SUSTAINABLE
URBAN AREAS
9

Policies for improving energy efficiency in the European housing stock

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Delft, 12 June 2006
Minna Marjaana Sunikka

1 Introduction

1.1 Energy as an environmental and economic problem

Many argue that anthropogenic interference in the carbon cycle is the most serious of all the sustainability issues facing the world in general and the industrialised countries in particular (IPCC, 2001a; King, 2004; Conisbee and Simms, 2003; EEA, 2005). Some scientists claim that we are approaching the 'point of no return' in climate change, albeit the most radical impact will only be seen in the decades to come (IPCC, 2001b; Caldeira et al., 2003; Santer, 2005). We tend not to think about heating our buildings as an environmental problem. There is a clear link, however, between domestic energy consumption and carbon emissions that are causing climate change (Lowe, 2005). Human activities such as combustion of fossil fuels cause greenhouse gas emissions, resulting an increase in the greenhouse effect and thus climate change (IPCC, 2001c). In the European Union, buildings account for over 40% of total current energy consumption and 30% of all CO_2 emissions (Bourdeau, 1999; EC, 2005). About two-thirds of energy consumption in buildings in the EU takes place in the housing sector (YM, 2005). As regards depletion of natural resources, the construction sector is estimated to generate approximately 40% of all man-made waste, and construction and demolition wastes add up to some 180 Mtons in Europe each year (Report DGX1 EC, 1999). According to the World Watch Institute the entire global community will run out of raw building materials by approximately 2030 if this trend continues (Brown, 1990).

There is also an economic dimension to energy consumption in buildings: energy consumption levels in the European Union are rising, and an increasing percentage of the energy is imported. Self-sufficiency in energy in the EU has declined by an average of 1.5% per year, while energy consumption has increased 2% and carbon dioxide emissions 1% per year. The European Commission forecasts an energy dependency of 70% in 2030 compared with 50% today (EC, 2001; 2005). This has an important geopolitical dimension and is expected to come with a price tag, especially once fossil fuels start drying up.

Recognition of the environmental and economic dimensions of energy consumption has led to an international response. In the late 1980s concern about anthropogenic climate change resulted in negotiations to mitigate the threat. Under the Kyoto Protocol the governments of the industrialised countries agreed to reduce their total levels of CO_2 emissions by 5.2% on the 1990 level between 2008 and 2012, thus increasing the pressure on governments to adopt CO_2 reduction strategies (FCCC, 1997; UN, 1992). The Kyoto Protocol entered into force in February 2005, marking the beginning of the process to reduce greenhouse gas emissions, and negotiations have begun on a second commitment period to follow on from the Kyoto period in 2012. Some industrial countries, notably the US, did not ratify the Kyoto Protocol but published an alternative plan in 2005, along with Australia, China, Japan, India and South Korea, to develop a regional pact on greenhouse emissions, the Asia-Pacific Partnership for Clean Development and Climate, emphasising the use and availability of the latest technologies to limit emissions. On top of this, independent of Federal policy, nine US states are expected to announce a plan to freeze CO_2 emissions from major power stations by 2009 and then reduce them by 10% by 2020, and the mayors of more than 130 US cities have agreed to meet the emission reduction targets envisaged in the Kyoto agreement.

The scale of the challenges, both in relation to Kyoto and beyond, is illustrated by a study by the Royal Commission on Environmental Pollution in the UK, which has recommended that UK carbon dioxide emissions should be reduced by 60% on the 1997 level by 2050 (RCEP, 2000). The government adopted this target in its Energy White Paper (DTI, 2003). It may aim at proportionately even tougher carbon reduction targets in buildings, to take account of the greater challenge posed in areas such as transport and given that climate change is proving to be more of a threat than previously anticipated (Boardman et al., 2005).

1.2 Energy efficiency in buildings

According to EC forecasts, if energy efficiency could be increased 1% annually until 2010, two-thirds of the potential energy saving in the EU could be achieved. This would comply with 40% of the EU's Kyoto obligation to reduce greenhouse gas emissions by 8% on the 1990 level by 2010-12, by cutting 200 Mtons of CO_2 emissions per year (EC, 2005). Improving energy efficiency in existing buildings is often considered to be one of the most cost-effective ways of cutting carbon emissions (Ashford, 1999; Van der Waals, 2001). Energy efficiency and the use of renewable sources in the construction sector could also contribute to self-sufficiency and solving peak demand and stand-by capacity problems (Sinden, 2005).

Organic trends in household energy consumption conflict with the EU's environmental and economic energy policy targets, however: while average indoor temperatures are continuing to rise, more space is being heated for longer periods of time and service demand for appliances and domestic hot water and lighting is increasing. In the UK for example, comfort standards in housing have been rising steadily for 30 years at over 2% a year, more than offsetting energy efficiency improvements, with the result that energy consumption has kept rising (DEFRA, 2004a). There are fears that domestic electricity demand is about to escalate in the EU, particularly as a result of growth in consumer electronics and home office equipment, and possibly air conditioning (Fawcett et al., 2000): residential electricity demand there could be 22% above the 1990 level by 2010. This is reinforced by demographic developments: over time, changes in population and declining household size produce more households, which could result in a 33% increase in total energy demand per 100 occupants because of the larger housing consumption in the UK – and other EU countries – if nothing else changes (Boardman et al., 2005). There will consequently be increasing pressure to reduce, or at least stabilise, energy consumption in the domestic sector.

This study makes a distinction between energy efficiency and energy conservation. Boardman (2004) has illustrated this in the following way. If a family wants to use less energy, to conserve petrol, without changing their car, they would travel less distance. This would require behavioural changes, such as walking to work more often. Change might be involuntary, because a price rise meant they could no longer afford to travel so much, or it might be a chosen lifestyle change. In the former case, it is reversible if the household gets richer and can afford the old level of consumption. An alternative energy conservation scenario could be that the family decides to buy a similar new car which is more energy-efficient. This requires capital investment. They then have a range of choices between still driving the same amount, which requires less petrol in the more efficient car – demonstrating in their behaviour both energy efficiency and energy conservation – and continuing with the old level of expenditure and the same quantity of petrol – which gives them more kilometres and represents energy efficiency, but not energy conservation. In housing, energy conservation means less heating or less use of appliances. Energy efficiency entails improving the energy performance of a building and appliances, which requires investments in insulation and new systems or appliances. The study focuses on energy efficiency, since adequate heating is regarded as a basic need and people are unlikely to use appliances less in order to conserve energy; improving the thermal performance of a building, on the other hand, has a considerable carbon reduction potential, especially if coupled with changes in user behaviour (ECN/RIVM, 1998; EC, 1999; Van der Waals, 2001; De Jonge, 2005; Klunder, 2005; Boardman et al., 2005).

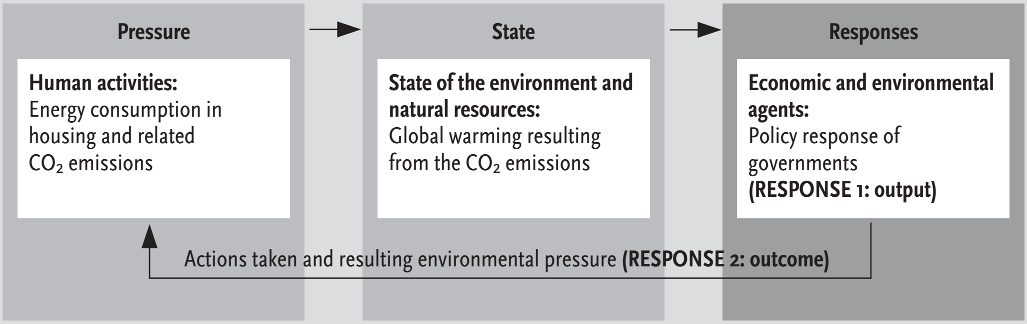
Urban renewal provides a good intervention point, as energy improvements can be coupled with other renovation measures that would have been carried out anyway. Also, neighbourhood renewal – both physical and economic – is essential to ensure that investments in energy efficiency pay off, as the value of a building depends not only on the quality of the building itself but also on that of the surrounding buildings, the infrastructure and the neighbourhood; consequently urban renewal provides an incentive to spend more on improving building quality (Awano, 2005). Urban renewal is defined as creating conditions for improving the quality of housing, work, production and the environment in and around the cities by taking measures aimed at the spatial management of the residential environment. It addresses situations in which the market on its own does not manage to produce the desired transformations (Verhage, 2005). Traditional urban renewal of the 1970s and 1980s was state subsidised and steered by municipalities, mainly focused on the pre-war housing stock. In recent years in the Netherlands, for example, the priority has shifted towards programs directed at single properties and public-private initiatives to improve market position of the post-war housing stock (Skifter Andersen and Leather, 1999). Bus (2001) defines sustainable urban renewal as a district-based approach geared to solving existing problems, preventing new problems, improving the quality of local environment and reducing supra-local environmental pollution. No official policy for sustainable urban renewal has been defined but it is assumed to take a more holistic approach to improving the area from a social, economic and environmental point of view.

1.3 Policy as a societal response

The study is set in the context of environmental problems (global warming and the depletion of natural resources) rather than a more general concept of 'sustainability', as the ambiguous concept of sustainable development has caused confusion and frustration when approaching environmental problems and is still the subject of debate, definitions varying from the ambiguous concept of the Brundtland report (WCED, 1987) to suggestions of treating it as a purely technical concept (Beckerman, 1994). A holistic view of sustainability makes for a comprehensive view of environmental problems and fewer spillover effects, but it has also reduced the urgency of environmental problems: it has taken a long time for climate change to be accepted as a fact, for example. When approaching environmental problems the study adopts the Pressure-State-Response model, an internationally recognised framework used to provide a core set of indicators for environmental performance reviews (OECD, 1993a; 1993b). The thinking behind the Pressure-State-Response model in relation to carbon emissions in the housing sector is illustrated in Fig. 1.1.

Global warming, and climate change, is thought to occur when human activity causes an increase in atmospheric greenhouse gas emissions (Monni, 2005). In this study the environmental pressure -in particular CO_2 emissions- comes from space heating and the use of consumer appliances. This affects the *state* of the environment. The society responds to the state of the environment, e.g. with government policy to cut carbon dioxide emissions. This societal response affects the environmental pressure, making the model into a loop. The study focuses on the third step in the model (policy as a societal

Figure 1.1 Energy consumption in the residential sector in terms of the Pressure-State-Response model



Source: OECD, 1993a; modified by author

response) and the actions taken as a result. Response is seen as government policy and defined as the action and non-action of the system in response to the demands made on it (Rackhoff and Schaefer, 1970). In Fig. 1.1 the feedback arrow illustrates *actions* taken as a result of the government policy that affects the environmental pressure (housing-related CO_2 emissions) and the resulting state of the environment (changes in global mean temperature) that the policies are designed to anticipate.

This research does not concentrate on energy efficiency on its own but in terms of policies and institutional changes. The concept of sustainable development used here is the institutional one: sustainability is considered as being essentially a problem of governance in the broadest sense (Perman et al., 2003). The study focuses on government policy, based on the assumption that the market's ability to solve environmental problems is limited and government intervention is needed. If the market worked effectively and with the right cost-benefit ratio, the monetary value of energy efficiency measures would be reflected in the resale value of homes (Clinch and Healy, 1999), but there seems to be insufficient market demand for sustainable building (SBR, 2001; Baumann et al., 2002). As environmental problems involve spillover effects, and there can be unintended consequences from e.g. introducing regressive energy taxes, it is necessary for one party to have an overall view of policy. The market cannot decide that CO_2 reduction is necessary, nor can it establish the international framework (King, 2004). The fact that pollution control is a conscious social and political process that cannot and should not be left to market forces has been recognised by Wijffels (2002), who points out that investments in production need to be made more attractive by creating a market, e.g. using mandatory measures, and Bowers (1997). If improving energy efficiency is left to industry and households, which make renovation decisions at very long intervals compared to institutions, they may not be well enough informed yet to make the changes necessary.

1.4 Aim of the study

The aim of the study is twofold. Firstly, it aims to provide information for national governments in the EU on how to improve their sustainable building policies so as to increase carbon reductions in the existing housing stock. It recognises that policy, in the applied sense, is concerned with both maintaining current patterns of order and precipitating change (Jenkins, 1978), and although policy styles change, this tends to be incremental and radical innovations are rare (Wurzel et al., 2003). Given that policies that conform to accepted practices and rules are most likely to be adopted (Jordan et al., 2003), because of the complexity of environmental issues and the way they relate to economic and social concerns (Gregory, 1989), the study tries to suggest effective, cost-efficient and legitimate policy instruments that take the nature of renovation into account. Policies are considered as not only reacting to but also anticipating problems, as once the environmental problems are bad enough the reaction could come too late.

Secondly, the research tries to contribute to a discussion on a good indicator of response in the context of reducing carbon emissions in the housing sector in the Pressure-State-Response model (OECD, 1993a) because a good indicator is seen important in the implementation and evaluation of an anticipating policy. In order to identify the right indicator it considers both government policy (the societal response) and the actions taken as result of that policy (see Fig. 1.1). An indicator is defined as a parameter that provides information on a phenomenon for a specific purpose. Indicators reduce the number of measures and parameters normally required to give an exact representation of a situation and simplify the communication process by which information on the measurements is provided to the user. Three basic criteria for the selection of indicators as used by the OECD are policy relevance, analytical soundness and measurability (OECD, 1993a).

The study focuses on one sector (housing) and one aspect (energy efficiency). Governments and scientists recognise that energy consumption is a measurable way of establishing a link between global environmental problems and private households, and a suitable approach to tackling energy efficiency is thought to offer a conceptual framework that could be adapted to other environmental problems, and another sectors, as well. Using in-depth analysis in one sector, the study aims to clarify and specify the ambiguous concepts of sustainable development and sustainable building.

1.5 Problem definition

Notwithstanding the carbon saving potential identified in the existing housing stock (Van der Waals, 2001; Klunder, 2005; Boardman et al., 2005) the environment continues to play a small part in urban renewal, where energy efficiency measures are still not being applied on a large scale (Bus, 2001; Priemus, 2002). Energy efficiency is affected by various types of inertia, and a more realistic understanding of the nature of housing renovation is key to designing an effective policy to reduce carbon emissions from the existing housing stock. Current policy measures and budgets, however, seem to be decided with little reference to the specific needs of renovation in the housing sector (Van Hal, 1999; NOVEM, 2002; Murakami et al., 2002a; Hasegawa, 2002 and 2003; Thomsen, 2003; OECD, 2004; Awano, 2005) instead of making precise estimations and basing policy measures on detailed sets of requirements and actual costs. The Pressure-State-Response model (OECD, 1993a) sees policies as indicators of a societal response to the state of the environment, but with a lack of consideration for the actions they generate, which actually determine the environmental pressure.

The problem is formulated as follows:

What is the current policy approach that is being used in the EU Member States for reducing CO_2 emissions from energy use in the housing sector, and how has this approach been implemented in national building regulations and economic instruments? What actions have been taken in response to government policy in the social housing sector in the Netherlands, and what are the main factors that have contributed to inertia in the effort to realise improvements in energy efficiency? To what extent is stronger government intervention possible and necessary for circumnavigating the barriers? What policy approach could be an effective, cost-efficient and legitimate response strategy for improving energy efficiency in the existing housing stock without causing negative side-effects, and what role could the EC Energy Performance of Buildings Directive (EPBD) play in such a strategy? What would provide a good indicator of response in the context of reducing global greenhouse gas emissions in the housing sector in the Pressure-State-Response model (OECD, 1993a)?

1.6 Research questions

The problem is broken down into three primary questions and eleven subsidiary questions, which are addressed in Chapters 2 through 7:

1 What is the current policy in EU Member States for reducing CO_2 emissions from energy use in the housing sector as a societal response to global warming and the depletion of natural resources, and how do these policies relate to the existing housing?

1.1 What are the possibilities for energy-efficient upgrading in housing renovation (Chapter 2)?

1.2 What approach has been adopted in the national sustainable building strategies of the Netherlands, Germany, France, Finland and the UK in terms of policy, implementation and response (Chapter 2)?

1.3 What sustainable building requirements are specified in the building regulations in the Netherlands, Germany, France, Finland and the UK (Chapter 2)?

1.4 How are negative and positive fiscal incentives applied in sustainable housing policies within the enlarged European Union (Chapter 3)?

2 What actions are being taken in response to government policies on sustainable housing, and what are the main obstacles to achieving carbon savings in the existing housing stock, using the Netherlands and the UK as examples?

2.1 What environmental efforts have been made under the heading of sustainable management in the social housing sector in the Netherlands in response to the Sustainable Building Agreement in 1998 and government policy (Chapter 4)?

2.2 What factors (technical, economic and with regard to implementation) lie behind the inertia regarding energy efficiency and low carbon supply in urban renewal in the Netherlands (Chapter 5)?

2.3 What is the anticipated impact of energy certificates under the Energy Performance of Buildings Directive (EPBD) on the existing housing stock in the UK, and how can the impact be maximised (Chapter 6)?

3 Is stronger government intervention possible and necessary for improving energy efficiency in the existing housing stock in the EU, and what policy approach would be likely to produce and effective, cost-efficient and legitimate response strategy for reducing global greenhouse gas emissions in the housing sector?

3.1 How can the European Union contribute to the improvement of energy efficiency in the housing sector, beyond the efforts that are being made by the Member States (Chapter 7)?

3.2 How should the national and local governments in the EU use legislation, fiscal instruments and information in their policies for reducing carbon emissions in the existing housing stock, and what role could the EC Energy Performance of Buildings Directive (EPBD) play in it (Chapter 7)?

3.3 How can social housing providers in the EU improve their energy-efficiency policies to reduce global greenhouse emissions in the existing housing stock (Chapter 7)?

3.4 What would be a good indicator of a societal response to reducing carbon emissions in the housing sector (Chapter 7)?

1.7 Research method

Based on the research questions, the study consists of three main themes: policy and implementation (RQ1 – policies), response (RQ2 – actions) and *pol-*

icy recommendations (RQ3 – response strategies). The first theme is qualitative, the second one quantitative. A qualitative analysis of policies and how they are implemented is needed to show the feasibility of incremental improvements. An empirical quantitative study of the actions taken is required to assess the effectiveness of the current policy approach and identify obstacles that need to be considered when it comes to stronger government intervention and circumnavigating the barriers.

In order to answer the first question on policy, current sustainable housing policies and regulations and fiscal instruments in the European Union countries are identified in an 'as is' policy analysis, based on a description and explanation of current policies (Chapter 2). This is a synthesis of a case study and a comparative analysis. Policy-making can be separated from policy content (the substance of the policy), and policy process (the given set of methods, strategies and techniques by which a policy is made) (Jenkins, 1978). The analysis focuses on content, as processes vary from one country to another. Analysis can reveal the strengths and weaknesses of a policy but not absolute solutions, which are country-specific. It should be considered that the impact of a policy can be the result of various factors and it depends crucially on political commitment and user behaviour. To make a comparative analysis of sustainable building policies they should ideally be evaluated either in two identical places where the policy is implemented in one and not in the other, or as a 'before and after' comparison (Tricart, 1991). The first option is not feasible, as the areas are not comparable. The second option is feasible, but it is difficult to determine the less immediate effects or composite effects of a combination of actions, and even to analyse the immediate effects. In sustainable urban renewal, many improvements may be due to general trends rather than the renewal programme (Alterman, 1991).

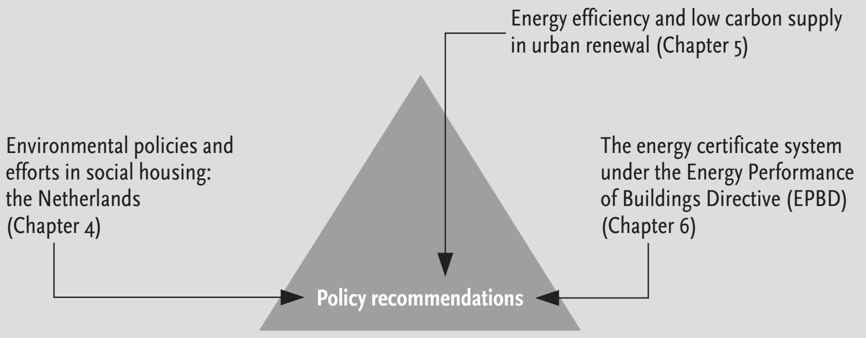
Implementation focuses on the policy instruments used (Chapters 2-3). Policy instruments can be defined as techniques available to governments to implement their policy objectives (Howlett and Ramesh, 1993; Schneider and Ingram, 1990). The study is based on the most common classification of policy instruments into three types: direct regulation, economic tools and communication tools (Kemp, 2000; Driessen and Glasbergen, 2000; Murakami et al., 2002a). Direct regulation includes policy instruments that try to impose environmentally benign behaviour by means of orders or by laying down standards in law. Economic tools influence the economic attractiveness of environmentally benign behaviour and try to overcome market imperfections, since the environment can be seen as a public good for which there is insufficient market demand. Communication tools try to persuade people to adopt environmentally benign behaviour on a voluntary basis (Jordan et al., 2000) and are generally considered as additional policy instruments, not substitutes for economic or regulatory policy instruments (Kemp, 2000; Ekelenkamp et al., 2000). In practice, policy instruments very often combine more than one concept.

The data on policies and implementation is taken from key policy documents, expert interviews and literature from the selected EU countries, preceded by interviews and a wider survey (of the baseline years 2000-2005). Because of the labour-intensive nature of the material analysis it was decided to select five EU countries which already have experience with sustainable building policies. The countries had to represent good practice in sustainable building in Europe and be wealthy, since climate change does not follow the logic of going through the inverted U-curve where countries start out poor and clean, then industrialise and become wealthy and polluted, and finally become rich enough to afford pollution control. In contrast to this principle of 'the better the economy, the better pollution can be controlled', the rich countries are the greatest polluters (Von Weizsäcker, 2005) and the examples for the policy analysis were selected from them.

Question 2 on response is discussed in the empirical part of the thesis, a quantitative study of the actions that current policies generate (Chapters 4-6). As it is extremely rare that what is deemed desirable is also feasible in terms of time and money (Van der Voordt and Van Wegen, 2002), it is important to describe actions (outcome) rather than just policies (output). Given the depth of the study it was necessary to reduce the number of countries studied still further to two, the Netherlands and the UK. Since the mid-1980s the Netherlands has emerged as an international leader in the environmental field, and it has a tradition of effective planning (Cohen, 2000) and an established sustainable building policy (Sunikka, 2001). The UK is an interesting case study of domestic energy efficiency, as it has one of the oldest and least energy-efficient housing stocks in Europe, and around 4.3 million households in England are officially designated as 'fuel poor', i.e. unable to obtain adequate energy services (mostly space heating) for 10% of their income (Smith, 2001; DEFRA, 2004b). The empirical part of the thesis is broken down into three modules: a management survey in Chapter 4, two urban renewal case studies in Chapter 5 and an analysis of the anticipated impact of the Energy Performance of Buildings Directive (EPBD) (EC, 2003) in Chapter 6. The conclusions and recommendations based on the empirical part of the thesis need to be consistent from every point of view, as Fig. 1.2 shows.

1. The first module of the empirical part focuses on housing management in the Dutch policy context (Chapter 2). The evaluation of the response to the Sustainable Building Agreement drawn up with the Dutch social housing sector, the government and third parties in 1998 (Sunikka and Boon, 2002a; 2002b) is based on the data from the surveys of the Agreement. Sustainable housing management is studied as an example of policy impact, as it can provide an overview of strategic choices and the impact of policy on procedures. This is examined in Chapter 4.

