christoff, 1996). It is not surprising that this discourse has become institutionalised in Freiburg, as the city's economy is tightly integrated with eco-technology in research and development, manufacture, exports and tourism. As Hajer points out, discourses gain strength when they become 'positionally' acceptable – when they promise tangible benefits to people of influence.

The second common strand is the discourse of the 'demonstration project' (*Demonstrationsobjekt*). This is a transparent example of a discourse constructing its own subject matter, in that you have to be a believer (someone who belongs within the discourse community) to see what the speaker sees. To a believer, PV is a demonstration of pure green energy, the solution to climate change. To an unbeliever it is a technically over-sophisticated waste of money – money that could have saved four to six times as much CO₂e if spent on wind power or modest home insulation.

This 'demonstration project' language has a kind of rearguard defensive use, serving to hold a more specific discourse in place when its rationale is under threat. When the shortcomings of Vauban, PV and over-strict building refit regulations were pointed out to interviewees, they frequently responded in terms such as: 'Even so, this is a much-needed demonstration

¹⁷ Foucault (1976) identified this phenomenon of 'marginalised discourses' in his study of approaches to sexuality.

project.' Framing it as a demonstration project excused it from having to make a real, tangible contribution to climate protection, and insulated it from technical critique.

Another response to questions challenging PV's economic efficiency was the claim that it will come into its own in the future: 'It will certainly become economically viable' in 3, 5, 10 or 15 years (depending on the interviewee) 'if we just keep on with it.' This too is a discourse that constructs its own object, since the future has not happened yet. Such discourses are self-reproducing and well insulated from critique. They serve to protect other, more subject-specific discourse from having to engage with non-believers.

Freiburg's climate protection programme is impressive compared to that of many cities, but it has, in a sense, been captured by discourses that limit it. They do this because they are constructed largely to serve other ends: protection for local industry; the development of a high-tech economy; promotion of a visible 'green' image for the city's tourist industry; attracting well-educated middle-class migrants to the city. These needs are blended with genuine concerns for the environment, but the resulting mix ends up serving two masters, with the environment often taking second place while appearing, on the surface, to be the driving force.

DISCUSSION AND CONCLUSIONS

Much of the literature on sub-national governments' climate protection efforts carries an air of celebration, as researchers are understandably pleased to find these lesser authorities taking up the task in which national governments are slow to act. However, these bodies' efforts can be just as easily diluted by toxic discourse or misplaced endeavour as those of national governments. As we have seen, hegemonic discourse can divert a municipality from effective realization of its GHG reduction aims, while making it look as though these are being achieved. This raises several concerns.

Firstly, research on sub-national governments' climate protection programmes needs to adopt a firmly critical stance, subjecting them to scrutiny from angles and perspectives that may not be dominant within the sub-national body concerned. This paper has outlined one way of doing this, focusing on hegemonic discourses and the veracity of their descriptive elements. Hegemonic discourses are not necessarily toxic, but they indicate an area to look in, for possible mismatches between the physical world and discursive constructions of it within the institution. It is also useful to listen for 'marginalized' discourses (Foucault, 1976) amongst people outside the system, as these provide clues to alternative ways of seeing the physical things that policy is dealing with. Further, engineering knowledge and mathematical skill need to be brought to bear on suspect areas. Municipalities deal in drains, transport networks, electrical gear, gas pipes, kilowatts, thermodynamics, boilers and jackhammers. These are the media through which municipalities seek to reduce GHG emissions, and there is no avoiding the need for researchers to check they are doing the job the municipality claims for them.

Secondly, there are important philosophical issues in talking about 'descriptive elements' of discourse. Such talk assumes that actual physical realities are *represented in* language, not merely *constructed by* it, and that a researcher can stand outside this ontological-epistemological axis and assess how well the two poles correspond with each other. This paper has been able, partially, to side-step this issue, as the research has worked within the broad underlying assumptions of the municipality, i.e. that human-induced GHGs are set to cause dangerous climate change, and that elected authorities must therefore reduce GHG emissions quickly and deeply. However, many environmental claims are contested, or at least contestable in principle. In such cases, to avoid ending up with a standoff between two or more discourses that construct their subject matter in opposing ways, a much more rigorous philosophy of how to critique the epistemological-ontological axis would be needed.

There is promising work in this area among critical realist writers (e.g. Lawson, 2006; Sayer, 2000; Shotter, 1993; Bhaskar, 1989), while Bruno Latour's recent works (2004; 2005) have addressed this issue within the tradition of science and technology studies.