Figure 1.2 Three modules of the empirical part of the thesis

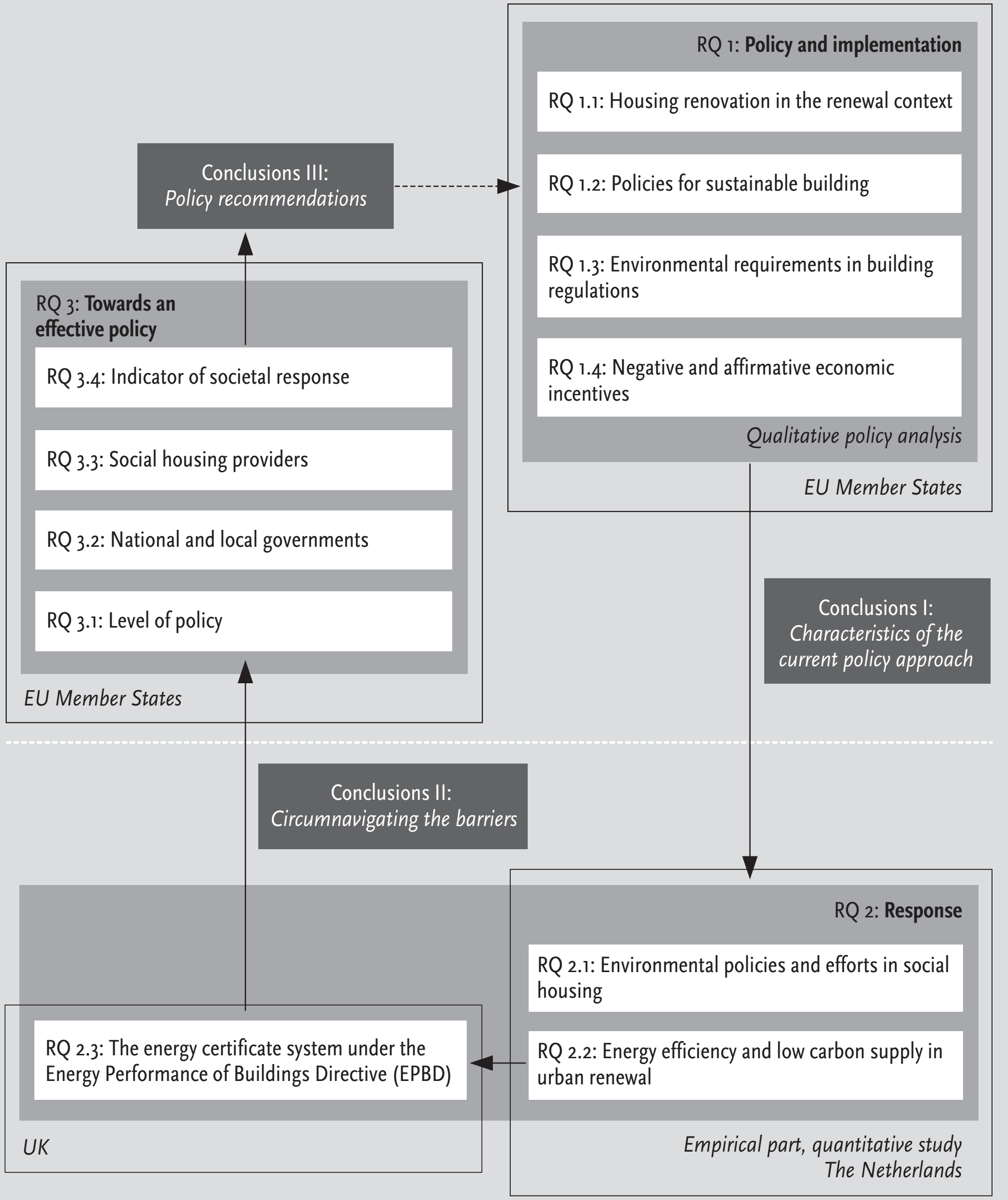


Source: author

2. The second module of the empirical part presents two case studies of urban renewal in the Netherlands. Case studies can be used for explorative, descriptive, explanatory or illustrative research (Yin, 1993). This study is based on an explorative approach, looking at the feasibility of policy targets in practice, not testing a hypothesis. Inertia when it comes to carbon reduction is examined in terms of the technical, economic and implementational obstacles. The 'energy triad' approach is adopted because it is a generally recognised concept. It sets out three steps to achieving sustainable energy consumption: avoiding unnecessary energy consumption, using non-finite sources, and clean and efficient use of finite sources (Duijvestein, 1998). The case studies on urban renewal in the Netherlands were selected on the basis of two criteria: they had to involve a late post-war housing district where most of the regeneration operations will be carried out, and they had to include some aspirations and objectives regarding sustainable building (Boon and Sunikka, 2004). Renovation-based interventions in the housing stock would appear to be better options from the environmental point of view than demolition and new build (Klunder, 2005; De Jonge, 2005). Renovation is regarded as filling the gap between maintenance and demolition and new construction and is taken to mean improving all or part of an apartment block or estate. The first case study (Hoogvliet, Rotterdam) focused on the first step, avoiding unnecessary energy consumption. The second (Western Garden Cities, Amsterdam) focused on the second step, using non-finite sources to provide heat and electricity. Every case study in urban renewal differs in terms of location, structure and market demand, and the small number of case studies here calls for caution when interpreting the results, but it is thought to be adequate to show the main obstacles. The case studies are examined in Chapter 5.

3. The third module of the empirical part is the forward-looking part of the thesis and focuses on the EC Energy Performance of Buildings Directive (EPBD), which was introduced in 2003 as the main policy instrument to address energy saving in buildings in the EU and has to be implemented in all the Member States by 2006 (EC, 2003; Beerepoot and Sunikka, 2005; Sunikka, 2005). Chapter 6 examines the implementation of the EPBD energy certificate system in the UK in a qualitative study, a quantitative analysis and a discus-

Figure 1.3 Outline of the thesis in relation to the research questions



Source: author

sion of the most probable, and the preferred, impact scenario in the UK.

Based on the aim of the study, the policy recommendations focus on the implications for national governments in Chapter 7 (conclusions). Given the focus of the study, the EU countries may be assumed to be those to which the resulting recommendations will be applied in the first instance.

1.8 Limitations

The study is based on some fundamental assumptions that should be taken into account when considering the findings (Chapter 7).

Neo-classical economists define two notions of sustainability in terms of natural capital: weak sustainability and strong sustainability. Strong sustainability requires that any losses of natural capital in public investment projects are compensated for by shadow projects that create natural capital of equal value, so that the stock of natural capital is kept constant or allowed to increase (Bowers, 1997). Weak sustainability occurs when all the environmental impacts of private decisions are internalised through taxes and public investment satisfies a cost-benefit test when environmental effects are given a monetary value. Incremental improvements suggested in this study refer to weak sustainability. Strong sustainability may be required for really sustainable development, but it implies a radical change in all sectors, and for the purposes of this study we assume that this is not feasible yet. The research limits itself to current policies and their incremental improvements.

The study looks at sustainable development from an anthropological rather than ecological point of view. It seeks a balance between human needs and environmental load. The approach emphasises human, urban and ecological interaction aimed at finding integrated solutions (Barton, 2000; Hough, 1995; Tjallingii, 1995 and 1996) and reflects the idea of sustainable development combining biophysical limits and human needs. In the built environment this is associated with the concept that building quality should be related to its environmental impact (Murakami et al., 2002b).

Sustainable building is defined as aiming to reduce harmful environmental impacts caused by construction, buildings and the built environment (MVROM, 1990). Sustainable housing management is defined as the maintenance, refurbishment and renovation of dwellings in such a way that the burden on the environment from the actions taken and the energy, water and materials used is reduced (Sunikka, 2001). The term ‘environmental policy’ is used in parallel to ‘sustainable building policy’. In the first stage of the study sustainable building includes energy, materials, waste and water, but including all these aspects in the later stages would have made the scope of the study too wide. As the research focuses on energy efficiency, the concept of sustainable building is related to the energy conservation impact. Most studies determine energy saving potential in existing buildings between 30-40% (ECN/RIVM, 1998; EC, 1999; Van der Waals, 2001). This improvement of energy efficiency is taken as a basis for a comparison at a building level. Assessing the impact of policies, the reference level is adopted from the anticipated stabilisation of energy consumption. In the UK, for example, demand for energy services such as comfort and home entertainment has increased by over 2% a year in recent years, more than offsetting energy efficiency improvements, so energy consumption has kept on rising, and there is no indication that the service demand trend will fall much below the current rate of around 2% per year. Whether energy consumption rises or falls over the next 20 years will depend on the energy efficiency rate (around 1.5% per year in 2000), and whether it can stay above the service demand trend (DEFRA, 2004a). Energy efficiency measures focus on the demand side. Considering embodied energy in buildings and materials, maximisation of energy supply from sustainable sources, improving thermal performance of the building envelope and energy efficient equipment, this research focuses on improving the thermal performance of the building envelope as it is considered as a necessary first step towards using more sustainable energy sources such as heat pumps while also increasing comfort. Regarding improvements in the energy supply, the term ‘more sustainable’ is preferred over ‘renewable’ as not all sustainable solutions qualify as renewable energy sources. As the research is limited to incremental improvements and aims to address the majority of stakeholders in the residential sector instead of few forerunners, energy measures focus on insulation and energy efficient windows instead of more innovative new technologies.

Electricity demand for household appliances is beyond the scope of this analysis because as products their application is assumed to differ from buildings, namely due a shorter life cycle, a less complex installation process and the industry being the main stakeholder of a policy. Unlike the market for household appliances, building markets are nationally orientated and differ from country to country. In many European countries, the housing market seems to have a structural market failure in terms of supply and demand, where for a long time, the demand for housing has exceeded the supply. In the market for household appliances, a consumer is able choose from a number of brands, each made by one specific manufacturer. When buying a house, a consumer does not have much choice and is not necessarily aware of the manufacturer. In the housing market, a lack of information is only one of several market failures. A consumer is probably interested in information about energy consumption but is not likely to be able to use this information in the purchasing decision since there is no variety of choice in housing.

The approach to improving energy efficiency adopted in the study is technical/scientific. The research is orientated towards technical measures, not the process. It recognises, however, that technical solutions can contribute only a small amount to reducing environmental impact: we heat homes for people, not buildings, and what is considered as an adequate indoor temperature, for instance, depends on the occupant. The behaviour of occupants is recognised as an essential factor in energy consumption.

The study focuses on European Union countries, and the research into technical building aspects in the empirical part of the thesis was based on the housing stock in the Netherlands and the UK. The concepts of sustainable development, building and maintenance used here should be seen in the European context; the concept and focus may differ in other countries. In terms of type of tenure (owner-occupied housing, social rented sector and private rented sector) this study focuses on the social housing sector in the Netherlands (Chapters 4 and 5). Social housing is defined as dwellings owned by non-profit making landlords who manage their properties within a public framework that aims at moderate rents and adequate quality and targets tenants with below-average incomes (Priemus, 1995).

The research was conducted in 2001-2006, leading to the publication of articles that are now chapters of the thesis, so these may contain some repetition and sometimes even inconsistencies. Inconsistencies partly relate from the policies themselves, which are strongly affected by political preferences and approaching elections. A new government may stop a well-running policy program if environmental objectives are not one of its priorities or resources are needed in another sector. The increasing knowledge about energy efficiency in buildings, development of products and experience from the implementation of policy instruments also lead to a reorientation of policies. When certain energy efficiency measures become commonly applied in practice, investing in policies targeted at these measures becomes very inefficient.

New policy developments and evaluations of sustainable building policies and energy saving targets are constantly taking place in the EU countries, so the information presented in the study is very time-sensitive: the EC Energy Performance of Buildings Directive (EPBD) was not in the picture at the start of the study in 2001, for example. We recognise that the research takes place against this changing economic and political framework: e.g. the EU now consists of 25 Member States instead of 15. Five years ago it was still felt necessary to emphasise the potential of the existing stock to deliver energy savings, which is why this is repeated in Chapters 3 and 4; it has now become a recognised issue in policies in most European countries (PRC, 2005). The study focuses on the present, but any assumptions that needed to be made are based on probabilities and include uncertainties, as is the case with any attempts to describe the future. The analysis of the implementation of the EPBD, for example, aims to quantify points for discussion but it is not a forecast; and uncertainty still dogs data on climate change, since not all the relevant processes are fully understood yet (Monni, 2005).

Some argue that the hypothesis of anthropogenic climate change is robust and broadly based (Lowe, 2000). The study has adopted the theory of climate change, accepting that there is evidence on climate change, global warming is caused by human-related CO_2 emissions and can thus be reduced by restricting energy demand (King, 2004) and that there are consequent environmental and socio-economic impacts. Some argue that, notwithstanding global warming, increased oil prices and the development of renewable energy sources will result in the elimination of fossil fuels, so no regulatory action is required

(Lomborg, 2002). The study disagrees with this argument (see subsection 1.3). The findings are also consistent with the decarbonisation of energy sources, however. Most sustainable energy technologies require buildings with a low energy demand, so improving the thermal envelope of the building is the first step towards using more sustainable energy sources such as heat pumps, and it can increase comfort, making investments in energy efficiency worthwhile, also in the long term, involving a switch to sustainable fuel.

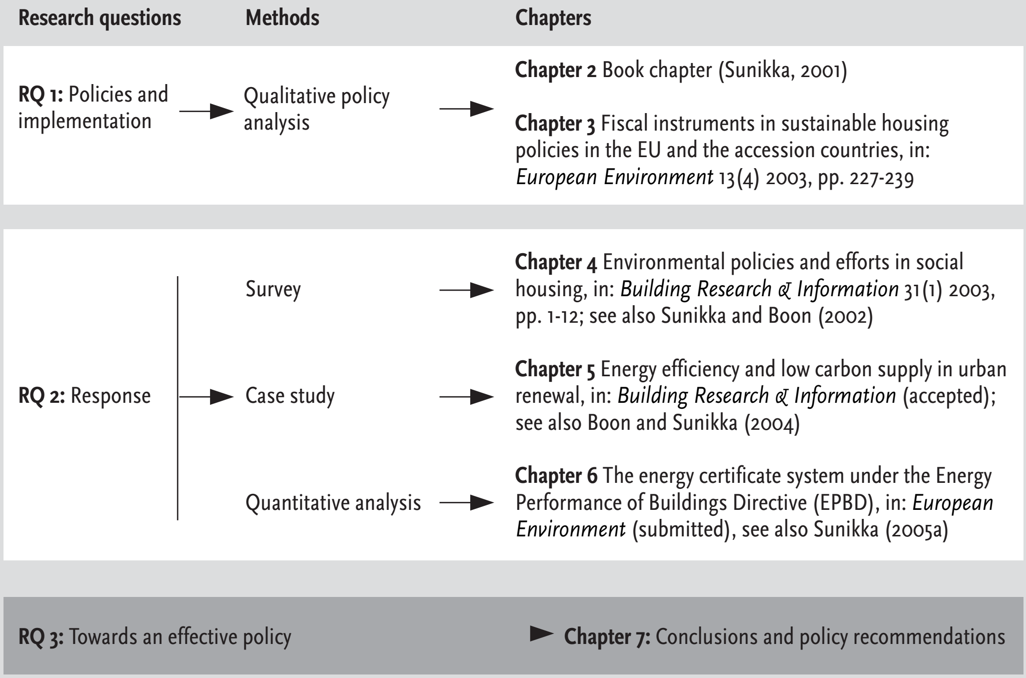
1.9 Research environment

The research was conducted at OTB Research Institute for Housing, Urban and Mobility Studies of Delft University of Technology, an interfaculty research organisation within the University involving the Architecture, Civil Engineering and Geosciences, and Technology, Policy and Management faculties. The research first started as part of the Delft Interdisciplinary Research Centre (DIOC) The Ecological City, continued by the Delft Centre for Sustainable Urban Areas (SUA), and is part of the Sustainable Housing Transformations research programme. It is related to the programme's two other dissertations on sustainable housing: *Sustainable Solutions for Dutch Housing, Reducing the environmental impacts of new and existing houses* (Klunder, 2005) and *Cost-effectiveness of sustainable housing investments* (De Jonge, 2005), and forthcoming doctoral theses by Milou Beerepoot (Effectiveness of energy policies for housing and potential for promoting innovations reducing CO_2 emissions) and Karin Soldaat (Consumer behaviour with regard to sustainable building options).

In order to expose the empirical part of the thesis (Chapters 4-5) to expert appraisal the research was conducted in the framework of the Habiforum programme 'Innovative Land Use' (BSIK) an expert network promoting innovations in spatial planning with government funding, and Corpovenista (Housing Associations Renewing the City, a project running in 2004-2007), a joint venture of Aedes (the branch organisation of Dutch housing associations), a number of Dutch housing associations, the Dutch government and SBR (Stichting Bouwresearch). These stakeholders sat on the steering committee of the project and commented on the results during the project.

The research into the EPBD energy certificate system in the UK (Chapter 6) was conducted in the Lower Carbon Futures research group at the Environmental Change Institute (ECI) of the University of Oxford. It took place in the framework of the 40% House project, which investigated how the UK government's commitment to cut carbon emissions by 60% can be achieved in the housing sector, focusing on demand-side influences on residential carbon emissions which can be changed through government policy. Carbon emissions from the UK housing sector were modelled using the UK Domestic Carbon Model (UKDCM). The 40% House scenario took as its starting point the

Figure 1.4 Research questions and methods in relation to chapters of the thesis



Source: author

best available projections of demographic change, and assessed what level of social and technological change would be required to make deep cuts in carbon emissions at the same time as allowing substantial growth in the total number of dwellings (Boardman et al., 2005). Implementing the Energy Performance of Buildings Directive was considered as one policy variable that could facilitate the renovation of the existing housing stock in the UK, and the research outcome was used as background material for the 40% House research project.

1.10 Organisation of the thesis

Question 1 (*policy*) is examined in Chapters 2 and 3. Chapter 2 is based on the book *Policies and regulations on sustainable building* (Sunikka, 2001) and the article *Sustainable buildings in Europe: Government policies and regulations* (Sunikka and Vijverberg, 2002) (published in Open House International, 27 (2), pp. 30-37). Chapter 3 is the article *Fiscal instruments in sustainable housing policies in the EU and the accession countries* (Sunikka, 2003) (published in European Environment, 13 (4), pp. 227-39).

Question 2 (*response*) is answered in Chapters 4-6, the article *Environmental policies and efforts in social housing: the Netherlands* (Sunikka and Boon, 2002a) (published in Building Research and Information, 31 (1), pp. 1-12; see also

Sunikka and Boon, 2002b), the article *Improving energy efficiency in urban renewal: case studies* (Sunikka, 2006a) (accepted to Building Research and Information; see also Boon and Sunikka, 2004) and the article *The energy certificate system under the Energy Performance of Buildings Directive (EPBD): improving the energy efficiency of the existing housing stock* (Sunikka, 2006b) (submitted to European Environment in 2005; see also Sunikka, 2005).

Question 3 is answered in Chapter 7, which focuses on the conclusions and policy recommendations.

Fig. 1.4 shows the chapters in relation to the research questions and methods.

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2 Policies and regulations for sustainable building: a comparative study of five European countries

Sunikka, M., 2001, **Policies and regulations for sustainable building, A comparative study of five European countries**. Delft (Delft University Press).

To provide a better understanding of how to launch an effective policy, this chapter presents a state-of-the-art overview of contemporary government policy on sustainable building, and environmental requirements in building regulations, in the Netherlands, Germany, France, the UK and Finland. It addresses the research questions: what are the possibilities for energy-efficient upgrading in housing renovation? What approach has been adopted in the national sustainable building strategies of the Netherlands, Germany, France, Finland and the UK in terms of policy, implementation and response? What sustainable building requirements are specified in the building regulations in the Netherlands, Germany, France, Finland and the UK? The chapter is based on a study 'Policies and regulations for sustainable building, A comparative study of five European countries' (Sunikka, 2001). The information originally analysed in 2000-2001 was updated in the beginning of 2006.

Abstract
A great deal of research into sustainable building has been done in recent years, but it takes a long time for ambitious policies and research findings to be adopted in the day-to-day practice of the construction industry, where the concept is still seen as vague and peculiar. To provide a better understanding of how to launch an effective policy, this article presents a state-of-the-art overview of contemporary government policy on sustainable building, and environmental requirements in building regulations, in the Netherlands, Germany, France, the UK and Finland. It is based on a study conducted for The Ecological City, one of the key projects of the Interdisciplinary Research Centre at Delft University of Technology.

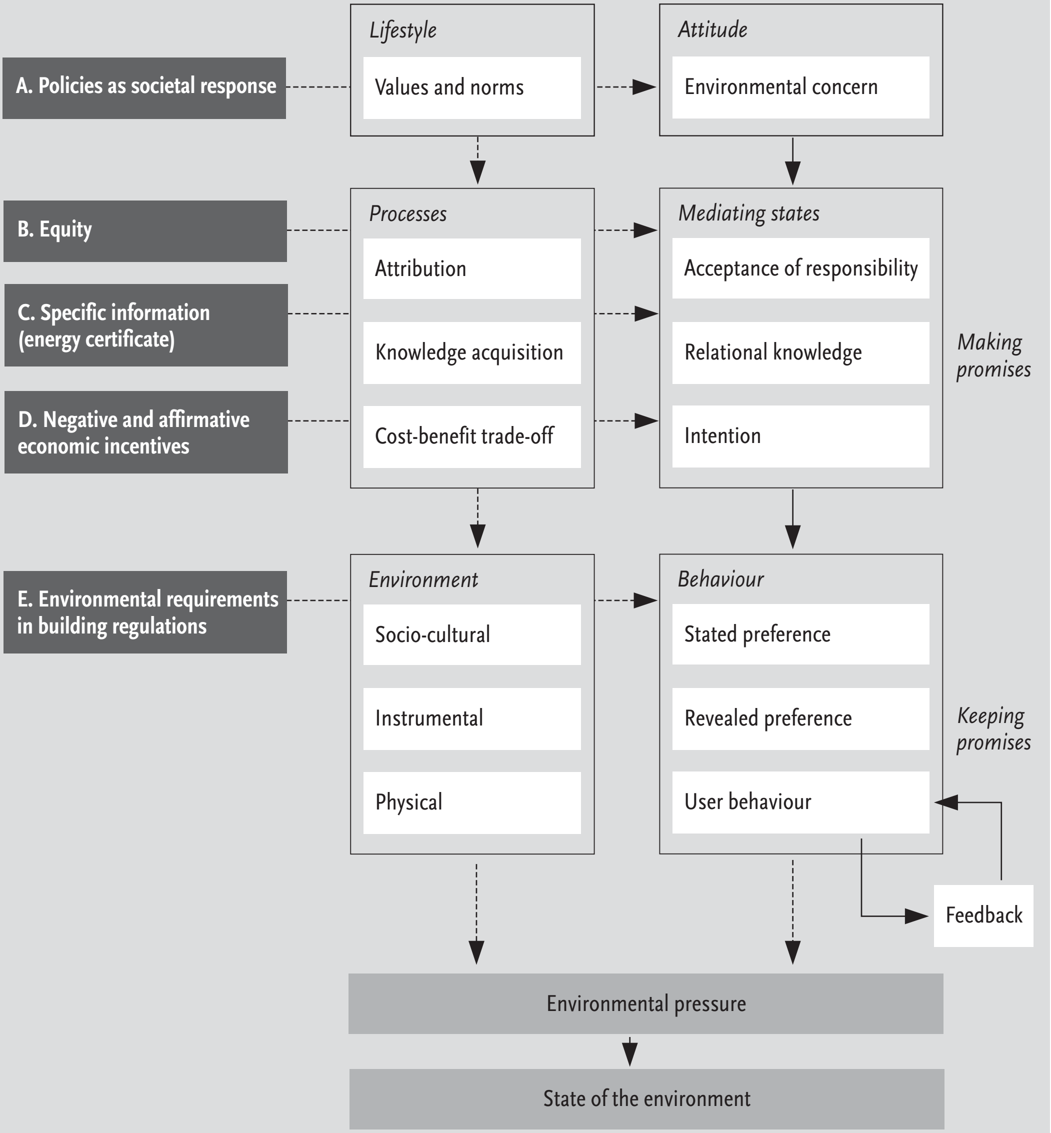
Keywords: Sustainable building, policy, building regulations, energy saving, material and waste management

2.1 Introduction

Under the Kyoto agreement the industrialised countries have agreed to reduce their total levels of CO_2 emissions by 5.2% on the 1990 figure between 2008 and 2012 (UNFCCC, 1997). The European Union is preparing to implement this commitment as a community, taking the community's emissions and restrictions as a whole. Under Article 4 the breakdown within the European Union is Finland 0%, Netherlands -6%, UK -12.5% and Germany -21%. It cites 1990 and 2010 as the base years. The Kyoto Protocol will increase the pressure to make concrete efforts to reduce carbon dioxide emissions from buildings, which account for over 40% of total energy consumption in the European Union, and 30% of CO_2 emissions (Bourdeau, 1999; Awano, 2005). The construction sector itself is estimated to generate approximately 40% of all man-made waste, and construction and demolition wastes add up to some 180 Mtons in Europe each year (Report DGX1 EC, 1999). According to the World Watch Institute the entire global community will run out of raw building materials by approximately 2030 if this trend continues (Brown, 1990). A great deal of research into sustainable building policies has therefore been done in recent years (Van Hal, 1999; Murakami et al., 2002; NOVEM, 2002; Van der Waals et al., 2003; Hasegawa, 2003; OECD, 2004; PRC, 2005; Awano, 2005), but it takes a long time for ambitious policies and research findings to be adopted in the day-to-day practice of the construction industry, where the concept is still seen as vague and peculiar.

The study addresses the environmental pressure from the residential sector, focusing on reducing carbon dioxide emissions and the depletion of natural resources by extending the life cycle of the existing housing stock. Policy instruments are often used without understanding that attitude and behaviour are seldom related. In order to gain an understanding of why positive attitudes have not materialised in actions, Fig. 2.1 is used as a framework in this study (van Raaij, 1998). Fig. 2.1 shows that policies (A) influence the values and lifestyle norms of households, which should show up in attitudes as environmental concern. Before attitudes materialise in actions, however, there are mediating states: stakeholders of a policy have to accept their responsibility, understand environmental impacts of their actions and be able to consider cost-benefit trade-offs in their intentions to act. Factors that influence these states are equity (households need to feel that everyone is doing their share to reduce carbon emissions) (B), specific information (C), and negative and affirmative economic incentives (D). Building regulations (E) shape the socio-cultural, instrumental and physical environment, which consequently shapes behaviour, from stated preferences to revealed preferences and user behaviour. The environmental pressure is a result of the socio-cultural, instrumental and physical environment and the behaviour of occupants, and is not what might expected based on attitudes (making promises),

Figure 2.1 Policies and policy instruments in the context of a behavioural model by Van Raaij (1998; the structure has been simplified and modified by the author and some terms have been defined differently)



Source: Van Raaij, 1998; modified by author

since not all intentions materialise in behaviour (keeping promises).

The policy analysis in this study is based on a description and explanation of current policies (Twaalfhoven, 1999). The Netherlands, Germany, France, the United Kingdom and Finland were selected as representing advanced sustainable building in Europe. Being members of the European Union, these countries have similar political conditions, and they share a certain consensus on the concept of sustainable building that makes consistent comparison possible. The policies are described in terms of actual policy and its implementation. The study focuses on the research questions: What is the nature of renovation in the residential sector that policies for sustainable building need to consider and what are the possibilities for energy efficient upgrading in housing renovation? What approach have the Netherlands, Germany, France, Finland and the UK adopted in their national sustainable building and renovation strategies? What principal requirements do the building regulations lay down in support of national strategy on energy saving, materials and waste management and water conservation?

The study regards the aim of sustainable construction as being to reduce harmful environmental and health impacts caused by construction, buildings and the built environment (MVROM, 1990), which need to be seen in the European context. It focuses on four generally recognised and measurable aspects of sustainable building: energy saving, materials management, waste management and water conservation. In terms of type of tenure (owner-occupied housing, social rented sector and private rented sector) this study focuses on the social housing sector. Social housing is defined as dwellings owned by non-profit making landlords who manage their properties within a public framework that aims at moderate rents and adequate quality and targets tenants with below-average incomes (Priemus, 1995). The concept of sustainable development used here is the institutional one (Perman et al., 2003). The study makes a few references to the effects of specific national programmes, but it is not an impact analysis. Many policies and tools have a relatively short history, and countries have yet to collect consistent information on the impact of their strategies; for a comparative analysis of sustainable building policies they should ideally be evaluated either in two identical places where the policy is implemented in one and not in the other, or as a 'before and after' comparison (Tricart, 1991). It should be noted that new policy developments and evaluations of sustainable building policies and energy saving targets are constantly taking place in the EU countries, so the information presented in the study is very time-sensitive. It provides an overview of developments in sustainable building policies around 2000, updated in the beginning of 2006.

The study begins by discussing the nature of renovation in the residential sector in section 2.2. Section 2.3 discusses the approaches to sustainable building in the five countries. The data have been obtained from national ministries and other government agencies involved in developing legislation, administrative procedures and action programmes that have an impact on the built environment and housing subsidy criteria, and the 27 national progress reports for the third conference of European Ministers on sustainable housing (NOVEM, 2002). Section 2.4 compares the environmental requirements in the building regulations, that also represent the state of the art in new construction, regarding energy saving, materials and waste management and water saving. The European Union's environmental policy is described in section 2.5. Section 2.6 draws conclusions.

2.2 The nature of renovation in the residential sector

Renovation will become the dominant construction activity in Europe in the coming years (Kohler et al., 1999). Policies for sustainable building are often compared to policies for sustainable products but there are several differences between products, new construction and management of the existing stock that should be considered while setting sustainability policies for the existing housing stock. Buildings do not remain in a passive state once built; they are maintained and changed. Neglecting maintenance or renovation has consequences for the condition of a building, and non-action also has cost implications. The cost efficiency of energy measures depends on their timing in relation to the maintenance cycle. Compared to new construction, renovation can be time-consuming and labour-intensive. External incentives like urban renewal and major maintenance (usually with a 15-20 year cycle) provide a good intervention point, as improvements in energy efficiency can be coupled with other renovation measures that would have been undertaken anyway, thus decreasing the cost. Urban renewal enables addressing the negative externality in a neighbourhood that, if deteriorating, make extra investments unattractive in the rental sector if increases in rents are not possible due to the unwanted location anyway. The long life cycle and the slow turnover of buildings compared to products such as household appliances are likely to delay the implementation of the energy saving potential identified in the existing stock. The long life cycle can be a benefit, however: once an energy-saving measure is implemented it will deliver for a long time to come.

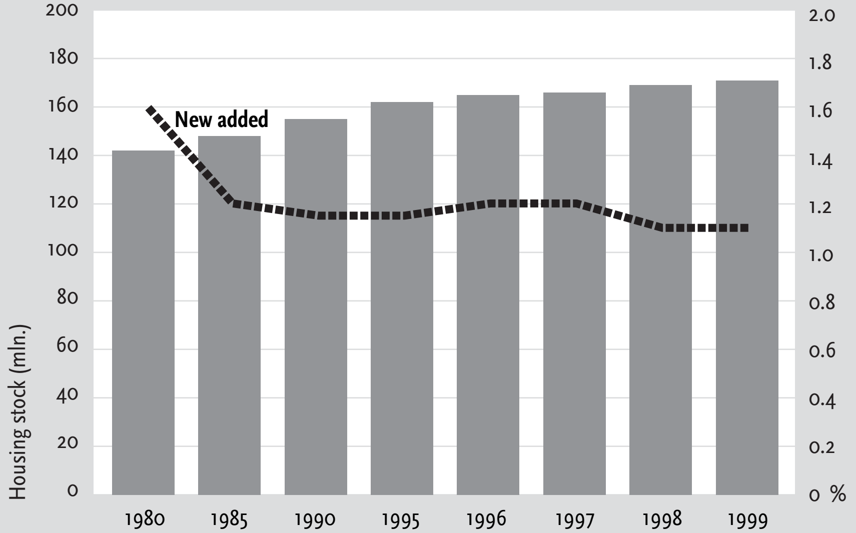
Compared to new construction, more renovation is done by private households and consumers than professional operators. Many occupants tend to rely on informal repair diagnoses made by themselves or relatives or friends, who are not necessarily aware of energy conservation measures. In the owner-occupied and private rental sector, the occupants may not have any experience of procurement or getting a contractor. Renovation is sometimes considered as providing opportunities for the construction industry (Awano, 2005), but owing to the high labour cost, small scale and labour-intensive nature of renovation it is bound to become more expensive and it actually increases the DIY (do-it-yourself) market.

In the Netherlands renting from the social sector is popular among many socio-economic classes. However, in many countries, the tenants in social housing are primarily the economically disadvantaged, who have little choice as to where they can live. The groups in question include foreign immigrants, young families and the unemployed. These tenants, who often receive housing allowances, do not have extra money to invest in environmental improvements. Households living in badly insulated homes already pay higher energy bills owing to higher consumption and thus suffer more from taxes, without having the resources or access to low-interest loans to invest in energy efficiency. Through their relatively high energy bills and high obstacles regarding insight and selfhelp ability, these people are less interested in energy saving and therefore less active in gathering information on it, and they also make less use of the facilities than the high-income group (Bruel and Hoekstra, 2005). There are also different kinds of renovation, and occupants' antipathy to renovation may increase if they have to move out temporarily during the work or be moved to new homes altogether.

If a household decides to renovate, it is more attractive to invest in work that brings immediate pleasure, such as a new kitchen or bathroom, than in technical improvements, which are often invisible once they have been made, as immediate payoffs are overvalued relative to more distant ones (Brocas et al., 2004). This present-day bias, also known as hyperbolic discounting, is one of the factors in the inertia when it comes to improving energy efficiency in renovation. Waals et al. (2003) argue that cost-related barriers are only partly true, as cheap options like double-glazing are sometimes left out in renovation projects but more expensive technology, like photovoltaic systems are successfully applied. Solutions for reducing carbon dioxide emissions are unlikely to be adopted in urban renewal projects unless people feel they have more to gain than economic and technical benefits; this applies particularly to comfort and quality. If energy measures can serve two purposes, they may have a better chance of being implemented: for example, solar energy has a high demonstration value, showing off the residents' energy concerns and the investments they have made, and this could reduce the inertia when it comes to improving energy efficiency and increase willingness to pay.

When international objectives are translated into national strategies in the building sector, differences arise owing to factors such as population density, political conditions, the national economy, geography and climate conditions. Table 2.1 and Fig. 2.2 provide basic information on variables which affect national sustainable building strategies. Population density, for example, which places pressure on new construction and has an impact on land use, varies considerably among the selected countries, and the Netherlands is already facing a shortage of land for building along with the need to preserve open spaces in the near future. The figures, however, conceal marked regional differences: although Finland is otherwise sparsely populated, the Helsinki Metropolitan Area has a population of 0.89 million people with a density of 1,199 inhabitants per sq. km. What policies are suitable also depends on the tenure mix, as structures of ownership differ from one country to another: in the Netherlands social housing accounts for 75% of the total rented stock, whereas the corresponding figure for Germany is a mere 15%. With the exception of Finland, where the government strongly supported housing construction during the recession in the nineties, the percentage of social rental housing among newly completed residences is on the decline. The age structure

Figure 2.2 Annual new housing in the EU as a percentage of the total housing stock



Source: Thomsen, 2002

of the existing housing stock also varies considerably from one country to another: the stock in Finland and the Netherlands is relatively new, and as it was built primarily after the energy crises in the seventies it is also relatively energy-efficient, whereas the existing housing in Germany and France is older and was built to less stringent standards, especially the UK has major physical problems in the older housing stock (Skifter Andersen and Leather, 1999).

The housing sector is very sensitive to demographic changes that influence housing demand. The useful floor area per dwelling has continued to grow due to increasing prosperity and the resulting space consumption; in the Netherlands, the average useful area per dwelling was 112.0 m^2 in 1998 (Sunikka, 2001). Increased floor area means a need for more energy and land. In addition to placing new demands on the social housing sector, these trends also have a direct environmental impact. For example, the household structure is changing, contributing to increased heating energy consumption. In 1999, single and two-person households accounted for over a third of all households in all of the countries studied. In the Netherlands, the average size of households dropped over a twenty-year period from 2.8 in 1980, to 2.3 in 1999, even dipping as low as 1.6 in the greater Amsterdam area. In 1999, the average size of German households was 2.2 persons, the lowest in this inventory; 33% of the Dutch and 37% of the Finnish households consisted of single persons (Haffner and Dol, 2000). According to the forecasts, households will continue to diminish in size, which will result in an ever-greater demand for small, affordable apartments. Another clear trend is the increasingly ageing population, which will change the future composition of social housing tenants (Sunikka, 2001). It is expected that in 2020, every fifth citizen in the countries studied – with the exception of the Netherlands – will be over 65 years old (Haffner and Dol, 2000). Due to changing family structures and a more individual style of living, many of the elderly will be living alone. This will

Table 2.1 Basic variables that affect national sustainable building strategies

Country, area, population and population density						
		km²		Population x1000 (2001)		Population/km²
Netherlands		41,034		15,987		390
Germany		357,031		82,260		230
France		544,000		59,344		109
United Kingdom		242,910		59,756 (in 2000)		246
Finland		338,145		5,195		15
Age of dwelling stock						
	Year	pre-1919	1919-45	1946-70	1971-80	post-1980
Netherlands	2000	7.4	13.3	32.3	18.4	28.6
Germany	1998	16.0	13.0	48.0	11.0	11.0
France	1996	21.0	12.0	33.0	13.0	21.0
United Kingdom	1996	20.0	21.0	22.0	25.0	13.0
Finland	2000	1.8	9.4	31.2	23.8	32.7
Dwelling stock by type of tenure (% of total stock) in 2000						
		Rent	Social rented dwellings as % of rented stock		Owner-occupied	Other
Netherlands		47	75		53	0
Germany (1999)		57	n/av		43	0
France (1999)		38	41		54	8
United Kingdom		31	69		69	0
Finland		31	52		58	11

Source: Sak and Raponi, 2002

soon create a need for requirements regarding accessibility in social housing.

The estimates of how much savings are possible in buildings vary but a typical value is 30%-40% improvement in energy efficiency (ECN/RIVM, 1998; Slot et al., 1998). This does not imply that the same decrease in total energy use or CO_2 emissions would be feasible because even if there was policies to address this potential, it not likely that the policy can be implemented in such a way that all these savings will be achieved. Housing prices and investments are very sensitive to changes in the economy. Policies imposed on the housing sector are complicated by the fact that while housing is considered as a basic human need that everyone has a fundamental right to, at the same time it is subject to the market economy. Building activity in the construction industry is one of the industrialised countries' main economic bases, accounting for around 5-15% of GDP and 40-55% of gross capital formation, and the sector is a major industry and a large-scale employer (Awano, 2005). Measures that restrict or regulate construction, e.g. to support renovation, have an impact on the national economy and are thus not always favoured by government. Feasible policy targets require information about the developments of the existing housing stock. Traditionally, housing surveys have been used for these purposes but compared to predicting demand in new construction, there is a lack of reliable data on renovation and demolition rate. Demolition rate is usually derived from the assumed life times of buildings so that with life expectancy of 50 years, the demolition rate is estimated to be 2%, whereas the real demolition rate has been much lower, in Germany for example, it is has been close to 0.5% (Kohler and Hassler, 2002). The reasons for demolition are complex and do not necessary correlate with the age or the technical state of the buildings. When buildings reach the end of their functional life cycle, their technical life cycle usually still has a long way to go. Policies tend to forget that housing management is a question of financial choices. During its economic service life a building should create a positive cash flow so the gross annual rent exceeds the costs of running and operating the building. The actual service life can be even shorter if the price that the owner of the building would obtain for selling or using the site for redevelopment is higher than the value of the existing building in current use (Awano, 2005). Collecting knowledge of the building stock is important for an anticipating policy and its' evaluation.

2.3 Government policies on sustainable building

The Netherlands
The first comprehensive environmental policy in the Netherlands was the National Environmental Policy Plan Extra, dating back to 1989 (MVROM, 1990). The national strategy was redefined in the Action Plan for Sustainable Building, Investing in the Future (MVROM, 1995) and the Second Action Plan (MVROM, 1997a). The environmental objectives were based on four principles: harmonisation, implementation, consolidation and preparation. Current policy on sustainable building in the Netherlands stresses urban development, consumers and energy (MVROM, 1999a). Government strategies and regulations are slowly turning towards existing buildings, and the government has set a target of reducing CO_2 emissions from the existing building stock by 3 Mt by 2010 compared to the organic trend (MVROM, 1999b). Another trend is a shift of focus to the urban level, where developments are taking place, and where far more aspects of sustainable development can be taken into account. The urban renewal programme was introduced in 1997, and a few years later the objectives were set out in a housing white paper (Nota Wonen, MVROM, 1997b; 1999b). Although ambitions have since been lowered, the objectives are still high, encouraging redifferentiation of the housing stock, demolition and conversion in order to restructure a large number of urban districts with a large proportion of social rented housing. The paradox of the compact city, which is pursued as an ideal in current planning policy, is dealt with in the Second National Environment Policy Plan (MVROM, 1993): environmental problems can accumulate in a compact city and can easily exceed the maximum permitted levels, while the environment should still be a crucial factor

even in cities. The compact city can support sustainability and reduce the demand for transport but it may put more pressure on open spaces, the environmental pressure per unit is high and there are problems with living conditions and noise (Priemus, 1999). The Dutch housing sector is unique in that housing associations manage a large volume of housing: some 75% of the total rental stock in the Netherlands consists of social housing units and renting is popular among large segments of the population. In 2000, 36% of all housing in the Netherlands was social housing (Kruythoff and Haars, 2002). Social housing is mostly concentrated on urban renewal areas so housing associations have a very central role in the process (Ouwehand and Van Daalen, 2002). The introduction of a bigger role for the market mechanism in urban renewal in the national report on housing in 1989 was an important move in the direction of a property-led approach to urban renewal, followed by the operation in 1995 through which the housing associations were made financially independent from the central government, making the risk-reward aspect of renewal projects more important for them. For housing associations, urban renewal increases the value of their housing stock so their existence already facilitates urban renewal (Verhage, 2005).

Dutch policy has been implemented by a mix of legislative push (building regulations) and voluntary pull measures (subsidies, voluntary agreements, communication tools) aimed mainly at the construction industry as the principal target group (MVROM, 1990). An example of a measure that combined various policy instruments was the Energy Premium Regulation (EPR) scheme: this included the Energy Performance Advice (EPA), Green Investment scheme and Regulatory Energy Tax (REB), which was introduced in 2000 to encourage households to invest in energy efficiency measures (including in the existing housing stock) – only to be abolished in 2004. The Dutch government invests substantial amounts in urban renewal and intends to spend about US $2 billion up to 2010 to promote urban restructuring (Priemus, 1999). In order to facilitate coherent and integrated policy it has brought together a number of subsidy schemes in the Investment Budget for Urban Regeneration (ISV), a special purpose grant scheme designed to improve the quality of the urban environment.

Environmental aspects still play only a minor role in renewal projects in the Netherlands, however, (Bus, 2001) and the importance of investment in such things as nature conservation and landscape (‘green investment’) and water management (‘blue investment’) is still underrated (Priemus, 2002). Notwithstanding well-defined series of policy plans on sustainable building, great efforts are still needed to achieve the widespread application and firm embedding of sustainable building in day-to-day building practice. Lack of demand and low willingness-to-pay remain the main obstacles to sustainable building (SBR, 2001). The most successful area in Dutch sustainable building policy has been information dissemination. The National Package for Sustainable

Building, a collection of common measures and recommendations to achieve sustainability (SBR, 1998a; 1998b), has been available for residential building since 1995, and is well known in the Dutch construction sector: 61% of building permits adopted measures from the Package, and as many as 80% in 2000 (MVROM, 1999c). The average reduction in the environmental load attainable by adopting these measures is still rather small, however (Blaauw and Klunder, 1999). Awareness of the policy instruments has been good and they are regarded as legitimate, but they have not been so successful in terms of environmental effectiveness and cost-efficiency. The Energy Premium Scheme (EPR) was well known to the target group, but it attracted a large proportion of free-riders, as many of the measures eligible for funding were already standard practice in the industry by the time it was introduced. The average cost to the government worked out at 300 euros per tonne of CO_2 reduction, and the administrative cost of handling the applications was high, with each application leading to a relatively small energy saving (Harmelink et al., 2005a). Voluntary long-term agreements (LTAs) have played an important role in sustainable housing policy in the Netherlands. In 1997, Aedes, the umbrella organisation for Dutch housing associations entered into an environmental agreement with the government on behalf of its members. To help housing associations translate the agreement into a practical environmental policy, Aedes has also developed methods such as the Manual for Sustainable Construction and Management and a step-by-step plan for Sustainable Housing Management. The research shows, however, that voluntary long-term agreements (LTAs) have not led to higher priority being attached to investment in energy saving in the sectors involved, and they are less effective and efficient than the government anticipated (Harmelink et al., 2005a). In spite of comprehensive subsidies the energy efficiency of most of the existing stock in the Netherlands is still poor, and a considerable energy saving potential has been identified (Slot et al., 1998; ECN/RIVM, 1998; Van der Waals et al., 2000; Harmelink et al., 2005b).

Germany

The first Environmental Programme in Germany dates back to 1971. Environmental protection has been an important component of local policy over the past thirty years, and in 1994 the principle of sustainable development was laid down in the German Constitution in terms of ‘bearing responsibility for future generations’ and German environmental policy was set out in the Environmental Policy Report. The German government has not defined a series of action plans specifically for sustainable building, but it is seen as making a major contribution to sustainable development: the National Climate Protection Programme (NCPP), for example, identified the renovation of existing buildings as a priority. Private households and buildings are expected to be responsible for additional reductions in emissions of 18-25 Mt, 17-19 Mt of this from four specific groups of measures to save energy in buildings and save electricity (BMU, 2000). Sustainable building policy stresses energy efficiency, the promotion of solar energy and waste management, often from a very technical point of view. An important event in this area was the Solar Energy in Architecture and Urban Planning Conference in Berlin in 1996, at which the Ministry of the Environment declared that society's concept of energy was in need of a thorough overhaul. Passive energy houses – a concept being developed by the independent Institute for Passive Housing – have become well known and are considered a national innovation, and a new trend aims to change buildings from passive energy consumers to energy producers. The field of building biology, by contrast, is a materials-based specialist area of sustainable construction, which views users as key actors and promotes the use of natural materials and a healthy indoor climate. Building biologists have occasionally engaged in arguments on energy development and, for instance, criticised passive energy houses for using environmentally unfriendly materials and large amounts of insulation, which prevents buildings from breathing (Van Hal, 1999). Environmental protection in the traditional, ecological sense, is also an important issue in planning. The German government sees protecting biological diversity as a focal issue in the 21st century. Reusing built-up land and preserving natural areas will in future take priority over new uses, and all new land designated for construction projects must undergo an environmental analysis.

Many national governments are afraid to resort to environmental taxation and other stringent measures as part of environmental policy, but the general population in Germany seems to accept measures of this kind. German policy can be characterised as mandatory, consisting mainly of push measures relying on building regulations and standards that support environmental objectives, as well as pull measures such as subsidies and education. Much emphasis has also been placed on information in an effort to promote environmental values in general. The 'lifelong learning' process begins in the nursery, and is based on shared responsibility. Environmental taxes are used as an essential tool to enforce sustainable building practices and to implement the polluter-pays principle. The Ecological Tax Reform was introduced in 1999 to encourage energy saving and promote renewable energy sources: energy tax revenue is partly used to fund renewable energy projects (IEA, 2000) but also other aspects that do not contribute to environmental improvements like pension funds. The objective of German environmental policy is to internalise the external costs of environmental protection: applying the polluter-pays principle would thus require energy-related costs to be fully integrated in home owners' and occupiers' expenses. In 1996 the Federal Environment Agency in Germany studied energy-induced damage related to habitation: according to the research the energy-related costs amounted to €7.7 billion per year, or roughly €2.5 per square metre of the total housing stock per year (Lintz, 2000). Regulations and norms in Germany ensure that social housing providers observe certain environmental measures, including in renovations. Their pursuit of environmental policies and investments in sustainability improvements are not left to their discretion, depending on their resources. However, the volume of German social housing is not that large, or significant, accounting only for 15% of the country's total housing stock. In fact the German term for social housing refers more to a subsidy system than the physical housing stock. The financial impact of German public policy has been reflected on the social housing sector with the introduction of new thermal regulations and the renovation expenses.