Thirdly, more rigorous definitions need to be formed as to what qualifies as GHG emission reduction by a sub-national body. The Tutzung effect, relevant to Freiburg but disregarded by its key actors, suggests that certain GHG reductions within municipality boundaries can lead to increases outside those boundaries. This may also be the case with PV, where massive subsidies, coming from outside the municipality, can be seen as requiring increased GDP, which results in increased GHG emissions nationally. With regard to Vauban, this paper has argued that 'embedded' GHG emissions for new housing – many of which are generated outside the municipality – should be included in Freiburg's tally. The issue of extra-boundary GHG emissions warrants more discussion so that we can get a better picture of the degree to which local action is producing global benefits.

Fourthly, much of the concern of this paper resonates with the broader topic of evaluation of environmental policy instruments. Mickwitz (2003) outlines the diverse range of issues to be considered in exploring the worth or value of any particular policy instrument designed to reduce pollution or protect the environment. These issues include: whether the policy fulfils its stated objectives; how good the objectives are; what unintended consequences there are; what it costs; whose world view defines what an environmental problem is; and the extent to which the solution has a global reach or merely shifts burdens from one geographical place to another. As of yet there is little, if any, systematic development of criteria and methods to evaluate (i.e. work out the worth and value of) the climate protection initiatives of sub-national governments. There needs to be such development so that these governments have to face rigorous critique before extolling themselves as achievers and leaders in climate protection.

Finally, the results of studies using more critical models, such as the one presented here, need to be fed back to the municipality in question for their response. Papers such as this can be seen as further instances of discourse. The discourse created in such a study needs to be allowed to challenge a municipality's prevailing discourses with a view to reopening the arguments. Despite the ubiquity and apparent insularity of these discourses, the people who echo them are intelligent and ethically motivated. Ideas change. Hegemonic discourse can be unseated. Sound academic criticism could help a municipality improve its approach to climate protection.

Key to the actor aliases:

PG1: Interview with leading Green Party politician

PS1: Interview with leading Social Democrat Party politician

A1a and A1b: Interviews with city administrator

A2: Interview with city administrator

E1: Interview with 'badenova' energy supply company administrator

B1: Technical briefing from city administrator, public transport

B2: Technical briefing from city administrator, climate protection programme

B3: Technical briefing from manager, thermal refit firm

R1: Interview with photovoltaic technology researcher

R2: Interview with photovoltaic technology researcher

References

- Anderson, Kevin and Bows, Alice, (2008), 'Reframing the climate change challenge in light of post-2000 emission trends,' *Phil. Trans. R. Soc. A.* 366: 3863–3882.
- Bhaskar, Roy. (1989) *Reclaiming Reality: a critical introduction to contemporary philosophy.* London: Verso.
- Bijker, Wiebe E.; Hughes, Thomas P. and Pinch, Trevor (Eds.) (1989) *The Social Construction of Technological Systems*, Cambridge, Mass: MIT Press, 261-280.
- Billig, M. (1987) *Arguing and Thinking: A Rhetorical Approach to Social Psychology*, Cambridge: Cambridge University Press.
- Bulkeley, Harriet and Betsil, Michele (2003). *Cities and climate change: urban sustainability and global environmental governance*, Routledge, Oxford.
- Bulkeley, Harriet and Kern, Kristine (2006). 'Local government and the governing of climate change in Germany and the UK.' *Urban Studies* 43:12, 2237-2259.
- Christoff, P., 1996. 'Ecological modernisation, ecological modernities.' *Environmental Politics* 5(3): 476-500.
- Collier, Ute (1997). 'Local authorities and climate protection in the European Union: putting subsidiarity into practice?' *Local Environment*, 2:1, 39-57.
- Collier, Ute and Löfstedt, Ragnar E. (1997). 'Think globally, act locally? Local climate change and energy policies in Sweden and the UK.' *Global Environmental Change*, 7: 1, 25-40.
- COM (Commission of the European Communities) (2008) COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS: 20 20 by 2020 Europe's climate change opportunity. Brussels: European Commission.
- Durkheim, E (1966) *The Rules of Sociological Method* (trans. Sarah A. Solovay and John E. Mueller, edited by George E. Catlin). New York: Free Press.
- Eco-Watt (ECO-Watt Gesellschaft für ökologische Projekte mbH) (2008) 'Das ECO-Watt-Pilotprojekt Staudinger Gesamtschule.' Available at <http://www.eco-watt.de/index.php?id=6> accessed 7 July 2008.
- Eco-Watt (ECO-Watt Gesellschaft für ökologische Projekte mbH) (2008a) 'Project „ECO-Watt-Project“ Building a Negawatt Power Plant in a School.' Available at http://www.eco-watt.de/fileadmin/user_upload/pdf/proj_eng.pdf accessed 7 July 2008.
- EEA (European Energy Agency) (2005), Household consumption and the environment. EEA Report No 11/2005. Available at: http://reports.eea.europa.eu/eea_report_2005_11/en/EEA_report_11_2005.pdf
- EEG 2004: *Erneubare Energien Gesetz* (Renewable Energy Sources Act): *Act revising the legislation on renewable energy sources in the electricity sector* 1 Of 21 July 2004. German Federal Parliament, July 2004. Includes revisions of the 2000 Renewable Energy Sources Act.