As a result of long-term policy and the promotion of green consumption patterns, partial results have been achieved in the overall stabilisation of national energy consumption and waste generation (Federal Statistical Office, 2001). Germany has a considerable capacity for treating demolition waste, though the processing facilities available vary from one region to another. High waste costs have made the construction industry pay attention to the amount of materials they are using, reuse and recycling. Ecology is recognised as a positive value throughout society and, unlike in other European countries, green consumption is a well-known and accepted concept in Germany. Delay between scientific statements and political action has been shortened by information dissemination by the media (Haigh, 1996). Public awareness has contributed to the political importance of the environment. Not all the policy targets have turned out to be feasible, however. Under the climate protection programme for existing buildings the Federal Investment Bank (KfW) has offered loans at 3% below market interest rates for measures to reduce emissions with a minimum CO_2 reduction of 40 kg per m^2 per year. An allocation of around €3.2 billion has thus enabled 166,600 dwellings to be renovated (BMVBW, 2004). These subsidies are likely to yield a CO_2 reduction of 2-2.5 Mt by 2005, less than half the CO_2 reduction anticipated in the National Climate Protection Programme (Wagner et al., 2005). Four measures under this programme, with concrete CO_2 reduction targets totalling 17-19 Mt, will deliver roughly a third. The results expected from policies would appear to be overestimated, given delays in implementation, watering-down of policies when they are implemented and the inclusion of policies beyond the national scope; some of the expectations have been overoptimistic, too, with policy-makers tending to overestimate outcomes when under pressure to deliver overall targets (Wagner et al., 2005). In the beginning of 2006, the new government decided to make an annual investment of €1.5 milliard in the programme to reach the national CO_2 reduction targets. The aim is to reach a 5% annual reduction in the energy consumption of buildings built before 1978 (Cobouw, 2006). However, the new government has also considered decreasing or stopping the eco-taxes that might cause Germany to lose its position as a forerunner in environmental policies.

France

The French government recognises building as a central social, economic and environmental concern, but it has not yet set out a specific action programme for sustainable construction, apart from the High Environmental Quality (Haute Qualité Environnementale) initiative. The HQE concept covers the whole life cycle of a building, under the main headings of eco-construction, eco-management, comfort and health. Environmental aspects should be integrated in every phase. After new construction the objective is to extend the sustainability of existing buildings. HQE is generally estimated to result in a 5-15% increase in investment cost because of the additional time involved in studies, new materials and non-standard working practices. These costs should be offset by energy savings (Association HQE, 2000). Minimising waste is one of the priorities in sustainable building, and the Green Construction Sites programme (Chantiers Verts) aims to minimise disturbance from construction sites to the surrounding environment, to support environmental waste management and to integrate waste management procedures in environmental management. As regards general energy policy, France has reiterated its need to develop renewable energy sources to maintain self-sufficiency in energy because of its very limited domestic energy resources and dependence on imported energy and nuclear power. Almost 80% of the electricity consumed in 1998 came from 57 nuclear power plants. The government had planned to obtain 100% of the country's electricity from nuclear power, but environmental objections to this have increased in recent years (IEA, 1998). In 2000 France announced an extensive ten-year plan to cut down carbon emissions in order to meet the Kyoto commitments on reducing greenhouse gases from transport, industry, agriculture and construction. It has been estimated that it will only be possible to fulfil international agreements if the construction sector stabilises its CO_2 emissions and the transport and energy industries cut theirs by one-third (Habitat et Société, 2000). As can be seen from the riots in French suburbs in autumn 2005, urban restructuring is an urgent issue in France. The French government launched a major urban renovation programme in 2000, environmental housing management being one of the topics. In France, urban renewal focuses on social housing areas in the suburbs (banlieus). In the past socio-cultural and socio-economic objectives were at the core of the urban renewal policies but the actual policy aims to attract private investment into urban areas, focusing on the physical-economic objectives (Verhage, 2005). Compared to other EU countries, the role of the state in urban renewal procedures remains important, although the role of local planning authorities is increasing. In 2000, the French social housing providers, the HLM institutions, committed themselves to the principle of sustainable development. The policy targets are ambitious, but of descriptive nature and without measurable objectives, monitoring will be difficult. Environmental agreements, which allow incentives in energy and waste improvements in HLM residences, have been made between the social housing sector, ADEME and Gaz de France.

Enforcing the thermal regulations is among the priorities set in an effort to achieve the targets in the construction sector, but the French approach to sustainable construction, as represented by the HQE scheme, can be described as voluntary and holistic: it is not restricted to a limited range of specific technical issues and it is one of the few approaches that consider the spatial quality of buildings as part of sustainable construction by emphasising locality. Public projects are current HQE priorities and used as an example to promote sustainable building. Experimental building projects can be granted financial support from the government provided they are approved as ‘environmental quality’ schemes (REX-HQE). In the field of urban renewal, the state provides subsidies for improvements to existing social housing through a programme known as PALULOS (Prime d’Amélioration du Logement à Usage Locatif et Occupation Sociale). A reduced VAT rate of 5.5% applies to renovation, conversion and rehabilitation work on social rented housing. In the Paris region there have been efforts to examine the use of particular economic instruments to encourage sustainable construction (Sellier, 2005). In France, VAT can be reduced for renovation projects, a provision that has enabled investments in energy efficiency.

In general, sustainable development is still a relatively new concept in France: Germany implemented just under 1,500 Agenda 21s in 1999, for instance, and France only about 20. Factors that have slowed down the promotion of sustainable housing in France include the general pattern of consumer behaviour and attitudes towards recycling or environmentally friendly consumption, which are still not very ecological. Also, potential innovations in the eco industry have yet to have any impact on consumption patterns (Bourdeau et al., 1998): reuse of construction waste, for example, is still inefficient as compared to that in Germany or the Netherlands. The existing housing stock in France is relatively old and thus energy-inefficient. Most homes were built before 1975, the year when the first thermal building regulations came into force.

United Kingdom

Reflecting the increasing importance of climate change on the political agenda, the UK government adopted the ambitious target of reducing carbon dioxide emissions by 60% by 2050 in its 2003 Energy White Paper (DTI, 2003). The white paper brings together all the existing policies on achieving carbon reductions and provides a framework for energy policy. The general strategy for sustainable construction, Building a Better Quality of Life, sets out ten themes for practical action (DETR, 2000). It is the industry-led Rethinking Construction report, however, that has become a banner under which the government, the construction industry and its clients are working together to improve the quality of the construction sector (Egan, 1998). The Egan report does not focus on environmental issues, but it overlaps with sustainability objectives in several areas, and also puts emphasis on improvements in the social housing sector. The UK government's Green Paper on Housing, published in 2000, commits the government to implementing the Egan report. The government has also launched a Foresight Programme setting out scenarios for the future of various industries, including the construction sector, by 2030, providing a framework for future development scenarios (DTI, 2000). Reducing the amount of waste at all stages is one of the main targets of UK policy, and the government's objective is to reduce the proportion of waste destined for landfill from 70% to 60% in 2005. Less Waste, More Value is a government programme that promotes the waste hierarchy. It sets the following priorities (in order of importance): waste reduction, reuse of waste, recycling and finally waste disposal (DETR and the Welsh Office, 1998). In the UK, a housing policy is regarded mainly as a means to solve housing problems for the poorer sections of the population, so housing rehabilitation policies are focused on selected dwellings and people for which renewal on market terms in not expected to take place without public support (Skifter Andersen and Leather, 1999). In addition to the role of the public sector, materialised in single-purpose agencies (Urban Regeneration Companies) that followed the report of the Urban Task Force in 1999, private households play an important role in urban renewal in the UK (Verhage, 2005).

Government policy uses fiscal and regulatory policy instruments to promote sustainable building. The Office of the Deputy Prime Minister expects the revision of the building regulations in 2005 to bring an improvement of around 25% in the performance of new dwellings and 25-27% in the performance of new buildings other than dwellings. Improvements on a lesser scale will also be obtained whenever people carry out work on existing buildings, compared to the 2002 regulations (ODPM, 2004a). The Home Energy Conservation Act requires local authorities to plan for a 30% reduction in CO_2 emissions from new residential construction by 2011. The Landfill Tax was introduced in 1996 to induce the construction sector to minimise, reuse and recycle waste, and it has already contributed to an increase in crushing and recycling sites (Hasegawa, 2003). The UK government puts a lot of effort into researching and promoting sustainable building, but it implements its strategy mainly through voluntary measures and relies on the private sector. The way sustainable building is seen, it should also make good business sense and improve the image of the building industry. In the Opportunities for Change report, the construction industry's response to government policy, commercial operators indicated their interest in the government taking the lead in sustainable development (DETR, 1998). The government is tracking progress towards the Egan agenda with an annually published set of Key Performance Indicators (KPIs) that measure building performance at project level. The KPI sustainability set covers waste, energy, water, ecology, transport and recycling.

The quality of existing housing in the UK is poor compared to that in Germany or Finland (Sunikka, 2005), and the carbon reduction targets cannot be met unless this improves (Boardman et al., 2005). The technical potential of the UK stock to deliver energy savings, irrespective of cost, is estimated at 40-42% (DEFRA, 2004a). The economic potential, on the other hand, is lower because of long payback times and the fact that it is not generally economic to replace equipment much before the end of its useful life; the economic potential for the existing housing stock is estimated at 17-21% for 2010 and 28-32% for 2020. On top of this, the UK government recognises that around 4.3 million households in England are officially designated as 'fuel poor', i.e. unable to obtain adequate energy services (mostly space heating) for 10% of their income (Smith, 2001; DEFRA, 2004b). Because of the outdated stock, a lot of effort has focused on improving energy efficiency in the UK housing stock by means of subsidies, energy labelling and minimum standards, and building regulations, which are estimated to yield a total saving in carbon emissions of around 5 Mt per year in 2001: grants and subsidies contribute 39% of this, building regulations 50%, and energy labelling and minimum standards 11% (Shorrock, 2005). The social housing sector, which accounts for 60% of the total rental stock in the UK, aims in its own actions to support the government policy and the Egan agenda. The Housing Corporation, which regulates and funds the Registered Social Landlords in England, published its Environmental Policy in 2000, emphasising the integration of sustainability in all Corporation actions. That policy emphasises the importance of integrating sustainability in all actions and criteria. Sustainability is also one of the four main themes of its Innovation and Good Practice programme.

Finland

Owing to the cold climate, energy saving in space heating has been a concern in Finland since the seventies; it was not until the late eighties, however, that government strategies for sustainable development began to develop. The current Government Programme for Sustainable Development, including a monitoring programme, is the third document outlining national measures to promote ecological sustainability to reduce the use of non-renewable resources, improve ecological values, and improve the state of the environment in general (YM, 1998a). The Ministry of the Environment, along with key actors in the building and real estate sector, set out the Government Programme for Ecologically Sustainable Construction in 1998 (YM, 1998b). The government sees the construction and real estate sector as a major contributor to sustainable development: the sector is required to focus on energy efficiency, water economy and waste management, clean indoor air, and the durability and useful life of buildings and their components. The national carbon reduction targets in order to achieve the Kyoto targets are set out in the National Climate Strategy (KTM, 2001). Construction and improving the energy efficiency of the existing stock are two of the main areas in the strategy. The Promotion Programme for Renewable Energy Sources aims to double the use of renewable energy sources – which is already high compared to that in other European countries – by 2025 on the 1995 level, entailing a 50% increase in energy generation from renewable sources by 2010 (KTM, 1999). The construction industry produces 8 Mtons of waste every year, of which roughly 27% is recovered and 73% disposed of (Finnish Environment Institute, 1999). Construction and demolition waste is not commonly reused as a product; it is crushed and used as new material or burned for energy consumption, as most of the waste material is timber. Except in the south of the country, long distances to recycling stations are also a problem, as the country is large and sparsely inhabited. The Government Construction Waste Decree (1997) and the National Waste Plan set concrete targets, requiring 70% of all building waste to be graded and recycled in 2005. The National Strategy for the Built Heritage (2001), the Architectural Policy Programme (1998) and the National Building Programme also promote the repair and maintenance of buildings and reductions in energy consumption (Prime Minister's Office, 1998a; 1998b; 2002).

Supplementing energy requirements in the building regulations, training and information play a key role in the implementation of the Ecologically Sustainable Construction programme, and Finnish sustainable development strategy emphasises voluntary agreements between trade and industry and the government as one key measure. A market-oriented approach is seen as the most effective and positive means of promoting sustainable development in general, rather than mandatory enforcement through laws. There are fewer fiscal incentives for sustainable building than for example in the Netherlands, but the state does support home renovation with its repair grant scheme. €15-17 million a year is allocated in the form of energy subsidies for apartment blocks, the aim being to encourage owners to maintain and improve the housing stock, but these are not directly linked to improving environmental performance. Single-family homes, which account for almost 50% of space heating energy consumption, are outside the scope of publicly supported energy audit programmes. The Housing Fund of Finland (ARA), which grants state loans and approves interest subsidies for social housing, aims to integrate environmental issues in the subsidy criteria in the near future. If this plan is actually implemented, it will make social housing providers very conscious about sustainable building.

Buildings in Finland are so well insulated that the annual amount of energy consumed per cubic metre is similar to that in southern countries, partly because the Finnish housing stock is new: 65% of the rented housing was built after the energy crisis in the seventies, when triple glazing was introduced for windows. Nowadays heat recovery is compulsory in practice. Even if the energy performance of buildings is relatively good on a European scale, according to energy audits of buildings and processes supported by the Ministry of Trade and Industry, buildings have a conservation potential of up to 20.5% of heating, 7.6% of electricity and 13% of water consumption, and there is room for improvement in waste management. There are generally fewer problems with compliance in the Finnish construction sector than in the UK, for example: cf. the effectiveness of voluntary policy instruments such as energy-saving agreements to promote energy efficiency and the use of renewable sources made by the Ministry of Trade and Industry with various sectors in 1997. The agreements, which cover 60% of total energy consumption, were evaluated in 2005 and found to be relatively successful: they were estimated to have contributed an annual saving of around 1.3 Mton of CO_2 and €92 million per year in energy costs, with an investment of €19 million in energy assessments and subsidies (Heikkilä et al., 2005). The Finnish government also spends large amounts of money on sustainability research and public information. In 2000, for example, the real estate and construction industry began identifying trends to 2010 (in the Finnish Real Estate Cluster's vision for 2010). A lot of research work was done during the nineties, especially into materials and life cycle requirements, but the impact on practical construction has not been significant: in some cases innovations were slowed down by the market and ineffectiveness factors (Working Group on Eco-Efficiency, 1998). The Ecologically Sustainable Construction programme was evaluated as a whole in 2002 (Hakaste, 2002), but it is difficult to determine the actual outcome, since the programme did not include quantitative targets and the targets set for the construction sector are fragmented among a number of policy documents.

2.4 Building regulations

Building regulations represent the hard core of policy implementation in day-to-day building practice. This section compares the environmental requirements in the building regulations regarding energy saving, materials and waste management and water saving in the five countries.

Energy

In all five countries the trend is to tighten up thermal requirements in the building regulations in order to decrease energy consumption, CO_2 emissions and related life cycle costs. Finland and Germany have the most stringent thermal regulations. The 2004 version of the Finnish building regulations stepped up the thermal requirements by 30%, from a level that was already high, and made heat recovery from exhaust air compulsory. If the owner does not want to recover the heat, a corresponding amount of energy has to be saved by improving the building's thermal insulation. This compensation principle cannot be applied the other way round: more effective heat recovery is only permitted instead of thermal insulation in very special cases such as log constructions where the walls cannot meet the U-value requirements. With the 2002 thermal regulations also setting requirements for existing buildings, Germany will come up to and even surpass the Scandinavian standards. In the United Kingdom and France the thermal requirements are still not particularly demanding, although in France, for example, new regulations should bring up to a 60% saving in energy consumption from new housing, compared to the majority of dwellings built before 1975, when the first thermal requirements came into force; mechanical cooling, for instance, is only permitted after alternative structural solutions have been explored. In England and Wales the SAP rating (Standard Assessment Procedure for Energy Rating of Dwellings) is based on energy consumption. The closer the SAP factor is to the maximum value of 100, the better the energy condition of the building. New homes complying with building regulations should have a minimum of SAP 75, the unofficial recommended minimum for energy efficiency being 60. The English Housing Condition Survey in 1996 found that 84.6% of dwellings were at or below SAP 60, with 8% at or below SAP 20. In the private rented sector in England 21% are at or below SAP 20 (Smith, 2001). The UK government used an incentive scheme known as 'SAP 80+', under which housebuilders producing homes with SAP scores of over 80 were provided energy-saving promotional literature that could be given to prospective buyers. In the Netherlands the Energy Performance Coefficient (EPC) has been tightened up regularly, requiring high insulation values for the envelope combined with high-efficiency heating and ventilation and including a CO_2 emission factor depending on energy use. The EPC is expected to be stepped up from 1.0 to 0.8 in 2006 (MVROM, 2005). It only targets new construction, however, and has thus been criticised because of the energy-saving potential of the existing stock and the health risks from poor indoor climate (Cobouw, 2005).

Lately England and Wales and Germany have imposed minimum insulation requirements for replacement building components in existing housing and efficiency requirements for replacement boilers. In most countries, however, wall insulation is exempt from meeting the thermal requirements for a new dwelling. In Germany, when more than 20% of the area of a component has to be changed, it has to be replaced in line with the requirements for new construction (ENPER-TEBUC, 2004): for example, owners of existing buildings are required to replace windows in line with the regulations on new construction when more than 20% of the window area needs to be changed. The Dutch building regulations already lay down some requirements for existing buildings, but it is difficult to check if these have been complied with, especially if there is no requirement to notify the inspection authorities, and they are complex to enforce in the residential sector where renovations are concerned (section 2.2).

In order to prepare for the mandatory implementation of the EC Energy Performance of Buildings Directive (EPBD) in 2006, all the countries are drawing up legislation laying down performance-based thermal requirements and minimum energy performance requirements for buildings over 1,000 m² undergoing major renovation (EC, 2003). The main requirements under the EPBD are:

- To harmonize energy calculation methods based on overall energy performance.
- To set minimum energy requirements for new construction and major refurbishments.
- A compulsory energy certificate for new and existing buildings when they are constructed, sold or rented: this must not be more than 10 years old and the appraisal must be carried out by independent qualified experts. In addition to detailing the building's current energy efficiency level, the certificate must include recommendations on cost-effective improvements in energy performance. Energy certificates have to be displayed in public buildings.
- Compulsory boiler/heating and air-conditioning inspections.

In some countries, e.g. Finland, the EPBD is the first measure to lay down specific requirements for existing housing, and all five countries are experiencing problems with the timing of its implementation. In the event of a lack of 'qualified and/or accredited experts' the Member States have an additional three-year transition period to apply Articles 7-9 of the Directive and most countries are likely to avail themselves of this option. Table 2.2 compares readiness for the implementation of the Directive in the UK, the Netherlands and Finland (Warren, 2003; Haakana, 2004; Van Ekerschot, 2004). These countries were examined as regards the implementation of energy certificates because of the focus later on in this study. Thanks to its experience of performance-based energy regulations, the Netherlands seems to be furthest forward in the implementation of the Directive.

Incorporating the requirement to have an energy certificate (EPBD, Article 7) for property transactions in the building regulations is also a question of taking legislative action. A system of this kind already exists in Finland, where the requirement of a Maintenance Manual for buildings was introduced in the building regulations in 2000. This is a document which advises users on the maintenance of the materials and equipment used in new buildings. It is a data management system, similar to a car service logbook, that aims to ensure that properties are properly maintained and to improve the standard of maintenance work. The compilation of Maintenance Manuals is compulsory for state-subsidised housing and will be compulsory in the private sector at some future date. The energy certificate can be incorporated in the Manual. In the UK the plan is to include the energy certificate in the information provided by sellers for property transactions in the owner-occupied sector, the Home Information Pack (HIP) (ODPM, 2004b). HIPs will make for a shift in the housing resale market from 'caveat emptor' (let the buyer beware) to 'caveat

Table 2.2 Readiness for the implementation of the EPBD in the UK, the Netherlands and Finland in December 2004

UK	the Netherlands	Finland
Articles 3-4: Adoption of a methodology and energy performance requirements		
Partly satisfied. Energy performance-based regulations: Standard Assessment Procedure (SAP), an energy cost-based rating.	Partly satisfied. Energy performance-based regulations: Energy Performance Coefficient (EPC), including CO_2 emissions.	Not satisfied. The method is being developed; an energy performance indicator has not been decided upon yet. Heat recovery is compulsory in practice.
Article 5: Renewable energy sources		
Partly satisfied.	Partly satisfied.	Not satisfied.
Article 6: Existing buildings		
Partly satisfied. Installation, replacement and substantial alteration/ extension of systems are all subject to the provisions of Approved Document L2 (for non-domestic/residential buildings).	Partly satisfied. Replacement building elements are required to comply with minimum insulation level, but in practice this is hard to verify: e.g. replacing windows does not require notification to the inspection authorities.	Not satisfied, but local authorities can demand upgrading to new construction standards. The EPBD is the first regulation to affect existing buildings; requirements depend on the general targets for the existing stock.
Article 7: Energy certificate		
Compulsory SAP energy certification scheme is already in use for new dwellings and linked to building regulations since 1994, but not for other dwellings. 180,000 new dwellings a year are labelled this way. There are also the National Home Energy Rating (NHER), BREEAM for office buildings and EcoHomes by BRE.	The energy certificate will most probably be the – now voluntary – Energy Performance Report (EPA) for residential buildings. The development of the EPA for utility buildings is in the final stage. The EPA consists of an energy evaluation by the EPA advisor and recommendations on improvements and costs. A certificate for new dwellings needs to be developed.	Not satisfied, no certification scheme in use. Environmental classification of buildings and energy auditing exist only on a voluntary basis. Development of the certificate has not yet started.
Articles 8-9: Inspection of boilers and air-conditioning systems		
Does not satisfy. New regulation is being prepared.	Legislation for boilers over 100 kW. Most boilers are gas-fired heating systems. New regulation is needed for a few non-gas-fired boilers and boilers older than 15 years.	Does not satisfy, but regular chimney sweeping is compulsory and boiler inspections are likely to be linked with this.
Article 10: Independent experts		
Does not satisfy.	Does not satisfy. Will probably be linked up with current systems such as EPA advisors.	Does not satisfy. Possibly done by energy auditors (who do audits now) or condition auditors in conjunction with assessments of building condition (when buying a house). In new construction one of the design documents, produced by an HVAC designer.

Source: Warren, 2003; Van Ekerschot, 2004; Haakana, 2004; Sunikka, 2005 vendor' (let the seller beware) that should revitalise the market (Awano, 2005).

At the moment the thermal regulations focus on the end-use of energy and reducing the need for space heating by means of insulation and better systems, but carbon reduction could also be achieved by using renewable energy sources to meet the energy demand. The European Union has undertaken to double the proportion of renewable energy from 6% in 1995 to 12% in 2010 – a major government objective in all five countries –, and it is discussing increasing the use of renewable energy sources to 20% by 2020, from a level of 6% in 2001 (Committee on Industry, Research and Energy, 2005). Article 5 of the EPBD deals with the use of renewable energy sources, but the requirement only applies to buildings exceeding 1,000 m² and the use of these sources is only suggested, not compulsory. None of the five countries lays down any requirements for the use of renewable energy sources in existing housing (Beerepoot, 2004).

Material and waste management

Most of the mandatory requirements in the building regulations relating to building materials or products apply to the physical level and address hazardous substances. They usually concern indoor air quality: Finland, for example, has regulations on indoor climate quality relating to levels of radon and formaldehyde. Action to minimise the health risks from harmful substances has been taken in all five countries. The EU Dangerous Substances Directive lays down the consensus on hazardous materials. There are hardly any mandatory requirements on building materials and products, except for a small number of manifestly high-risk products.

Waste sorting and recycling regulations are being implemented pursuant to the EU Waste Disposal Directives. In the Netherlands the Building Materials Decree, which entered into force in 1996, lays down mandatory regulations on hazardous building and demolition waste, the use of such demolition waste for civil engineering works and recyclable demolition waste. It also links material emissions to soil contamination. Strict regulations in the Decree that ban dumping recyclable waste ensure that 80% of the materials are reused in other construction work. In Germany the regions (Länder) have the power to set their own targets: the Berlin region, for example, has issued guidelines on building materials such as asbestos and tropical timber. A number of instructions and regulations have been drawn up laying down quality standards for recycled materials that have to compete with new materials. As a voluntary measure the Blue Angel eco-label is applied to building products, including materials and building components.

The EU Landfill Directive, which requires each Member State to draw up a strategy for a three-stage reduction in the quantity of biodegradable waste disposed of as municipal solid landfill, also has an impact on national legislation. The Netherlands introduced the Demolition and Construction Wastes

Table 2.3 Comparison of material and waste measures in building regulations in 2001

Materials	The Netherlands	Germany	France	UK	Finland
Substance level Material and product levels	■ The EU Directive on hazardeous substances: restrictions and ban of harmful substances. ■ Only a few mandatory requirements: for example insulation materials, paints and wood based boards. ■ Building Product Directive (89/106/ETY): the EU countries must have similar requirements to ensure safety and other qualities (energy efficiency, health and environmental performances) of building products.				
Waste	■ The basis for national legislation: the Waste Directive (European Council Directive 91/156/EEC, revised in 1991), the Hazardous Waste Directive (Council Directive 91/689 EEC) and the Landfill Directive (99/31/EC). ■ Future principle: the producer is responsible for the product until the end of its life cycle.				
	Disposal of recyclable waste is banned. Application of secondary materials should be accompanied with long-term assessment of the material impacts on the soil. *- Building Materials Decree.* *- Demolition and Construction Wastes Landfill Ban.*	Disposal of recyclable waste is banned. Waste must be managed in the same state it was created. Manufacturer is responsible for the product during its life cycle, and waste management must be included in product price. *- Waste Avoidance and Management Act.* *- Recycling and Waste Management Act.* *- Packaging Waste Ordinance.* *- Materials Recirculation Law.*	Relatively undemanding construction related waste legislation. Waste separation of household waste will be obligatory in 2002. *- Waste Disposal and Recycling for General Waste.*	Has been very reliant on landfill and the Landfill Tax is important to increase reuse and recycling of construction waste. *- Environmental Protection Act 90, Part II.* *- Environmental Act.* *- Special Waste Regulations.*	Relatively undemanding construction related waste legislation. *- Waste Act.* *- Waste Decree.* *- Regional Waste Plans.* *- National Waste Plan.*

Source: Sunikka, 2001

Landfill Ban in 1997: in conjunction with the quality requirements under the Building Materials Decree this has improved the acceptance and processing of demolition and construction waste in the Netherlands (Van Dijk et al., 2000). German waste disposal standards are among the strictest in the world: the Waste Avoidance and Management Act was revised in 1993 and the Recycling and Waste Management Act (Kreislaufwirtschafts- und Abfallgesetz, KrW-/

AbfG) came into force in 1996. The Acts prioritise waste prevention: waste that cannot be prevented must be recovered, and waste that has been designed for recovery must be kept and treated separately. Some municipal authorities already require all demolition permit applicants to submit a dismantling plan, showing the preparatory phases, the method of dismantling or demolition, and detailed information on the recycling of various materials (Schultmann and Rentz, 2000). The full cost of waste management must be included in the price of the product. The Materials Recirculation Act makes the manufacturer responsible for the product until the end of its life cycle. Waste must be managed in the same region where it was produced. Compared to that in Germany or the Netherlands, French waste legislation is still relatively lenient towards the construction industry. Table 2.3 shows country-specific measures based on the situation in 2001.

Water saving

The building regulations in Germany and the Netherlands require life cycle impact assessment: structures must not have any impact on ground water at any stage. The UK Water Resources Act, which came into force in 1991, protects surface and ground water from pollution, e.g. when construction work takes place in a contaminated land area. The Dutch building regulations lay down few rules on the discharge of waste water and rainwater. In spite of the fact that action to protect ground water areas is an important issue in all five countries, the building regulations do not include any requirements to reduce water consumption in buildings (Sunikka, 2001).

2.5 European Union policy

The role of the EU in environmental policy reflects the trends of supranational governance and the effects of globalisation. To what extent the EU should influence the Member States' environmental policies on housing and energy, which have hitherto been areas of national responsibility with micro-economic impacts, remains a point of discussion.

In principle, the European Union is very committed to sustainable development (Sunikka, 2001). In 1997, the European Union Treaty, also referred to as the Amsterdam Treaty, was revised with respect to sustainable development. The social and economic goals were complemented with an environmental dimension in order to achieve sustainable development. The Amsterdam Treaty in 1997 also required the incorporation of the protection of the environment into all relevant legislation. The European Union launches Environmental Action Programmes approximately once every five years in order to guide the environmental process. Mandatory EU policies are presented in directives, which the member countries are required to incorporate into their national legislation. However, adherence to the directives and the time taken to fulfil them varies in practice.

The European Union imports about half of its energy requirements; United Kingdom and the Netherlands are the only net exporters. Energy policies vary between member states. France relies on nuclear power, whereas Germany, France and UK produce high-cost coal. As a result, common energy policy is not easy to formulate. The most important energy-related objectives have been the promotion of energy efficiency and use of renewable resources, cross-border links, security of supply and advanced research. The objective of the Commission's White Paper 'Energy for the future – renewable energy sources' is to double the amount of renewable energy resources in the EU energy balance from 6% in 1995, to 12% in 2010 (COM [1997] 599 Final). Between 1998 and 2010, the Union intends to encourage the introduction of renewable energy sources by speeding up investment and building model communities that are based entirely on renewable energy. Development of cost efficient and environmentally friendly technology is supported with the JOULE-THERMIE program. Furthermore, the SAVE and ALTENER programmes emphasise energy saving in construction. The Electricity Market Directive (96/92/EU) opened gas and electricity markets progressively. However, commercialised markets can have negative impacts on the profit of renewable energy if the companies are not interested in more expensive energy options or investing in research.

The EU actions in air protection concern air quality objectives, emissions, ozone layer protection and prevention of climate change. Important air protection directives were accepted as far back as the eighties; many of those renewed. The purpose of the Integrated Pollution Prevention and Control Directive, the IPPC (96/61), which dates back from 1996, is to achieve integrated prevention and control of pollution, and to prevent and reduce emissions to air, water and land. The Energy Performance of Buildings Directive (EPBD) (EC, 2003) is the main instrument to gain energy saving in buildings (see section 2.3). Other relevant directives on energy efficiency of in buildings and appliances are the indication by labelling and standard product information of the consumption of energy and other resources by household appliances (92/75/EEC), the energy labelling of domestic electric fridges, freezers and their combinations (94/2/EEC) and their energy efficiency requirements (96/57/EC), clothes washers (95/12/EC), clothes dryers (95/13/EC), household dishwashers (96/6/EC), household lamps (92/75/EEC), household electric ovens (92/75/EEC), household air-conditioners (92/75/EEC) and energy efficiency requirements for ballasts for fluorescent lighting (2000/55/EC), to limit carbon dioxide emissions by improving energy efficiency (SAVE) (93/76/EEC) and the forthcoming directive on eco-design.

In 2000, the EU Directorate-General for the Environment published 'EU policies and measures to reduce greenhouse gas emissions' (COM [2000] 88) as a precursor to the ratification of the Kyoto Protocol. It has presented 'Green Paper Greenhouse gas emission trading within the EU' (COM [2000] 87), which is intended to prompt a discussion about trade in emission rights. This Directorate also introduced the European Climate Change Programme, ECCP, which seeks to unite the different parties involved in an effort to reduce carbon dioxide emissions for mutual benefit. It is an important role of the European Union to ensure that the national programmes meet the stabilisation target. The monitoring mechanism requires the Member States to report annually data on greenhouse gas emissions to the Commission so it can evaluate the contribution of the national programmes to the UN FCCC and the EC stabilisation targets (Haigh, 1996). The responsibility to devise national measures is addressed to the Member States.

According to the basic principles of the Union, technical borders that prevent common building product markets must be removed on the basis of the Building Product Directive (89/106/ETY). This means that the members must have similar requirements to ensure safety and other qualities of building products. Common requirements also involve aspects of energy efficiency, health and environmental performances. The Union has had its own eco-label since 1992. EU directives restrict and ban dangerous substances. There is also consensus in the Union about hazardous material substances. However, only a limited number of these substances are relevant to construction, such as asbestos and formaldehyde.

The Union's objectives are to prevent the creation of waste, to promote its re-use as material and energy, to reduce final processes, to improve dumps and polluted areas and to reduce and supervise the transport of waste. Except for re-usable materials, waste must be processed near the place it was produced. Moreover, waste produced within the EU's borders may not be transported beyond those borders. The idea that the material producer is responsible for the demolition of a product until the end of its life cycle will be a guiding principle in the future. The EU's basic legislation regarding waste and recycling is based on the Waste Directive (European Council Directive 91/156/ EEC, revised in 1991 Framework Directive on Waste, amending Council Directive 75/442 EEC) and the Hazardous Waste Directive (Council Directive 91/689 EEC). The Landfill Directive (99/31/EC) defines three classes of landfills: hazardous, non- hazardous and inert waste. The following wastes are banned from landfill: explosive, oxidising or flammable wastes, infectious clinical waste, tyres and liquid wastes. The Landfill Directive requires each member state to draw up a strategy for three-stage reduction in the quantity of biodegradable municipal solid waste disposed. It must be reduced to 75% in 2006, 50% in 2009 and 35% in 2016; the comparison year is 1995. Countries like UK, who rely on landfill for more than 80% of their municipal solid waste, have been granted a four-year extension to the targets. In the future, EU regulations on waste statistics may require the member countries to submit national situation reports based on the European Waste Catalogue (EWC).

In 1993, the European Union adopted a policy on Environmental Management and Auditing System (EMAS). Environmental management means integration of environmental issues into part of management and information dissemination in an organisation. It can help to introduce improvements, such as in energy and waste management or transport. The objective is to steer product development, processes and sub-contractors in a more environmentally friendly direction. In 2000, the ISO 14001 environmental system standard was included as a part of the EMAS. To join the system, an organisation is required to define its environmental policy and management system, which must include regular internal and external auditing. So far, the EMAS has been used more in the manufacturing industry, than, for instance, housing management. Generally speaking, however, it can be adapted for a variety of purposes.

There are great national differences between the Member States that make an implementation of an uniform policy for the existing housing stock demanding (see section 2.2). The implementation of the environmental policies of the European Union can be very bureaucratic. For example, a proposal made by the Commission does not become EU policy until it has been adopted by the Council and followed by the set procedures, the opinion of the Parliament is also not EU policy (Haigh, 1996). The bureaucracy can make setting the policy, implementing and monitoring it time-consuming costly, especially when the implementation and co-ordination has to be repeated in the national institutions.

2.6 Conclusions

The importance of the construction sector is recognised in national climate and sustainable development strategies, and the governments of the five countries have set out sustainable building policies for the housing sector. The Netherlands, Finland and the United Kingdom have laid down environmental objectives in sustainable building programmes. The German government has not set out a separate action plan for the construction sector but it has integrated environmental targets in an extensive system of building regulations, standards and fiscal incentives. Notwithstanding other initiatives, in particular the HQE scheme, France has not produced a separate action plan for sustainable building. Government policies emphasise the importance of energy conservation, reducing CO_2 emissions, waste prevention and reuse, life cycle issues, a healthy indoor environment and efficient land use. The descriptions of policy suggest that, despite differences in national emphasis, these EU countries seem to share a certain consensus on the concept of sustainable building and similar objectives, thus providing a solid platform for cooperation and information exchange between them. The policy objectives, however, are qualitative and descriptive, reflecting the complexity of sustainability issues, but at the same time open to interpretation and difficult to verify. Quantitative targets have become more common in recent years, but they are still set over a very long time frame and the measures required to achieve them are seldom defined: for example, the UK government's target of reducing carbon emissions by 60% by 2050 (DTI, 2003) and similar targets in the residential sector in Germany (BMU, 2000) and the Netherlands (MVROM, 1999b) are very ambitious, but fifty years is too far ahead to motivate changes in current behaviour. The strongest driving forces to make vague aims more specific have been the Kyoto Protocol and the European Union directives, which place pressure on governments to achieve measurable energy savings and reductions in waste. As water supplies are ample in all five countries, water conservation in buildings often seems to be overshadowed by other issues. Recognition of climate change is guaranteed to keep energy conservation at the focus of attention in future.

New housing production in the EU is 1.9 million units per year, or approximately 1% of the building stock. Homes are demolished at a much slower rate than they are built, so existing housing will make up an increasing proportion of dwellings over the next fifty years. Dwellings yet to be built will constitute 15% of the total housing stock in 2020 and 5-10% of the total housing stock in the Kyoto period of 2008-2012 (NOVEM, 2002). There is as much, if not more, energy-saving potential in the EU accession countries (Sunikka, 2003). Government policies since 2000 have recognised the importance of renovation in the residential sector, but imposing policy measures on private consumers, while housing is considered as a basic human need for everyone, remains problematic.

Large-scale renovation often takes place in urban renewal context. While comparing renewal policies it should be considered that in each case, urban problems occur in a specific geographical, economic and political context, so every country has its own way of understanding the problems while the policies are linked to the current policy administration, the general housing policy and characteristics of the housing market (Skifter Andersen and Leather, 1999). Consequently, also renovation strategies differ between countries. For example, in Finland, the renovations of state-subsidised housing aims to bring housing up to new standards whereas in France, the trend has shifted towards small renovations and improvements requested by tenants. As a common trend in urban renewal in Europe, priority has shifted towards programs directed at single properties. A move towards decentralisation has given local authorities more influence in urban renewal: local governments have a greater freedom to decide which dwellings should be renewed but they also have to pay a greater share of the costs (Skifter Andersen and Leather, 1999). The umbrella organisations for social housing in all five countries seem conscious about their role in the promoting sustainable building but face the ever-growing challenge of coping in a market where they are not allowed to operate at a loss. Because of the general and voluntary nature of public policies, social housing providers see their programmes more as general guidelines than as action plans, which would require radical changes in the current practices. Even the social housing sector is mentioned as one of the main target groups of sustainability policy in most countries; the public strategies do not address concrete objectives for it in particular. For this reason, the environmental approach has remained very cautious in practice. The environmental policies of the umbrella organisations focus largely on the community level, are very descriptive and general in their targets and may leave housing associations with a rather vague notion of what course they should actually take. At present, efforts towards sustainability are concentrated more in separate experiments in individual and demonstration projects than in systematic sustainable housing management. Given the general decline of governmental influence on housing associations, there seems to be a need for more pulling factors (e.g. environmental subsidies) or pushing measures (e.g. higher energy prices). Environmental agreements between the government and the construction sector are used as one measure to promote sustainable building. In Germany, social housing providers are required to observe certain ecological standards, which are more stringent than the requirements at the building regulation level, in order to fulfil housing subsidy criteria. In addition, state-specific programs can require particular environmental contributions from the residential sector. This option of integrating sustainability requirements in the subsidy criteria is an effective measure for pushing social housing towards more sustainability.

Environmental legislation related to the building industry in the five countries focuses primarily on energy, indoor air quality, waste and emissions of hazardous substances. Water saving in buildings receives no regulatory attention. Building regulations have traditionally been feature-based, but a trend has emerged towards more performance-based requirements. In all five countries the thermal legislation has been recently tightened up to support energy-saving strategies and revised to bring it into line with the European Union requirements, viz. the Energy Performance of Buildings Directive (EPBD) to be introduced in 2006. Extending the requirements in the building regulations to existing housing could have a significant impact on the construction sector's environmental performance. Based on installations, annual window renovation rates are estimated to range from 1.8% in Germany to 2.9% in the UK (ENPER-TEBUC, 2004). As the new construction rate is half or a third of the renovation rate in the five countries, if regulations were to be applied even just to window renovations this could have a significant impact on the energy efficiency of existing housing. Apart from the building regulations on energy and waste, the Netherlands, France, the United Kingdom and Finland have to a large extent adopted a voluntary approach to sustainable building, relying heavily on the environmental conscience of commercial operators. In most countries the authorities seem to be afraid to use environmental taxation and other harsh methods in their environmental policies and tend to think that voluntary measures will be more accepted and therefore more efficient. Under a market-led policy, however, the risk is that most commercial operators will focus exclusively on what they stand to gain.

One thing that clearly emerged from the study is that the national strategies do not seem to be ambitious enough to achieve really sustainable development as agreed at the UN Rio Conference in 1992 – not even in countries such as Germany, which have achieved partial results in stabilising energy consumption and waste production in spite of economic growth. Recent reports by the European Environment Agency conclude that most EU Member States have not succeeded in reducing the dangers of climate change, dying forests or decreasing biodiversity with their environmental policies (EEA, 2001; 2005). Under existing policies and measures, emissions in the EU are expected to be less than 3% below the 1990 levels by 2008-2012, as against the Kyoto Protocol target of 8% (EEA, 2005). Unless the OECD member countries establish more effective frameworks for action now, achieving the Kyoto targets will become difficult and very expensive (OECD, 1999). In the Netherlands, for example, the monitoring of the implementation of the National Environmental Policy Plans indicates that the CO_2 targets are not attainable within the time limits set using current methods. The German Federal Environment Agency has stated that technical progress and resource efficiency are not sufficient to achieve lasting environmental development, which can only be achieved by improving technological efficiency and changing consumer behaviour and legal and economic structures. The strategies could be more innovative, moving from environmental improvement to more of a problem-solving approach. All the national programmes seem to be fairly optimistic and confident, however. Governments, or consumers, do not accept the scale of the environmental problems, tend to trivialise the need for sustainable building and fail to respond to threats that are not immediate. It has taken a long time, for instance, for the concept of climate change to be accepted. Unlike in the energy crisis in the seventies there seems to be a lack of economic push factors to encourage energy conservation today.

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3 Fiscal instruments in sustainable housing policies in the EU and the accession countries

Sunikka, M., 2003, Fiscal instruments in sustainable housing policies in the EU and the accession countries, in: **European Environment,** 13 (4), pp. 227-239.

Based on the country progress reports of the 3rd European Ministers conference on sustainable housing in Belgium in 2002, the article presents an analysis of economic measures currently used to support sustainable housing in the EU and accession countries, indicating the areas where policy instruments are either focussed or lacking. It addresses the research question: how are negative and positive fiscal incentives applied in sustainable housing policies within the enlarged European Union?

Abstract
Although progressive government guidelines and knowledge about sustainable housing exist, progress in implementing them in practice has been slow. The perceived costs and the lack of market demand have been identified as the main barriers. A choice of fiscal instruments is essential in sustainable housing policies. This article presents an analysis of economic measures currently used to support sustainable housing in the EU and the accession countries, indicating the areas where policy instruments are either focused or lacking. Based on the country progress reports of the Third European Ministers Conference on Sustainable Housing in Belgium in 2002, the results indicate that environmental taxes and subsidies are used in the EU and the accession countries, but that they have had a low impact on the housing sector. An examination of the developments since 1996 shows that apart from energy initiatives resulting from the Kyoto Protocol, the lack of a strong driving force has kept progress slow. Conclusions are based on the analysis findings – the low impact of taxation on housing, the lack of environmental criteria in the reduced VAT rate and the narrow focus of subsidies. This article argues that enlargement of the EU presents opportunities for sustainable housing in Europe, if the fiscal instruments are enforced by legal means.

Keywords: fiscal measure, environmental tax, subsidy, sustainable built environment, housing stock, European Union.

3.1 Introduction

The building sector accounts for 25-40% of the final energy consumption in OECD countries, space heating being the largest proportion of energy consumption in both residential and commercial buildings (Hasegawa, 2002). In the Kyoto commitment, industrialized countries have agreed to reduce their total level of CO_2 emissions in 1990 by 5.2% between the years 2008 and 2012. The European Union is preparing to implement the commitment as a community, where its emissions and restrictions are studied as an entity. According to Kyoto Article 4, the division inside the European Union is, e.g. Finland 0%, the Netherlands -6%, the UK -12.5% and Germany -21%. The comparison years cited are 1990 and 2010. The Kyoto Protocol has increased pressure on governments to establish strategies aimed at reducing CO_2 emissions. In absolute terms, the largest energy end users are households and the tertiary sector (EC, 2001). In the Netherlands, households account for 15% of the country's total energy consumption (Ministry of Economic Affairs, 1996). Policies to regulate and promote sustainable housing have been developed across Europe, using instruments ranging from mandatory norms to guidelines that can be applied voluntarily.

Despite the available knowledge and instruments, a gap exists between government policy and practice, where sustainable housing has been adapted slowly. Several barriers at the policy and strategy level have been identified, especially the perceived costs of implementing environmental management, the lack of market demand and the poor capture of benefits (Sunikka and Boon, 2002). Consequently, sustainability measures are not adopted in large scale. In Finland, the survey of the National Programme of Sustainable Construction concludes that environmental knowledge is managed by a small group of pioneer organizations and companies that invest in research and development anyway, whereas the majority of the construction sector has not been able to respond to environmental requirements (Ministry of the Environment, 2002). Therefore, the next challenge is to shift sustainable housing from demonstration projects to wider applications. In this process fiscal measures play an important role because extra costs in applying environmental measures are one main barrier to sustainable housing. Incentives are needed to embed environmental measures in normal practice (Van Bueren, 1999).

The choice of fiscal instruments is an important issue in sustainable housing policies. This article presents economic instruments that are presently used to encourage sustainable housing in the EU member states and the EU accession countries. Fiscal measures are generally regarded as effective policy instruments, but there can be ideological and practical obstacles in their adaptation. In this article, the instruments are described in relation to environmental effectiveness, economic effectiveness, equity, administrative feasibility and acceptability (OECD, 1991). Opportunities to promote sustainable housing using economic policy measures are discussed. It has to be recognized, however, that the countries studied are in different stages of implementing sustainable housing and, therefore, need slightly different strategies and instruments. The building stock and the users are of heterogeneous nature, so the effectiveness of policy measures depends on the type of building and the ownership position. Different kinds of building type, e.g. housing or office buildings, have different requirements. This article focuses on housing, because it is the largest sector of the building stock. For example, in Finland housing accounts for 55% of the total building stock, while households also own 12% of the total building stock in the form of outbuildings, the remaining 33% consisting of industrial (15%), commercial (12%) and public buildings (8%) (Vainio et al., 2002). Furthermore, when new housing production in the EU is 1.9 million units per year, or approximately 1% of the building stock, the real potential for sustainable building and CO_2 reduction lies in managing the existing stock of residential buildings (Sunikka, 2001; van der Waals 2001). In the Netherlands, a 3.6 Mton CO_2 reduction could be achieved from existing housing if an average investment of €2,300 per dwelling was made and the energy tax was increased 2.5-fold to shorten the payback time (ECN, 1998). Another study estimates the CO_2 reduction potential to vary between 13 and 44%, which implies a reduction of 3.1–10.6 Mton, depending on the effectiveness of the measures used, while an average investment of €954 could already ensure a 13% saving (Slot et al., 1998). The energy saving potential in the EU accession countries equals, and exceeds, that in the EU countries. Effective policies must also reflect different incentives of tenants and owner-occupiers. Many households face significant capital constraints and information barriers. If an investment to improve environmental performance reduces operating costs but has high start-up costs, it may not be taken by tenants who think they will move or if the investment leads to increase in rents (Murakami et al., 2002). The difference between privately owned and rented housing is recognized in this study, but the policy measures are described without making a distinction between their implementation in different ownership sectors. The relation between sustainable housing policies and ownership positions in the EU and the EU accession countries is the subject for another study.