- Enseling, Andreas and Hinz, Eberhard (2006), *Energetische Gebäudesanierung und Wirtschaftlichkeit – Eine Untersuchung am Beispiel des ‘Brunckviertels’ in Ludwigshafen*, Darmstadt, Institut Wohnen und Umwelt GmbH.
- ERF (Energieagentur Regio Freiburg) (2007). ‚Einsparprojekt in Freiburger Schule mit Erfolg abgeschlossen,‘ 23.October.2007 http://www.klima-aktiv.com/article58_5064.html Accessed 2 June 2008.
- Foucault, M. (1975). *Discipline and Punish – The Birth of the Prison*, 1991 trans., Harmondsworth: Penguin.
- Foucault, M. (1976). *The History of Sexuality, Part I*, 1981 trans., Harmondsworth: Penguin.
- Foucault, M. (1972). *Archaeology of knowledge*. New York: Pantheon.
- Freiburg (2004a). Stadt-Freiburg, *Solarführer Region Freiburg*. Umweltschutzamt, Freiburg.
- Freiburg (2005a). Stadt-Freiburg, *SolarRegion Freiburg*. Umweltschutzamt, Freiburg.
- Freiburg (2005b). Stadt-Freiburg, *Solar Tours in Freiburg: a visitors’ guide on the tracks of the sun*. Umweltschutzamt, Freiburg.
- Freiburg (2005c). Stadt-Freiburg, *Umweltpolitik in Freiburg – auf dem Weg zu einer Zukunftsfähigen Stadt*. Dezernat für Umwelt, Bildung und Sport, Freiburg.
- Freiburg (2006b). Stadt-Freiburg, *Solar City Freiburg (DVD)*, Deutsche Bundesstiftung, Freiburg.
- Freiburg (2007). Freiburg, Stadtrat, *Klimaschutzkonzept Freiburg: Fortschreibung der Klimaschutzstrategie, Klimaschutzziele und des Massnahmenplans* - Minutes of the City Council meeting of 10 July 2007, the debate extending the climate protection strategy, climate protection aims, and plans to achieve these. TPO 6: Verbundene Debatte mit TOP 8. Freiburg Stadtrat, Freiburg im Breisgau, 10 July 2007.
- Freiburg (2008a). Stadt-Freiburg, *Freiburg Green City: Wege zur Nachhaltigkeit*. Büro für Nachhaltigkeit, Freiburg.
- Frondel, Manuel, Ritter, Nolan and Schmidt, Christoph M. (2008). *Germany’s solar cell promotion: dark clouds on the horizon*. Ruhr Economic Papers # 40, Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI) Essen.
- Galvin, Ray (2009) ‘German Building Regulations for Thermal Regulations of Existing Homes: Do They Help or Hinder GHG Reduction?’ Paper prepared for CSERGE Working Paper Series, in press.
- Gänzle, Stefan (2004). ‘Bündis 90 / Die Grünen.’ In *Parteien in Baden-Württemberg*, ed. Michael Eilfort, W. Kohlhammer GmbH, Stuttgart, pp124-145.
- Hajer, Maarten A. (1995), *The Politics of Environmental Discourse: Ecological Modernisation and the Policy Process*. Oxford: Clarendon Press.
- Hansen, James; Sato, Makiko; Kharecha, Pushker; Beerling, David; Berner, Robert; Masson-Delmotte, Valerie; Pagani, Mark; Raymo, Maureen; Royer, Dana L.;