This article is based on the country progress reports of the Third European Ministers Conference on Sustainable Housing in Belgium in 2002 (Novem, 2002a). The meeting aimed to develop the idea of sustainable development in housing policies, to promote the implementation of measures, to improve knowledge exchange between countries and to identify areas of common interest and possible policies at a European level. All EU countries and nine EU accession countries provided national progress reports addressing the existing policy context, policy instruments e.g. legislation and taxation, housing policy priorities, best practices in policy development and future directions. The national reports for the First European Ministers Conference on Sustainable Housing in Copenhagen in 1996, and the Second European Ministers Conference on Sustainable Housing in The Hague in 1997, were used as a reference source for the present study to examine policy developments since 1996 (MVROM, 1996; Seijdel, 1997). Evaluation of the impact of the fiscal measures was not possible in this study, because that kind of data is not yet available in most countries, and it would require modeling and a different research approach.

3.2 Environmental taxes for sustainable housing

The choice of policy instruments is guided by tradition. In economics, environmental problems are considered as externalities. Economic instruments promote the internalization of measurable externalities. There are two principal approaches to the control and correction of external effects: control and correction via taxes and subsidies (Pigou, 1932), and control and correction via the introduction of property rights (Coase, 1960). The Pigouvian tradition, which is dominant in Europe, is based on the idea that externalities exist because of the difference between the private and social marginal cost. With negative externality the social marginal cost exceeds the private marginal cost, suggesting a correction of the private marginal cost in the form of a tax (Boman et al., 1999). Taxation enables the internalization of the external costs of environmental damage and a mechanism for introducing price differentials to encourage more sustainable production and consumption patterns. The OECD countries have accepted the polluter-pays principle (PPP), where they agree to conduct their pollution-control policies so that the property rights lie with the sufferers. According to the polluter-pays principle, the polluters are taxed rather than the sufferers being subsidized. The state, in theory, uses tax revenue to benefit the citizens (Bowers, 1997). However, current prices do not reflect environmental costs and tax systems favour materials over labour (Van Bueren, 1999; Dorigoni and Gullí, 2002).

An examination of the national progress reports shows that the Environmental Tax Reform that aims at shifting taxes from labour onto the environment has been implemented in most European countries, e.g. in the Netherlands, Belgium, Denmark, Sweden, Finland, the UK, Austria, Germany and Italy (Novem, 2002b). However, the European Environment Agency reports that while pollution and resource tax revenues have grown, they still contribute a very small share and the impact of environmental taxes in practice is still low (EEA, 2002a). For example, despite increases in taxation from 1985 to 2001, energy prices for most fuels dropped and the overall demand for energy increased (EEA, 2002b). The national progress reports show that current environmental tax measures are only indirectly related to housing in terms of energy and CO_2 costs, but they do not set targets for the construction sector in particular. A number of EU member states have introduced housing-related tax measures, e.g. Belgium on water consumption and the UK an aggregate levy on the extraction of virgin construction materials. The Regulatory Energy Tax (REB) was applied in 2001 to Dutch households, which had to pay a third more for their energy. Research shows, however, that only half of the population is aware of the Regulatory Energy Tax and 2% take it into account in the use of electricity (Van der Waals, 2001). Some countries offer tax relief on measures that support sustainable development e.g. a tax relief for property transfers in disadvantaged areas. In the Netherlands, the landfill tax has reduced the amount of waste going to landfill from 49.7% in 1985 to 4.6% in 2000, and increased recycling from 49.5% in 1985 to 94.3% in 2000 (Hasegawa, 2002). Since its introduction in 1996, the landfill tax has also contributed to the increase of crushing and recycling sites in the UK (Sunikka, 2001). A landfill tax can effectively reduce the final disposal of construction and demolition waste if the tax rate is set high enough. However, households have no incentive to reduce the volume of waste generated as they receive no financial benefit from it. Financial savings that result from their efforts will be spread across all households, and since the number of households is very large, it is dissipated to the point of insignificance. In an incentive-compatible system households would be charged according to the volume of waste they produce for collection. On the other hand, incentive-compatible charges introduce the risk that households would resort to the illegal dumping of waste (Bowers, 1997). Other regulatory instruments, therefore, such as mandatory reporting and demolition permission, are needed to support these kinds of tax.

Most EU accession countries have introduced taxes that result from environmental damage. In the Baltic countries and Bulgaria, the tax revenue is used for Environmental Investment Funds, according to the recycled tax principle. However, in Poland and Romania, for example, environmental taxes have not yet been introduced and in the Czech Republic taxation law is being drafted. An examination of the country reports shows that in the EU accession countries there are some housing-related environmental taxes. For example, in Bulgaria a discount in the immovable property tax is provided for basic housing with an extra discount for disabled people, whereas the tax is increased for non-built plots in urban development areas (Novem, 2002b). Governments can use Value Added Tax (VAT) to support environmental investments. Some EU countries, such as the UK, France, Belgium and Luxembourg, apply a reduced VAT rate to renovations in order to encourage maintenance of the existing stock, especially in the social housing sector. In France, VAT of 5.5% is combined with the PALULOS subsidy for improvements in existing social housing. The combined overall aid package is worth 22%, or €13,000 per housing unit as a ceiling. This has enabled improvements to increase energy efficiency to take place (Sunikka, 2001). In Belgium, the federal government grants a 6% VAT rate for housing renovations and their adaptation to the needs of the disabled. However, although the criteria for the projects qualifying for the reduced VAT measure favour energy efficiency, the measure is currently used without specific criteria for environmental improvements. It can also be applied to products and materials. In the UK, the reduced VAT is applied to energy saving materials. The EU accession countries do not report that they would use the VAT measure for environmental improvements or renovations.

Many governments are afraid to resort to environmental taxes and other stringent measures in their environmental policy because of the feared political price. Taxation can negatively affect specific sectors of the economy that are relevant to the policymaker or create regional unemployment. This can conflict with the vote maximizing behaviour of the policymaker (Siebert, 1995). In Germany, however, the government has adapted a mandatory approach to sustainable housing. The position of Germany as a forerunner in energy policy is partly enabled by the eco-tax and the act on the sale of electricity from renewable energies that have created incentives for ecological modernization in energy supply (Tritten, 2002). The use of fiscal measures as an essential part of the German environmental policy may have a concrete impact on housing and housing costs in the future. In 1996, the Federal Environment Agency studied energy-induced (heat, hot water, electricity) damage related to habitation. According to their findings, energy-related costs amounted to €7.7 billion per year, or roughly €2.6 per square metre of the total housing stock per year. Absolute damage values came to approximately €21 billion or €7 per square metre of the total housing stock per year (Lintz, 2000). Thus, the application of the polluter-pays principle would involve passing on all the energy-related costs identified in the study to housing owners and occupants.

Taxes are presumed to achieve the least-cost solution and to provide continuous incentives to search for more cost-effective technologies to improve environmental quality (Siebert, 1995; Hasegawa, 2002). Taxes are effective when they are applied to products consumed in large quantities and combined with clear overall targets. From an economic point of view, they provide a source of financial revenue that can be pointed to environmental programmes. However, taxation can be problematic as a policy instrument. Energy taxes are unpopular with the electorate in general and with industry in particular. A regressive tax on a household's energy use may encourage people to save energy, but it might place an excessive burden on the poorer households, especially in the social housing sector, and create resistance in the privately owned housing sector. Taxation measures are more suitable for the professional construction industry than households, but even then the emission tax can be shifted to the consumer without efforts to change the current practice. Furthermore, the taxation does not define the pollution level: despite the costs to the polluters, the aggregate amount of pollution cannot be predicted. It depends on the forces of supply and demand and will be determined by them. The system of taxes requires supervision and can be bureaucratic, and, due to the time-consuming process of preparing and enacting the taxes, finding the right quality targets and identifying the polluters, prices should apply for a long time period. The allocation conflict can be an implementation barrier: the building owner should make the investment to reduce the operational load of the building, but his motivation is reduced by the fact that the tenant will enjoy the benefits. The use of tax measures depends on the targets: whether the charges are needed for financial purposes or whether more complex mechanisms are necessary to affect the behaviour. Complex systems can be more effective, but costly to apply, whereas simply measures seem practical, but are not necessary effective. It is essential that the target groups accept the taxation measures that are imposed on them. The acceptability can be increased with information, clear targets and schedule of introduction, consultation and progressive implementation. It can be expected that an individual who is better informed about environmental damages has a higher willingness to pay (Siebert, 1995). Also due to the acceptance issue, taxation is suitable in countries where sustainable building is already an established issue, e.g. Germany, Denmark or the Netherlands.

3.3 Incentives for sustainable housing

According to the Pigouvian tradition, if the externality is positive, the corresponding measure is a subsidy (Boman et al., 1999). A subsidy is a transfer of purchasing power from society to the industrialist or individual conditional on it being spent on the investment (Bowers, 1997). A subsidy can also be described as a negative tax.

An examination of the country reports shows that all EU countries have introduced subsidies for sustainable housing in some form, focused on measures to improve energy efficiency (Novem, 2002b). This focus stems from the priorities in national strategies for sustainable housing that, both in the EU and the EU accession countries, are focused on energy-related measures in new housing, whereas issues such as good indoor quality, sustainability of building materials, recycling of building materials and water-saving measures receive less attention. Few progressive countries have established subsidies covering the wider aspects of sustainable housing like the Green Investment in the Netherlands or Eco-Subsidy in Sweden. Austria is one of the countries that relies predominantly on subsidies in its sustainable housing strategy. Of the annual €2 billion subsidies provided for new construction, an important share is targeted at sustainable housing. The promotion scheme for sustainable buildings that has been established by law aims to increase energy efficiency, reduce CO_2 emissions and support market penetration of innovative technologies. Consequently, in the Salzburg area for example, 66% of all new buildings have been submitted to the promotion scheme and energy efficiency in new buildings has increased by approximately 40% in two years. However, despite the public acceptance, there are still doubts about the efficiency of the promotion schemes regarding favouring new buildings that increase ecological burden and social distribution of the subsidies (Novem, 2002b). An examination of fiscal measures shows that most subsidies in the EU countries are targeted towards new construction despite the considerable environmental and CO_2 potential that lies in managing the existing stock. General subsidies to encourage renovation and maintenance of the existing stock exist, but apart from some criteria to favour energy efficiency, renovation subsidies do not support sustainable housing targets in particular. The situation stems from the fact that new construction is given priority in sustainable building policies. A significant proportion of policy instruments for e.g. reducing CO_2 emissions target new buildings, while government intervention for upgrading existing buildings has been modest (Hasegawa, 2002). It is easier to apply environmental measures in new construction, both technically and regarding the process, since inhabitants are usually not involved and the target group consists of professional builders.

None of the EU accession countries have established a system of subsidies for sustainable housing in general, but half of them provide incentives and loans to improve energy efficiency in the housing stock (Novem, 2002b). In Slovenia there are subsidies to implement energy efficiency in housing, e.g. in terms of energy-efficient windows and solar collectors for hot water, and profitable loans are available for investments in energy efficiency (Sijanec Zavrl, 2001). In Slovakia government loans at low interest rates are available for investing in sustainable housing projects e.g. insulation and using renewable energy sources. Consequently, 10,000 homes have been insulated in five years. Furthermore, the State Housing Funds provide subsidies for renovation, the support package consisting of loans at low interest rates, with a condition that residential energy consumption is dropped by at least 20% as a result of the measures taken (Hadziivanov, 2001). The countries that do not have any subsidies available to support sustainable housing are all EU accession countries where the gross domestic product is low, e.g. Bulgaria, Romania, Poland, Malta and Cyprus. The smaller the GDP, the less likely the country is to have established subsidies. In contrast, the countries that use subsidies as established policy instruments have achieved a stable economic situation. Therefore, the extent to which sustainability is adapted depends on the country's financial situation and the degree to which more urgent housing needs have been met.

The investment in research and development is also greater in wealthy countries that already have knowledge of sustainable housing. The EU accession countries have fewer resources to invest in research. In economically unstable situations risks are avoided and research and development steps are not taken. In the EU countries research and development is one of the main instruments in promoting sustainability and distributing subsidies. The Scandinavian countries, the UK and Germany are investing great sums in providing support for environmental research and development, partly because the construction industry does not have much capacity to undertake research and is slow to adopt new technologies. However, despite information dissemination, the implementation of the research results is often limited to demonstration projects rather than adjusted more widely. Recent market research in the Netherlands and Sweden shows that there is no real market demand for sustainable building that is considered to have a negative impact on short-term benefits (SBR, 2001; Baumann et al., 2002). When consumers are not interested in investing in environmental measures, subsidies are the main instrument to promote sustainable housing by market actors. In the Netherlands 93% of the housing associations indicate that subsidies and other fiscal measures encourage them to implement environmental measures (Sunikka and Boon, 2002). Two-thirds of the housing associations find the current system of subsides undeveloped and 54% consider the subsidies too low (ResCon, 2002).

Subsidy programmes can be useful in the introduction of new technologies below the regulation level. They can encourage innovations and generate knowledge, especially in countries where the concept of sustainable building is new. A recent OECD report on sustainable housing policies concludes that subsidy programmes can encourage energy efficiency investment for both new and existing buildings, if the proportion of free-riders is reduced, but it is unlikely that such programmes could have large-scale impact because they require tax revenue expenditures (Hasegawa, 2002). Subsidies can support social equity better than taxation, especially in the existing housing stock, e.g. an insulation subsidy to reduce energy use can benefit the poor who otherwise could not afford it and reduce their fuel bills (Bowers, 1997). They can also help to overcome the contradiction between investment and benefit in sustainable housing: the owner has to make the start-up investment, whereas the tenant is the one profiting from lower operation costs. Subsidies do not, however, implement the polluter-pays principle adopted by the industrialized countries. They have to be financed by general taxes and in most countries subsidies already account for a large part of the budget. Subsidies should be carefully applied to building products because they can influence pricing in an unhealthy way and prevent environmental improvements when environmental damage costs do not have to be introduced in prices because of subsidies. They can be considered as a barrier to competition, which is in contrast to the principles of the EU. The free-rider problem exists in countries that are experienced in sustainable housing, e.g. in Germany and the Netherlands, where environmental subsidies can benefit parties that would have applied the option anyway. Consequently, subsidies for energy saving in buildings were reduced from €122 million in 2002 to €54 million in the Netherlands in 2002, one main reason being the free-rider problem. In fact, some countries at the forefront of sustainable housing, such as Denmark, do not use subsidies as a main policy instrument but rely on more mandatory measures instead.

Furthermore, an important issue in national environmental policies is to ensure that general subsidies do not support unsustainable development. Subsidies continue to distort the energy market in favour of fossil fuels despite the pressures these place on the environment, while there is much less support for renewable sources or energy conservation (EEA, 2002b). More than 90% of direct energy subsidies from European governments to the energy industry went to fossil fuels in 1997 (Greenpeace, 1997). In Germany's environmental assessment report in 2001, the OECD recorded that over 35% of the subsidies in Germany are classified as environmentally harmful. Examples of this can also be seen in the housing sector; there is a need to reform home ownership assistance for housing projects where currently buyers of existing housing receive half of the bonus which is granted for new housing (Tritten, 2002).

3.4 Policy developments

An examination of developments in fiscal policy instruments shows that, despite a number of positive developments, the general situation has changed little since 1996 (MVROM, 1996; Seijdel, 1997). In 1996, most European countries had not yet formulated a policy plan for sustainable housing. In the countries that had policy plans, measures focused on energy saving in new housing and at the building level. Some countries, e.g. the Baltic States, emphasized updating the existing dwellings to the current standards, but in general the attention was focused on new construction. The importance of the residential stock in energy saving and the reduction of CO_2 emissions have only recently been recognized politically. The contexts in sustainable housing policies are extending towards the existing stock, but this progress is happening very slowly.

Environmental taxation was not yet widely used as a policy instrument in 1996, and the Ecological Tax Reform had just been introduced in Denmark, Sweden and the Netherlands. Taxes on pollution were mentioned in Belgium, Finland, Greece, Italy and the UK. In the housing sector, environmental taxes were introduced e.g. for water consumption in Belgium, for water, CO_2 emissions and gas in Denmark and for energy in the Netherlands (MVROM, 1996). In 1996, the reduced VAT rate for renovations had already been introduced in some countries, such as Belgium. However, both taxation measures and the reduced VAT rate were only indirectly related to sustainable housing.

In 1996, most EU countries had established subsidies for sustainable housing, mainly focused on energy savings. France had fiscal allowances to stimulate the use of certain certified products, Germany subsidies for energy and indoor improvements and depreciation on investments in new technology and Austria subsidies for more sustainable energy sources and efficient land use. Austria, Belgium and the UK all had subsidies that depended on the income of the applicant. In the EU accession countries there was less scope for subsidies and greater emphasis on regulations instead. Half of the countries had general subsidies to promote the construction of new dwellings and renovation of the existing stock in 1996. In most cases the subsidies favoured sustainability, i.e. energy efficiency, but they did not address sustainable renovation targets.

An examination of the national progress reports in 1996, 1997 and 2002 shows that the Kyoto Protocol has been the main driver in stimulating both the EU and EU accession countries to develop national climate policies to achieve the CO_2 reduction targets and that this started even before the EU ratified it. Therefore, progress has focused on energy savings and EU directives in the EU countries. Lack of motivating factors, feared costs and low market demand have kept the progress in sustainable housing policies moderate, despite the amount of subsidies that governments have invested in environmental research and development. It has to be considered, however, that the year 1994 is considered as a culmination in policy-making (MVROM, 1996). The developments would be more striking, therefore, if an earlier year were studied.

3.5 The role of the European Union

In 2004, the EU introduced ten new members to the European Union: Poland, Hungary, the Czech Republic, Slovakia, Latvia, Lithuania, Estonia, Slovenia, Cyprus and Malta. The EU strategy for enlargement and accession of the applicant countries will have a considerable impact on European sustainable housing policies. In the national progress reports in 2002, the accession countries present the EU membership and fulfilling its requirements as the main objective of their housing policy (Novem, 2002b).

The environment is one of the areas where the accession countries need to achieve the EU standards. For example, the energy consumption in the EU accession countries is two to three times higher than the EU average. Structures to achieve and to control energy efficiency have to be established in terms of legislation, subsidies and the education of authorities. The modernization of the industrial sector has proven fast progress due to the participation of foreign investors, but the energy rehabilitation of buildings is following at a low pace (Bayer et al., 2002). All the EU accession countries have a large stock of prefabricated concrete housing built in the 1960s following the Soviet example. Problems are caused because of the flat roofs, weak joint points in structures, corroded pipes and weaknesses in the engineering systems. In Slovenia, the energy saving potential that could be achieved by renovating the existing block housing is estimated to be 60%, although economically viable energy saving may only reach 29% if a payback time of less than 10 years is considered feasible (Sijanec Zavrl, 2001). If thermal insulation were improved in prefabricated housing in Latvia, which accounts for a total 20 million square metres, an energy saving potential of 50% could be achieved. However, the renovation costs to achieve this objective are estimated to be $5.5-6.3 billion in Latvia (MVROM, 1996).

Some researchers consider the EU accession process as an opportunity for low-cost investments with higher emissions savings (Heller, 1998). For example, Poland has managed to reduce its sulphur emissions with 50% using legislative and fiscal measures (EC, 2002). The EU integrated product policy could also serve as one starting point to tackle unsustainable consumption patterns (EEA, 2002a). Others argue that, given the surplus of carbon-heavy brown coal in these areas, in the accession of new countries to the EU there is the possibility to veto partners of other member states seeking to delay action on e.g. climate change (Grant et al., 2000). While discussing the potential of the environmental policy of the European Union, it has to be considered, however, that the EU is primarily a trade union. The objectives of economic growth and liberalization of trade that drive EU integration are in fact quite unsustainable and can conflict with the development of an environmental policy. For example, the EU energy policy aims to ensure secure supplies of energy at reasonable prices and socially to ensure that all EU citizens can afford the energy services they need. Energy prices have generally fallen between 1985 and 2001, offering little incentive for energy saving. Low energy prices are likely to act as a disincentive to energy saving in housing and may encourage energy consumption. Estimated external costs of electricity production amount to 1-2% of the gross domestic product in the EU, excluding the uncertain costs of global warming. Comparison of these external costs with the current prices for electricity show that the external costs of coal and lignite electricity production are approximately 20-120% of household energy prices and 7-38% for gas-fired electricity production (EEA, 2002b). The EU can offer an opportunity for the integrated use of fiscal measures in environmental policy. The EU's Sixth Environment Action Programme stresses the need to internalize the external costs to the environment. It includes the promotion of the use of fiscal measures: environment-related taxes and incentives, a possible use of tradable emissions permits and emissions trading and the undertaking of an inventory and review of subsidies that counteract the sustainable use of energy with a view to gradually phasing them out. However, despite the fact that pollution taxes are increasingly emphasized as an effective instrument of environmental policy, the makers of EU environmental policy lack the ability to levy taxes, tax considerations being subject to a unanimity rule.

3.6 Conclusions

The country progress reports of the Third European Ministers Conference on Sustainable Housing in Belgium in 2002 were examined to describe which fiscal instruments are presently used in sustainable housing policies in the EU member states and the accession countries. Analysis of the use of taxation and subsidies as policy instruments led to several conclusions which could be used to encourage sustainable housing across Europe:

Environmental taxes have a low impact on housing
Applying the polluter-pays principle that the OECD countries have adopted requires internalizing the external costs of environmental protection. Environmental taxes and the Ecological Tax Reform are increasingly implemented in the EU and in the EU accession countries alike. However, despite positive results from e.g. the introduction of the landfill tax, the impact of environmental taxes remains low in practice, due to their modest rate. Furthermore, the measures are not directly related to housing. Taxation of housing-related environmental damages would be an effective measure to make current practice more sustainable, especially in countries where sustainable housing is already an established issue. It can also increase revenue that can be used for environmental programmes. However, tax measures need to be prepared and applied carefully, preferably progressively, because implementation could create unbearable financial pressure on low-income households.

The reduced VAT rate for renovations is not combined with environmental objectives
The reduced Value Added Tax (VAT) rate for renovations is used to encourage investments in the existing housing stock e.g. in France and Belgium, but without specific environmental criteria. The reduced VAT measure is not currently used in the EU accession countries, but it could be introduced to improve the environmental potential of the existing stock. However, more requirements for sustainable housing and energy saving need to be integrated in the selection criteria for the projects qualifying for the lower VAT rate.

Subsidies are narrowly focused
An examination of the national progress reports shows that all the EU countries have established subsidies to support environmental improvements in housing. However, the focus of current subsidies is limited to energy savings and only a few countries have established systems where sustainable housing

is considered more widely. Furthermore, most subsidies apply to new housing, widening the gap between new and existing dwellings. There are general fiscal measures to encourage renovation, but their criteria do not set environmental targets. Due to financial restrictions, subsidies are used as a policy instrument in only a few EU accession countries to encourage energy saving, whereas subsidies for sustainable housing in general do not exist. With the right allocation, subsidy programmes can contribute to the adaptation of sustainable housing especially in countries where the concept of sustainable housing is new, whereas the risk of free-riders is increased with experience. However, subsidies have to be financed by general taxes and they are not enough to make sustainable housing common practice if market demand is low. They do not comply with the polluter-pays policy and can be considered as a barrier to competition.

Fiscal instruments need to be combined with legal means
None of the fiscal instruments are self-policing. Taxes are not automatically paid and regulations are not necessarily obeyed. Therefore, the use of taxes and subsidies has to be backed up by law, a threat of sanctions and a monitoring programme. It has to be recognized that implementation and enforcement structures entail compliance costs and efforts to governments for implementation, monitoring and revision. A minimum number of well co-ordinated economic instruments on one sector can avoid overlapping, confusion and minimize implementation costs. Furthermore, it is necessary that fiscal measures are compliance with regulations. For example, in the UK, several energy subsidies are available while the thermal regulations remain blurred.

Policy developments resulting from the Kyoto Protocol
An examination of the national progress reports from 1996, 1997 and 2002 shows that developments in fiscal policy instruments since 1996 have been slow. The Kyoto Protocol has increased pressure on governments in the EU and the EU accession countries to establish strategies aimed at reducing CO_2 emissions. Consequently, a number of subsidies and taxation measures have resulted from the initiative, but they are still narrowly focused and their impact is low on wider applications. However, the Kyoto Protocol is a positive force and an illustration of the impact that an international initiative can have on national strategies.

The EU Enlargement presents opportunities for sustainable housing
The national progress reports show that one main objective of sustainable housing policies in the accession countries is to bring their current practice in line with European standards. The enlargement process of the EU, often presented as negative and risky from a financial point of view, presents great opportunities at an environmental level which are rarely discussed. The enlarge-

ment of the EU can support the accession countries in upgrading their existing housing stock, where there is a great capacity to provide environmental benefits. Public funds may not be sufficient regarding the renovation need so financing must be sought for from private–public partnerships and international institutions. To help the accession countries prepare for their membership, the EU has committed itself to financial assistance of more than €3 billion per year, disseminated through the pre-accession instruments – Phare, ISPA and Sapard – that are focused on the environment and infrastructure (EC-DG Enlargement, 2002). The pre-accession instruments could be orientated to improve the environmental potential of the existing housing.

Lack of market demand is a continuous challenge to sustainable housing
Governments across Europe face the challenge of stimulating the market demand for sustainable housing and making consumption habits more sustainable. Sustainable housing is not possible without the involvement of the industry, but the market's ability to solve environmental problems is limited and requires government intervention. Pollution control is a conscious social and political process that should not and cannot be left to market forces (Bowers, 1997). Governments must support sustainable technology and investments in production must be made more attractive by creating a market e.g. using mandatory measures (Wijffels, 2002). In addition to taxes, subsidies and building regulations, the market demand for sustainable housing should be stimulated with the development of other measures, e.g. labelling and standards such as ISO 14001. If the main responsibility in the sustainable housing process is pointed to the government, the question arises whether environmental problems exceed the capacity of the political systems to solve long-term problems. Oystein Dahle, the chairman of the Worldwatch Institute, argues that environmental problems are symptoms of political problems and that government policies are a reaction to, not an anticipation of, a problem (Dahle, 2002). Dahle considers policy development with new and existing instruments as the main challenge to sustainable development.

In the end, the use of fiscal policy instruments depends on the objective. Neo-classical economists define two notions of sustainability in terms of natural capital: weak sustainability and strong sustainability. Weak sustainability is met if all the environmental impacts of private decisions are internalized through Pigouvian taxes and public investment satisfies a cost–benefit test when environmental effects are given a monetary value. Strong sustainability requires that any losses of natural capital in public investment projects are compensated for by shadow projects that create natural capital of equal value, so that the stock of natural capital is kept constant or allowed to increase (Bowers, 1997).

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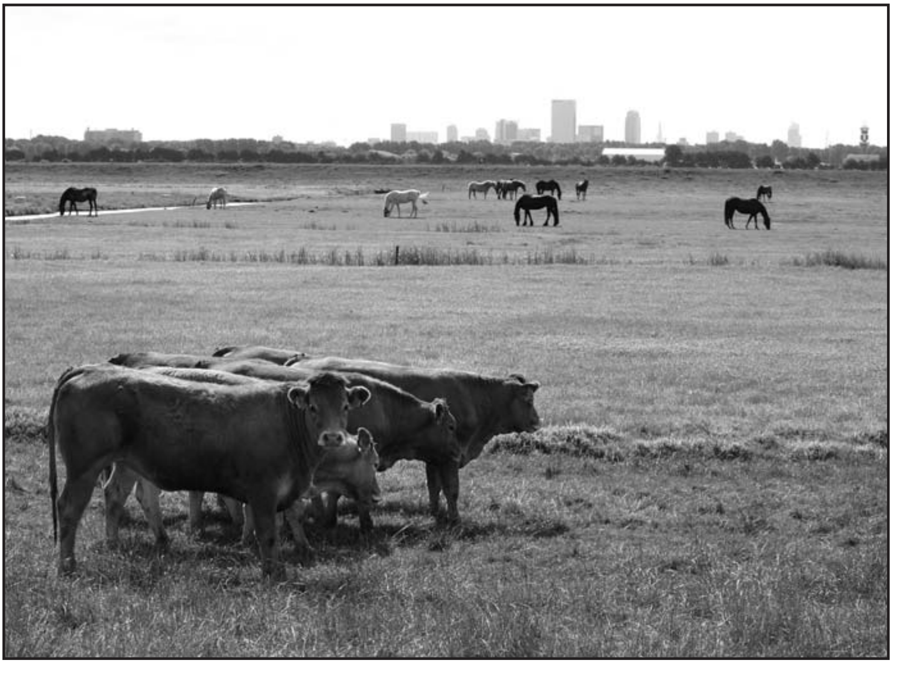


4 Environmental policies and efforts in social housing: the Netherlands

Sunikka, M., Boon, C., 2002a, **Environmental policies and efforts in social housing: the Netherlands. Building Research and Information**, 31 (1), pp. 1-12. Based on Sunikka, M., Boon, C., 2002b, **Housing associations and sustainable management, Environmental efforts in the Netherlands social housing sector**, Delft (Delft University Press).

As the first of the three modules in the empirical part of the thesis, the article describes government strategies and implementation of sustainable building measures in the social housing sector in the Netherlands. It addresses the research question: what environmental efforts have been made under the heading of sustainable management in the social housing sector in the Netherlands in response to the Sustainable Building Agreement in 1998 and government policy?

Abstract
Although progressive government guidelines and awareness of sustainable issues exists, progress in sustainable management in the social housing sector has been slow. A market research survey and analysis of the sustainable housing management by Dutch housing associations indicates the areas and organizations where policies, instruments and practices are focussed or lacking. Longitudinal trends are established using further surveys from 1993, 1998 and 2000 as well as comparing national strategies from five European Union countries (the Netherlands, Germany, the UK, France and Finland). Results indicate that efforts in sustainable management are misplaced with emphasis on procuring new buildings, not on operation and maintenance. Several barriers at the policy and strategy level are identified, especially the perceived costs of implementing environmental management, the lack of market demand and the poor capture of benefits. Special recommendations for government, housing associations and occupants are based on the findings – widening the focus of issues on sustainability, emphasizing the existing building stock, increasing the use of voluntary agreements, recognizing different capabilities in scale of housing associations and creating market demand.

Keywords: building stock, environmental policy, housing associations, management, social housing, sustainable built environment, the Netherlands

4.1 introduction

In the European Union, buildings account for over 40% of the total current energy consumption and 30% of all CO_2 emissions (Bourdeau, 1999). The Kyoto Protocol has increased pressure on governments in various countries to establish sustainable building strategies aimed at reducing CO_2 emissions. Sunikka (2001) studied the impact of national strategies in five countries that have adopted sustainability strategies for the construction sector: the Netherlands, Germany, France, the United Kingdom and Finland. Current policies in all five countries focus exclusively on new construction, which adds roughly 1% annually to the total building stock. In addition, Waals et al. (2000) concluded that the real potential for sustainable building and CO_2 reduction lies in managing the existing stock of residential buildings, and that housing associations, as managers of a large segment of the total housing stock, are key actors in fulfilling this potential. This area, however, has been largely ignored in current research and development activities.

Housing associations in the Netherlands are presented as a case study. The Dutch housing sector, 36% of which consists of social housing (Haffner and Dol, 2000), faces the task of reducing its CO_2 emissions by 25 Mtons between 2000 and 2012. This target can only be achieved through large-scale renovation of the existing housing stock, which for housing associations require an environmental policy and action plan.

The Dutch situation is situated in a broader context. Using a comparative analysis, environmental efforts in the social housing sector are examined in Germany, France, the United Kingdom and Finland. These countries were selected because they have comparable policies on – but different approaches to – sustainable building. An empirical analysis concentrating on the Dutch situation, provides insight into the environmental policies of housing associations, the instruments used and sustainable measures taken during maintenance, renovation, refurbishment, demolition and new construction. Drawing on similar research studies in 1993 and 1998, this analysis also examines developments in sustainable housing management that have emerged in Dutch housing associations since 1993. Finally, the opportunities for sustainable building and sustainable management in the social housing sector are discussed.

4.2 Background

The Netherlands

Two Action Plans have been published for sustainable building in the Netherlands (MVROM, 1995; MVROM, 1997). In addition to building regulations, the government uses other measures to stimulate the implementation of the strategy. However, the Action Plans for Sustainable Building do not set specific targets for the social housing sector in particular, a sector that accounts for 75% of the total rental stock and includes 2.3 million homes (Haffner and Dol, 2000). Social housing associations themselves have been searching for ways to promote sustainability. Aedes, the umbrella organisation for social housing associations, entered into an environmental agreement with the government on behalf of its members in 1998, and has developed strategies to translate the objectives into an environmental policy at the housing association level (see Quintis, 1999). According to Luten and Van Bakel (1997) and Weissmann (2000), costs and a lack of knowledge, appropriate instruments and information have been the primary factors preventing sustainability from really becoming established as common practice in the social housing sector.

Germany

Unlike most countries, Germany's sustainable building strategy uses norms and regulations (Liimatainen, 1995). According to the Federal Statistics Office (2000), Germany's stringent, long-term environmental policy has achieved partial results in terms of stabilising energy consumption and regenerating waste despite economic growth. The volume of social housing in Germany is relatively small, accounting for 15% of the total housing stock (Haffner and Dol, 2000). Building regulations ensure that social housing providers observe certain environmental measures, including renovations. Thus, they do not have the freedom to pursue environmental policies and invest in sustainable improvements based on their resources. All social housing providers must observe certain ecological standards in order to meet the housing subsidy criteria. The environmental ambition level for the subsidy criteria is higher than the building regulations. The financial impact of German public policy will soon be reflected in the social housing sector with the introduction of new thermal regulations. These regulations will also apply to the existing stock, and the renovation expenses anticipated as a result.

France

France has yet to develop an action program for sustainable building, despite an initiative known as the Haute Qualité Environnementale (High Environmental Quality) led by the Association HQE (2000). Sunikka (2001) found no special HQE legislation or nomenclature; sustainability is a relatively new issue in France, and general consumer patterns and attitudes are not yet very ecological. Social rental housing accounts for 46% of the total rental stock in France (Haffner and Dol, 2000), and can, therefore, efficiently promote sustainable building. Delebarre (2000) reports that French social housing providers made a commitment to the principle of sustainable development by adopting an environmental policy in 2000. While the policy targets are ambitious, they have been formulated descriptively. Without measurable objectives, monitoring will be difficult. The social housing sector, the National Agency for the Environment and Energy Management, and Gaz de France, the state-held gas company have entered into environmental agreements that provide for incentives towards introducing energy and waste improvements in social housing. VAT can be reduced for renovation projects in France, a provision that has enabled investments in energy efficiency.

The United Kingdom
The UK's strategy for sustainable construction is market-driven and linked to the improvement of competence in the construction industry (DETR, 2000). The problem with the industry-orientated approach is that market actors alone are unlikely to promote sustainable construction when the market for it is still weak (Sunikka, 2001). The social housing sector, which accounts for 60% of the total rental stock (Haffner and Dol, 2000), endeavours to support government policy in its actions. The Housing Corporation (2000), which regulates and funds the Registered Social Landlords in England, published its Environmental Policy in 2000. The policy emphasises integrating sustainability in all actions and criteria in the Corporation. As the targets are mainly descriptive, only time will tell whether the Environmental Policy will effect concrete change in current practices and how progress will be monitored. Given the recent decline in the government's influence on social housing, housing associations need to be motivated with environmental incentives and subsidies, a measure that has yet to be widely adopted in the UK.

Finland
The Finnish strategy in promoting sustainable construction relies heavily on the environmental awareness prevalent in the market. The Ministry of the Environment (YM, 1998) published its Programme for Ecologically Sustainable Construction in 1998. Unlike the other countries studied in this overview, Finland has no umbrella organisation for the social housing sector, which accounts for 48% of the total rental stock (Haffner and Dol, 2000). Finland's Housing Fund, which issues state loans and approves interest subsidies for social housing, aims to integrate environmental issues in the subsidy criteria in the near future. If this plan is actually implemented, it will make social housing providers very conscious about sustainable building.

Conclusions
This brief overview of these five European countries shows that each country's social housing sector appears to be aware of the role they can play in promoting sustainable building. However, current government strategies for sustainable building are general and voluntary. Moreover, they fail to pay adequate attention to the issue of renovating and managing the existing housing stock. While the social housing sector is often mentioned as a major target

group, government strategies do not address objectives for that sector in particular. Consequently, social housing providers see government policies more as general guidelines than as action plans, which require changes in current practice. For this reason, environmental approach has remained cautious in practice in all five countries.

4.3 Methodology

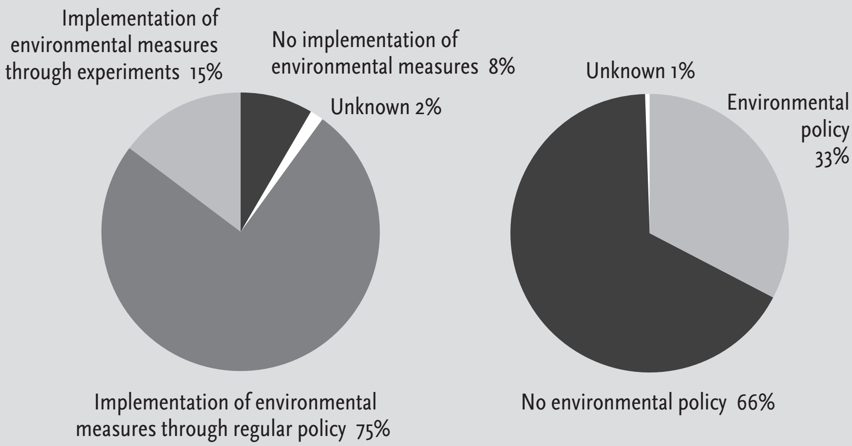
The Netherlands was chosen as a case study because of its large social housing sector and its experience in sustainable building. Of the five countries analysed, the Netherlands had the most developed sustainable building policy in its social housing sector (Sunikka, 2001). The description of practical sustainable management in the Dutch social housing associations is based on four surveys. This section describes how the survey data was obtained, and how it was used.

In 1998, the Dutch social housing sector, the Dutch government and a few third parties drew up the Sustainable Building Agreement, which includes a survey programme for the evaluation of environmental objectives. In the 2000 survey, 700 housing associations were sent a questionnaire addressing the qualitative and quantitative aspects of sustainable management, with 190 responding (Atrivé, 2001). The pool of respondents varied from housing associations that managed fewer than 500 dwellings to some in charge of over 10,000. The size of a housing association is likely to have some impact on how actively it implements the sustainable building agreement. Bearing that in mind, each answer was analysed in relation to how many dwellings the respondent managed. The anonymous questionnaire and limited number of questions limited the potential to make statistical cross-analyses, such as the managed stock and adaptation of an environmental policy.

This paper focuses on the results of the 2000 survey and examines the results of the corresponding survey in 1998, where 763 housing associations received the questionnaire, and 316 responded (Atrivé, 1998).

Two other surveys were studied, which provide an overall picture of developments in sustainable housing management in the Netherlands. In 1993, Quist and Van den Broeke (1994) conducted the Sustainability and Housing Maintenance Research Study for the Ministry of Housing, Spatial Planning and the Environment. One of the research objectives was to gauge the status quo in sustainable housing management and the environmental performance of social housing. Altogether, 253 housing associations and 362 commercial landlords were interviewed in connection with that study. The 1993 results are used as a reference source for the present study. This places the 1998 and 2000 survey results in a time perspective, and enabled the examination of developments between 1993 and 2000.

Figure 4.1 Environmental policies in Dutch social housing associations in 2000



Source: Atrivé, 2001

At the beginning of 2001, Stichting Bouwresearch (SBR) (2001) conducted an extensive study into attitudes towards sustainable building among municipalities and market actors, including housing associations. In total 2,341 questionnaires were received and analysed; 225 of those were from the housing associations. The SBR market research study enables an interesting comparison with the survey results, as the answers of the housing associations can be compared to those of other market actors, such as developers, architects and contractors. We will refer to the results of this market research study throughout this article.

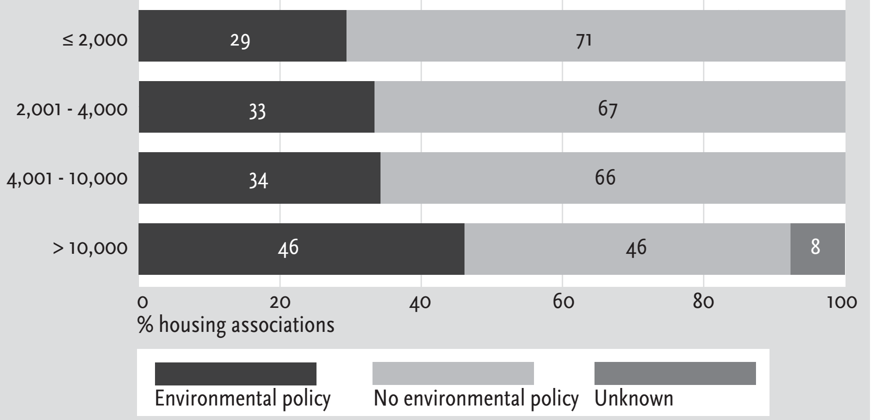
4.4 Sustainable management in the Netherlands

Environmental policies in housing associations

One third of the housing associations that responded to the questionnaire have an environmental policy (Fig. 4.1). However, the figure does not completely reflect what actually happens in practice, since housing associations can implement environmental measures without necessarily adopting an environmental policy. In total, 75% of the social housing associations indicated that they implement environmental measures regularly, and 15% through experiments. 8% of the housing associations implement no sustainable measures. According to the cross-analyses, this group consists mostly of small associations. On average, the housing associations with environmental policies are one third bigger than those with no such policies. As demonstrated in Fig. 4.2, the more dwellings a housing association manages, the more environmental policies it tends to adopt.

A correlation was found between the size of housing association and implementation of environmental measures (see Sunikka and Boon, 2002). Approximately 60% of the housing associations in the two smallest categories imple-

Figure 4.2 Environmental policies in Dutch social housing associations in relation to the number of managed dwellings in 2000



Source: Atrivé, 2001; Sunikka and Boon, 2002

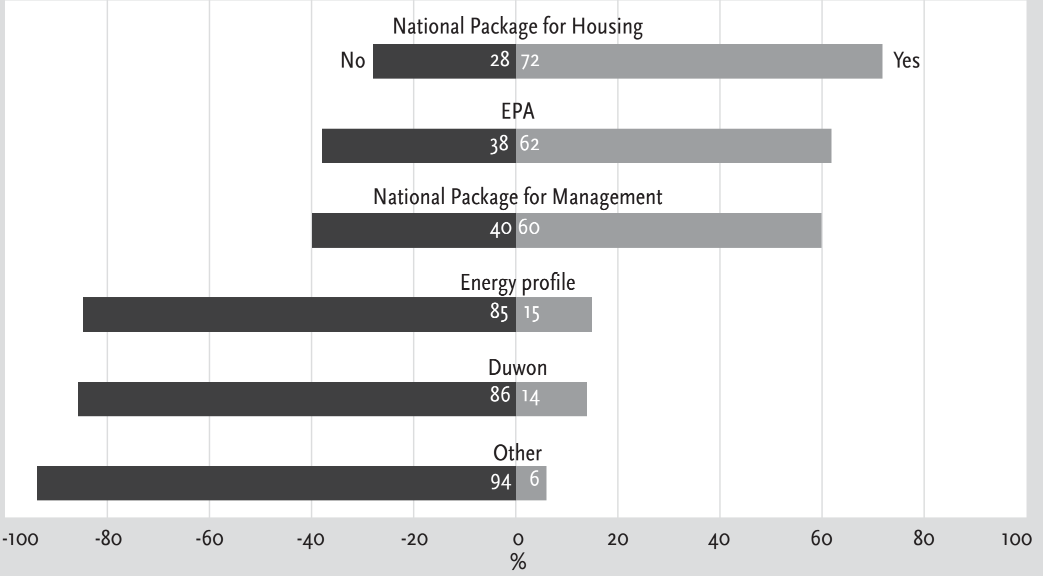
ment environmental measures, whereas nearly all of the associations managing over 1,800 dwellings implement them. However, the housing associations managing over 10,000 dwellings are not very active in implementing environmental measures despite their great capacity.

The housing associations were subsequently asked which environmental measures they would consider in new buildings and the existing stock. Energy and materials were the most popular measures to be implemented both in new and existing dwellings in 2000. However, the energy measures were based more on building regulations than on any initiative towards investing in experimental measures. Energy Performance Coefficient[1] (EPC) values below 1, which is the current building regulation level, are uncommon in new dwellings, even though the housing associations like to cite energy saving as a priority in their environmental policies. This implementation of building regulations can hardly be considered sustainable building. Solar panels are still rare in practice, and solar collectors were implemented in 8% of the new dwellings in 2000. Despite their well-established position in sustainable building, good indoor quality and water saving measures receive little attention in the housing associations, and are seldom implemented in practice. Flexibility, accessibility and safety measures are relatively popular, especially in new dwellings.

Environmental measures often become a focus of attention during the early phases in new construction, and in major projects in existing stock, such as renovations. Daily maintenance and demolition are the phases where sustainability receives less consideration. Sunikka and Boon (2002) conclude that this lack of attention to the existing stock poses a serious disadvantage to the future of sustainable building, as much can be done to benefit the environment with existing dwellings.

1 The EPC measures energy performance in buildings. The EPC may not exceed a certain fixed value that is defined in the Dutch Building Decree.

Figure 4.3 Use of sustainable management tools in Dutch social housing associations in 2000



Source: Atrivé, 2001; Sunikka and Boon, 2002

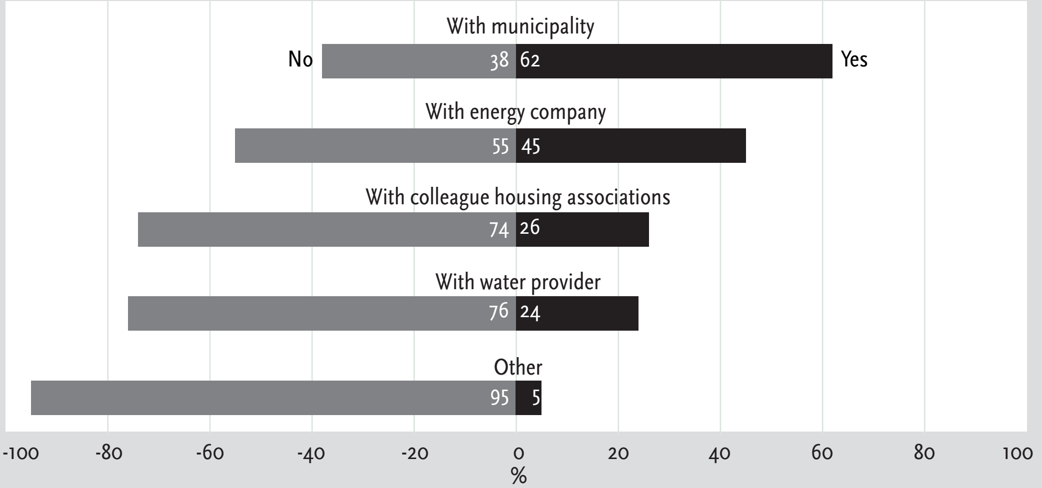
Use of sustainable management tools

In the Netherlands, a number of tools and methods have been developed for sustainable housing management, such as the National Packages for Sustainable Building, Duwon, Energy profile and Energy Performance Advice (EPA) (see Sunikka and Klunder, 2001). The National Packages for new housing and management (SBR 1998a; SBR 1998b) consist of sets of measures and recommendations for achieving sustainable building. Measures in the National Packages relate to materials, energy, water and the indoor climate. The introduction of the National Packages brought about consensus regarding the definition of sustainable building between the construction industry, product manufacturers, developers and government authorities in the Netherlands. However, the results of these measures in terms of reducing the burden on the environment are still relatively modest on average (Blaauw and Klunder, 1999). Duwon (SEV, 1997) is a manual that aids housing managers and decision-makers in taking account of environmental performance as a quality aspect in complex decision-making processes. The EPA has been developed to provide insight into the current energy performance of existing dwellings, and future dwellings when recommended energy measures are implemented.