- Zachos, James C. (2008), 'Target Atmospheric CO₂: Where Should Humanity Aim?' *The Open Atmospheric Science Journal* 2(15): 217-231.
Available at: http://pubs.giss.nasa.gov/docs/2008/2008_Hansen_etal.pdf
- Harré, Rom (2002), 'Material Objects and Social Worlds,' *Theory, Culture and Society* 19(5/6): 23-33.
- Harré, Rom (1993), *Social Being*. Oxford: Blackwell.
- HCEAC (2007) House of Commons Environmental Audit Committee. Beyond Stern: From the Climate Change Programme Review to the Draft Climate Change Bill, Seventh Report of Session 2006–07. *Report, together with formal minutes, oral and written evidence Ordered by The House of Commons to be printed Tuesday 10 July 2007* HC 460 Published on Monday 30 July 2007 by authority of the House of Commons London: The Stationery Office Limited.
- IEA (International Energy Agency) (2007). *Financing energy efficient homes: existing policy responses to financial barriers*, IEA, Paris.
- Jacob, Martin (2006), 'Marginal costs and co-benefits of energy efficiency investments: The case of the Swiss residential sector', *Energy Policy* 34 (2006) 172–187.
- Jaffe, Adam B., Newell, Richard G. and Stavins, Robert N. (1999), *Energy-Efficient Technologies and Climate Change Policies*. John F. Kennedy School of Government, Harvard University, Faculty Research Working Paper Series. Available at: http://papers.ssrn.com/paper.taf?abstract_id=198829
- Janssen, Ulrike (2007), *What is being achieved in Europe to fight against climate change?* Klimabündnis bulletin. Web version accessed 17 December, 2007.
<http://www.klimabuendnis.org/download/climate-alliance-what-is-being-achieved-en.pdf>
- Kates, Robert W. and Torrie, Ralph D. (1998). Global Change in Local Places. *Environment* 40:2, 39-41.
- Latour, Bruno (2005) *Reassembling the Social: An Introduction to Actor-Network Theory*. Oxford and New York: Oxford University Press.
- Latour, Bruno (2004) 'Why has Critique Run Out of Steam? From Matters of Fact to Matters of Concern,' in Bill Brown (ed.) *Things*, Chicago: University of Chicago Press.
- Law, John (Ed.) (1991) *A Sociology of Monsters: Essays on Power, Technology and Domination*, London and New York: Routledge.
- Lawson, Julie (2006) *Critical Realism and Housing Research*, London: Routledge.
- Leach, R. and Percy-Smith, J. (2001). *Local governance in Britain*, Palgrave, Basingstoke.
- Lerchenmüller, H., Bett, A.W., Jaus, J., Willeke, G. (2005), *Cost and market perspectives for FLATCON*. Web article:
http://66.102.9.104/search?q=cache:6VbMmzHBr1cJ:www.concentrixsolar.de/cms/upload/pdf/SCC_3_Lerchenmueller_2005_04_27_Paper.pdf+flatcon+cost&hl=en&ct=clnk&cd=1&gl=uk accessed 1 July, 2008.

- Lessa, Iara (2006), 'Discursive Struggles Within Social Welfare: Restaging Teen Motherhood' *British Journal of Social Work*, 36(2):283-298
- Lindseth, Garth (2004). 'The Cities for Climate Protection Campaign (CCPC) and the framing of local climate policy.' *Local Environment*, 9:4, 325-336.
- Lutsey, Nicholas and Sperling, Daniel (2008). 'America's bottom-up climate change mitigation policy.' *Energy Policy* 36, 673–685.
- Mickwitz, Per (2003) 'A Framework for Evaluating Environmental Policy Instruments,' *Evaluation* 9(4): 415-436
- Pels, Dick; Hetherington, Kevin; and Vandenberghe, Frédéric, 'The Status of the Object: Performances, Mediations, and Techniques,' *Theory, Culture & Society*, 19(5/6): 1–21
- Rabe, Barry G. (2004) *Statehouse and Greenhouse. The emerging politics of American climate change policy* (Bookings Institution Press, Washington, D.C., 2004).
- Rorty, Richard (1991) *Objectivity, relativism, and truth*, Cambridge and New York: Cambridge University Press.
- Sayer, Andrew (2000) *Realism and Social Science*, London: Sage.
- Schuler, Andreas; Weber, Christoph and Fahl, Ulrich (2000), 'Energy consumption for space heating of West-German households: empirical evidence, scenario projections and policy implications,' *Energy Policy* 28: 877-894.
- Shotter, John (1993) *Conversational Realities: Constructing Life Through Language*, London: Thousand Oaks.
- Timpe, Christof and Seebach, Dominik (2007). *Klimaschutz-Strategie der Stadt Freiburg: Abschlussbericht, Szenarien und Massnahmeplan Version 3.3*) Institut für angewandte Ökologie, Freiburg. Also available at http://freiburg.de/servlet/PB/show/1173335/Umwelt_Klimaschutz-Strategie.pdf
- Waldermann, Anselm (2008). 'CDU-Experten wollen Solarsubventionen radikal kappen.' *Der Spiegel* 07 May 2008.
- Woollmann, H (2004). Local government reforms in Great Britain, Sweden, Germany and France: between multi-function and single purpose authorities, *Local Government Studies*, 30:4, 639-665.
- Young, Stephen C. (Ed) (2000), *The Emergence of Ecological Modernisation: integrating the environment and the economy?* London: Routledge.