Fig. 4.3 shows that the National Housing Package was the most popular package used in the housing associations in 2000. The National Package for Management and Duwon were used less, although those who did opt for them rated them as useful.

69% of the users rated Duwon as sufficient or good, and 14% as fair. None of the users gave it a bad rating. However, 61% of the respondents were unfamiliar with Duwon, or had no opinion about the tool. The EPA was developed for energy efficiency in the existing stock. Over 50% of the housing associations

Figure 4.4 Environmental agreements in Dutch social housing associations in 2000



Source: Atrivé, 2001; Sunikka and Boon, 2002

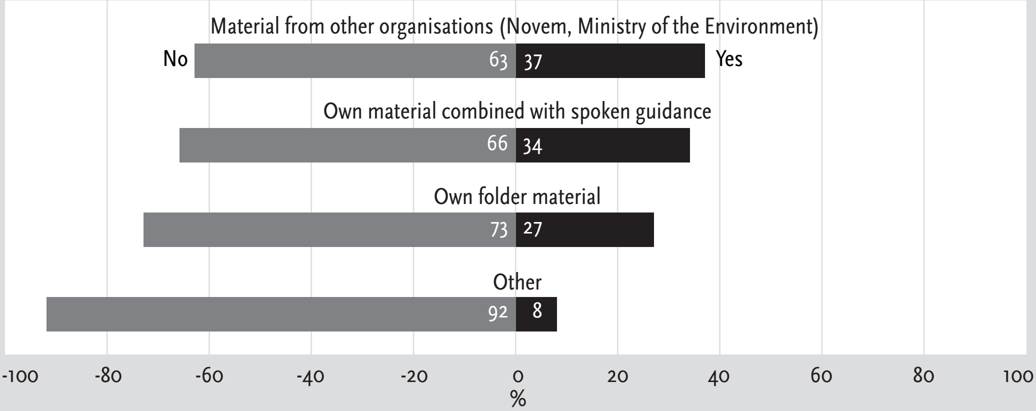
use the EPA, which gained popularity in a relatively short period due to its well-organised system and subsidy provisions. Therefore, the EPA is a useful model to follow in developing new methods to promote sustainable building. A total 38% of the housing associations rated it as good, and 47% as sufficient. A cross-analysis revealed these tools are used more in large housing associations than they are in the small associations. The average user of the National Housing Package is almost three times larger than non-users. Duwon users are six times larger than their non-user counterpart housing associations.

Environmental agreements

Two types of policies define sustainable building in the Netherlands: legislation for energy efficiency and convenants, which are voluntary agreements for sustainable building in general. These convenants are drawn up mainly for the purpose of establishing agreements with different parties on sustainable building. Deliberation amongst the parties involved is important in the process. These agreements are used to complement legislation, but have no legal status and are voluntary. Fig. 4.4 shows that most of the environmental agreements are drawn up between housing associations and municipalities.

The voluntary agreements focus on energy, but also cover other measures. Nearly 50% of the housing associations have entered into an agreement with energy providers to realise energy-saving objectives. Strikingly, energy is well covered in each agreement. By contrast, the practice of establishing agreements with other housing associations and water saving companies is less popular. The agreements between the housing associations and municipalities focus on new building. In the SBR market research study (2001), housing associations were asked whether their agreements cover construction of new dwellings and utility buildings and renovations of existing dwellings and utility buildings. According to the housing associations, 92% of their sustainable building agreements concern new dwellings, and only 55% renovations. Some

Figure 4.5 Environmental education of tenants in Dutch social housing associations in 2000



Source: Atrivé, 2001; Sunikka and Boon, 2002

housing associations consider both new building and renovation, but most of them focus only on new construction.

Cross-analyses relating the answers to the managed stock showed that the small housing associations enter into fewer agreements than their larger counterparts. The housing associations that have agreements with municipalities are, on average, almost two times larger than those who do not. Are housing associations that have entered into agreements with municipalities more active in implementing sustainable building measures than those who have not such agreements? A cross-analysis revealed that 42% of the housing associations that have established an agreement with a municipality have adapted an environmental policy; but only 18% for those with no such agreement. Furthermore, 89% of the housing associations that have an agreement with a municipality use the National Housing Package and 42% of them provide environmental education for their tenants. The latter figure is double the housing associations without such agreement.

Environmental education of tenants

Tenants play an essential role in reducing the environmental impact of dwellings during the operation and maintenance. Housing associations can educate their tenants about energy efficiency, water saving and other subjects by providing their own material to tenants, or making use of other organisations, such as the Ministry of the Environment. The results in Fig. 4.5 indicate that in 2000, one third of the housing associations provided energy-related environmental education materials for their tenants. Considering the volume of education materials already available about sustainable building, this is relatively little.

Cross-analyses regarding environmental policies showed that housing associations with environmental policies are slightly more active in providing environmental education to their tenants than those without such policies. In total, 37% of the respondents with environmental policies have invested efforts in environmental education; for those without policies the figure was 22%.

The SBR market research study (2001) shows that consumers are not very interested in sustainable building in the Netherlands. According to the housing associations, 33% of their tenants are interested or very interested in sustainable building, 49% of the tenants are somewhat interested, 9% have no interest whatsoever and 9% do not have an opinion. Furthermore, of those tenants who are interested in sustainable building, only few are willing to invest extra money in it. The housing associations that participated in the survey estimated that 16% of their tenants would be prepared to pay extra for environmental measures, and indicated that 6% would actually request sustainable building. Thus, the SBR market research study shows that most organisations and companies do not want to establish their profile as being associated with sustainable building. Only 6% of the housing associations indicated that they always associate sustainable building with their profile. Another 38% claimed to do so often, 41% sometimes or rarely, 14% never and 3% did not have an opinion.

Barriers to sustainable housing management

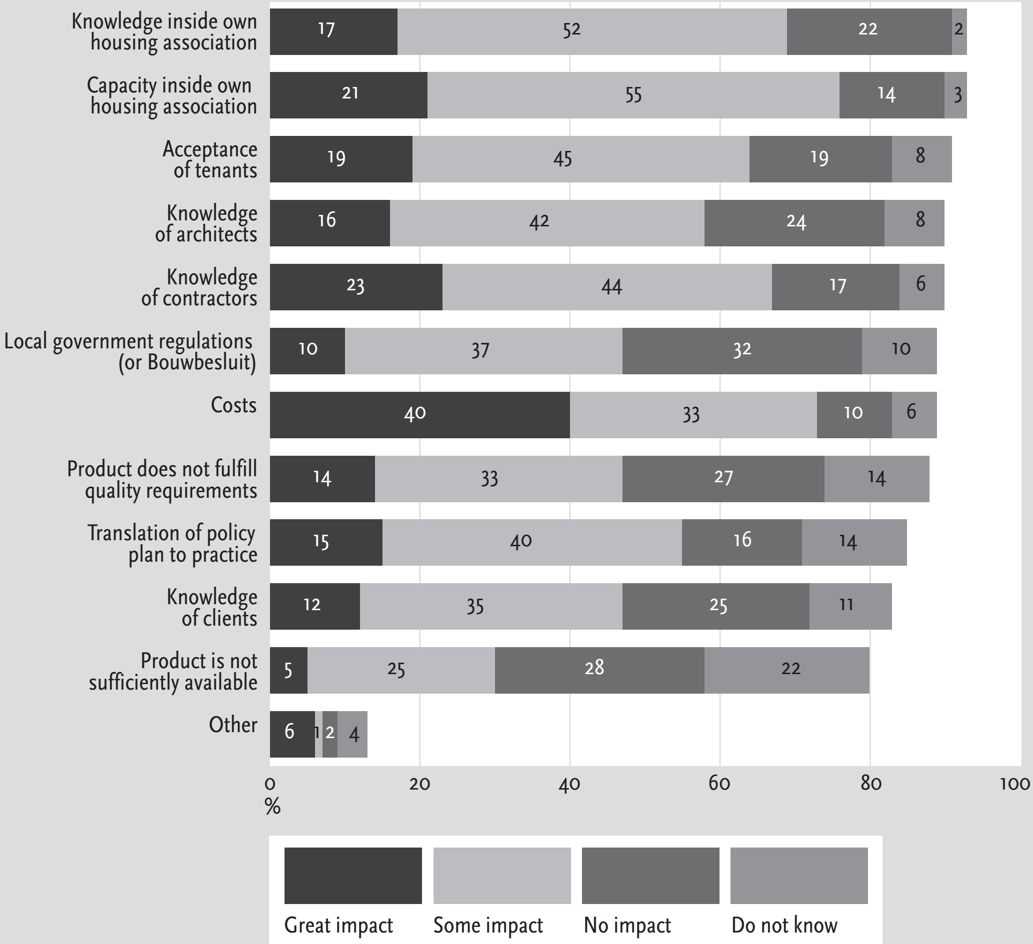
The above research results indicate that sustainable building is an issue well familiar to social housing associations in the Netherlands. However, it is still implemented modestly in practice. To find effective ways to improve this situation, barriers must be recognized and appropriate support measures introduced. The most important barriers to sustainable housing management in 2000 were the demands individual housing associations faced in terms of costs, capacity and knowledge (Fig. 4.6). The quality and availability of the product, and building regulations are seen as less of a barrier. Architects' and contractors' knowledge and capabilities are considered as more of a barrier than clients'.

Cross-analyses showed that approximately 75% of the housing associations with environmental policies found the process of translating policy into practice to pose a partial or major barrier. No correlation between the consideration given to barriers and the size of managed stock was found.

Developments in sustainable management

A comparison of the 2000 survey results to those for the 1993 and 1998 surveys shows, despite developments in national strategy, sustainable management in Dutch housing associations has developed little since 1993, and certainly not since 1998. Quantitative information about the measures implemented in 1998 and 2000 supports this finding. Housing associations spent an average of €2,964 per dwelling in sustainable building measures in new construction in 2000, and €71 per dwelling in the existing stock. As compared to 1998, the investment decreased by 25 % in 2000. Water saving measures showed a decline. Why sustainable management has not really improved is a question that requires deeper study. It should be noted, however, that attitudes have changed

Figure 4.6 Barriers to sustainable management in Dutch social housing associations in 2000



Source: Atrivé, 2001; Sunikka and Boon, 2002

since 1993, with the focus increasingly on costs. In the SBR market research study (2001), 43% of the housing associations cited subsidies as an important stimulation measure. They named subsidies more often than did other market actors, such as developers or contractors. However, according to Sunikka and Boon (2002), positive trends have also arisen. One major development to emerge since 1993 is the practice of drawing up environmental agreements with third parties. In that year, 6% of the housing associations named sustainable building agreements as a measure for developing and implementing environmental policies. By 1998, over 50% of the housing associations had established sustainable building agreements with municipalities, and 40% with energy-companies. A change has also emerged in the use of tools. The current tools did not exist in 1993. In 1998, 66% of the housing associations used the National Housing Package and 41%, the National Package for Management. Since 1998, the use of tools has continued to increase.

4.5 Conclusions

Sustainable management in the Dutch social housing associations was examined, because it already has experience of sustainable building policies. Although systems of social housing differ between countries, certain measures can be transferred from the Netherlands to Germany, France, the United Kingdom and Finland. Conditions in the Netherlands and the United Kingdom are similar enough for mutual exchange. Although the volume of German social housing is relatively small, these measures could be adapted and applied very successfully in a country with a larger volume of social housing. Sustainable housing management in Finland and France is fairly out-dated compared to the Netherlands, although several development activities are under way in this area. Analysis of the Netherlands led to several conclusions about sustainable management in the social housing sector which could be used to encourage sustainable building across Europe.

Cost is a primary barrier

Although research showed that housing associations have positive attitudes towards sustainable building, by 2000 sustainable management had not yet been successfully implemented in the Netherlands' social housing sector. A comparison of the results from the surveys conducted in 1993, 1998 and 2000 indicates, housing associations have not made much progress since 1993 in implementing sustainable management despite developments in government strategy, building regulations and incentives. The housing associations themselves cite the main barriers to sustainable housing management as costs, capacity and knowledge and the problem of acceptance by tenants. For most housing associations, cost is the primary reason for the slow implementation of sustainable building in daily practice. All five countries analysed recognised this conflict between environmental and economic values. In many countries, the market situation has changed radically in recent years, with housing associations increasingly expected to generate profits. Environmental investments are strictly limited by tight budgets as European social housing providers face the challenge of surviving within the market.

Sustainability management is too narrowly focused

Our research shows that, in total, 75% of Dutch housing associations implement sustainable building measures regularly, 15% through experiments, but less than half these housing associations have adopted an environmental policy. Material and energy-related measures are relatively well adopted in practice, especially in new buildings, whereas good indoor quality and water-saving measures receive little attention. The research results indicate that when housing associations actually implement environmental measures, the target level of the building regulations is seldom exceeded. Moreover, efforts towards sustainability are presently concentrated more in separate experiments than in systematic management, both in the Netherlands and the four European countries analysed.

Insufficient attention to the existing building stock

There is a lack of attention in the Netherlands to the existing stock in terms of sustainable housing management. Furthermore, sustainable building measures considered in the existing stock are usually in renovation, whereas in maintenance and operation phases sustainability is ignored. However, substantial environmental profit can be derived from existing dwellings. This situation, which is similar in Germany, France, the United Kingdom and Finland, is a serious disadvantage for the future of sustainable building. Therefore, ways to stimulate the renovation of existing stock should be sought.

Current tools for sustainable management are useful

A comparison of the survey results shows, that since 1998 Dutch housing associations have increasingly used tools such as the National Packages for Sustainable Building, Duwon and EPA. Furthermore, these tools were still rated as quite useful in 2000. The Energy Performance Assessment (EPA) focuses on energy conservation and was developed to provide insight into the current energy performance of existing and future dwellings when recommended energy measures are implemented. If housing is rated using the EPA, an extra subsidy of 25% is granted for any measures recommended. Over 50% of the housing associations use this tool, which gained popularity over a relatively short period due to its well-organised system and subsidy provisions. It is therefore clear that the EPA is a useful model to follow in developing new methods to promote sustainable building both in the Netherlands and elsewhere in Europe. However, when tools are adapted to other countries, data may need to be adapted because standards and approaches vary between countries.

Voluntary environmental agreements have become increasingly popular

Voluntary environmental agreements are typical of the type of sustainable building policies established in the Netherlands. The 2000 survey shows that most of the environmental agreements entered into by housing associations are with municipalities. These agreements focus on energy conservation, but are also expanding to include other aspects of sustainable building. Voluntary agreements may be of interest as sustainable building policies in Germany, France, the United Kingdom and Finland. The agreement between the social housing sector and the government that is described in this article could be adapted for the social housing sector in France or the United Kingdom. Considering the entire process of introducing the objectives of agreements at the housing association level, it might be useful to structure their own, rather vague, environmental policies.

Small housing associations are more passive than their larger counterparts
In the cross-analyses, a correlation was found between the size of association and their implementation of sustainable measures. The more dwellings a housing association manages, the more likely it is to have an environmental policy, to establish sustainable building agreements with third parties, and to offer its tenants environmental education. Housing associations with an environmental policy are approximately one-third larger on average than those with no such policies. 20% of the small housing associations have environmental policies compared to 50% of the large associations. Although based on the Dutch situation, other European countries can note that different target groups should be recognised in sustainable building policies and objectives should be specified according to their own needs.

Lack of market demand
The Dutch housing associations name subsidies as the most important measure to promote sustainable building in the 2000 survey. However, it is unrealistic to think that subsidies alone can increase sustainable building. The real threat to sustainable building is the lack of market demand. According to the market research study (SBR, 2001), very few consumers are willing to make any extra investments in sustainable building in the Netherlands, and many have no interest whatsoever in it. On the other hand, housing associations have not invested sustained effort in the environmental education of tenants, whose actions have a major environmental impact on the social housing sector. This problem of low demand should be taken seriously and ways to change general values and consumption habits to be more sustainable need to be searched for.

4.6 Recommendations

Housing associations need consistent environmental policies
According to the 2000 survey, several housing associations are planning to adopt an environmental policy in the Netherlands over the next five years. Successful examples of such policies could serve as an aid to these associations achieving this objective. In larger housing associations, standardised and international environmental management systems, such as the ISO 14001 or EMAS, can ensure an effective and consistent policy.

Small housing associations need motivation
The cross-analyses show that large housing associations are more active than their smaller counterparts in the Netherlands. Therefore, it is important to include small housing associations in sustainable building policies. Since the managerial needs of small and large housing associations can differ, efforts to encourage small associations may require policy adjustments.

Environmental education of tenants

The operation phase and tenants can play a key role in reducing the environmental impact of the social housing sector in every country. Housing associations should be encouraged to educate their tenants. It is not necessary for housing associations to produce environmental educational materials. More use of existing materials produced by other organisations, e.g. the Ministry of the Environment, is required on sustainable building and lifestyles. The information they provide should be clear and interesting to the target audiences.

More focus on the existing stock

To achieve the objectives in the national strategy for sustainable building, such as those regarding energy conservation, environmental policies need to engage with managing and renovating the existing stock. This applies both to government policies and strategies at the housing association level in all five countries analysed. Projects in the existing stock require systematic environmental policies and agreements with third parties. Current environmental agreements between housing associations and municipalities, to name one example, focus on new construction. Their scope, however, should extend to include targets for the existing stock as well.

Social and economic aspects need attention

Although energy and material measures are relatively well considered in housing associations, social and economic aspects of sustainable housing need more attention. Affordability of housing, accessibility and safety are essential in achieving sustainable solutions in social housing. New measures such as adaptability and safety are increasingly associated with sustainable building in the Netherlands. However, social and economic aspects were not included in the sustainable building agreements and sustainable management tools th at were described in this study.

Environmental improvements require regulations as well as subsidies

An efficient way of making housing associations take environmental action is to increase the use of mandatory measures. In practice, the standard set by building regulations is seldom exceeded without extra benefits in the Netherlands. Therefore, the target level of the current standards should be considerably raised. However, regulations can never affect the majority of buildings, since they apply primarily to new construction. Other measures, such as taxes, are also needed and environmental objectives should be included in housing subsidy criteria. Given the objective of affordability in social housing, more stringent measures and regulations must be counter-balanced by subsidies.

Again, the basic problem is the lack of market demand. Sustainable building is not a market asset and this situation needs to be changed. One concrete way to green the market could be the environmental labelling of houses.

Energy labels for domestic appliances have increased sales of the A-labelled goods, which are associated with good quality and long-term savings. An environmental label for buildings could assure consumers that they get value for their investment and increase interest in sustainable building. A standardised label could also reduce confusion in a growing market of different consultation and evaluation services.

Focus on the process

The development of instruments is not enough to promote sustainable building because much depends on the implementation process e.g., Dutch housing associations named lack of knowledge as an important barrier. Despite the availability of the instruments, a gap exists between government policy and practice. For example, one reason for the slow adaptation of sustainability improvements is housing associations have to make the investments whereas the tenants profit from a less expensive energy bill. The capture of benefits needs to be employed to motivate housing associations.

Implementation of environmental agreements needs control

The environmental agreement and its survey programme in the Dutch social housing sector aims to give sustainable management a precise and concrete form. However, when sustainable building is promoted with voluntary agreements and policy plans, a signed agreement does not necessarily guarantee any more action in practice. For example, housing associations with an environmental policy are not necessarily more active in implementing measures than those with no such policies. Therefore, documentation of the implementation of objectives is essential if the Dutch approach of voluntary agreements is adopted in other countries.

Focus on target groups

A gap exists between government policy and its implementation in practice, primarily by the barrier of costs recognised in all five countries analysed. One approach to the conflict between environmental and economic values is to divide the housing associations into different target groups, for example Leaders, Platoon and Laggers. Different tools can be applicable for each target group. Additional research is needed to specify more precisely the different target groups and their applied tools in making housing associations take environmental action in practice.

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5 Energy efficiency and low carbon technologies in urban renewal

Sunikka, M., 2006a, **Improving energy efficiency in urban renewal: case studies**. Building Research and Information (accepted). Based on Boon, C., Sunikka, M., 2004, **Introduction to sustainable urban renewal. CO_2 reduction and the use of performance agreements: Experience from the Netherlands**, Delft (Delft University Press).

The article is based on case studies in the Netherlands, where obstacles are identified in the context of urban renewal that need to be overcome if energy efficiency measures are to be implemented and space heating replaced with low carbon technologies. As a second module of the empirical part of the thesis, it focuses on the research question: what factors (technical, economic and with regard to implementation) lie behind the inertia regarding energy efficiency and low carbon supply in urban renewal in the Netherlands?

Abstract
Buildings belong to the most cost-effective sectors where CO_2 reductions can be achieved, and urban regeneration offers a good intervention point for switching to sustainable fuel sources, as changes in energy infrastructure can be coupled with other construction, thus decreasing the cost. However, the potential energy savings that are feasible do not match the more ambitious policy targets. Based on case studies in the Netherlands, obstacles are identified in the context of urban renewal that need to be overcome if energy efficiency measures are to be implemented and space heating replaced with low carbon technologies. The current free-market public policy instruments have not managed to address the obstacles identified in the case studies due to poor market signals, costs and payback periods, risks and lack of leadership on environmental targets and policies on sustainable urban renewal. The potential for stronger government intervention is examined for effectiveness in reducing both energy consumption and CO_2 generation. Legislation could produce a certain policy outcome in terms of CO_2 reduction in urban renewal in the Netherlands if compliance and legitimacy are ensured, but policy consideration is also required to account for the dilemma of low-income households and the rebound effects associated with occupant behaviours.

Keywords: Energy efficiency, carbon reduction, urban renewal, renovation, building stock, housing, public policy, the Netherlands.

5.1 Introduction

Improving energy efficiency in existing buildings is often considered to be one of the most cost-effective measures for cutting down carbon emissions (Ashford, 1999; Lowe, 2000; Van der Waals, 2001) and considerable energy saving potential has been demonstrated in different countries (Hekkanen et al., 1999; Badescu and Sicre, 2003; Hastings, 2004; EC, 2005). Urban renewal provides a good intervention point for energy improvements as they can be coupled with other renovation measures and provides synergy when performed together (Kohler and Hassler, 2002). Both physical and economic neighbourhood renewal is essential to ensure that investments in energy efficiency pay off, as the value of a building depends not only on the quality of the building itself but also on that of the surrounding buildings, the infrastructure and the neighbourhood. Consequently, urban renewal provides an incentive to spend more on improving building quality (Awano, 2005).

Energy efficiency and the use of renewable sources in the construction sector could also contribute to self-sufficiency and solving peak demand and stand-by capacity problems (Sinden, 2005). Urban environment policy, however, has yet to deal with the carbon dioxide issue (Priemus, 1999) and the environment continues to play only a small part in urban regeneration projects for example in the Netherlands (Bus, 2001; Priemus, 2002). Initial capital costs are emphasised over life cycle costs (Jones et al., 2002) and cost is often seen as the main barrier to adopting carbon reduction measures in urban regeneration, but this concern is based on a face value impression of cost rather than any consideration of the actual costs and benefits (Van der Waals et al., 2003).

In the Netherlands, the government has set a target of reducing CO_2 emissions from the existing building stock by 3 Mt by 2010 compared to the 'business as usual' trend (MVROM, 1999). If the market worked effectively and with the right cost-benefit ratio, the monetary value of energy efficiency measures would be reflected in the resale value of homes (Clinch and Healy, 1999), but there seems to be insufficient market demand for sustainable building measures (SBR, 2001; Baumann et al., 2002). A significant proportion of policy instruments for reducing CO_2 emissions still target new buildings, while government bodies have done little to upgrade existing buildings (Sunikka, 2001; Sunikka and Boon, 2003; Hasegawa, 2002; Murakami et al., 2002; Boardman, 2004b; Awano, 2005). The policies for the existing buildings that exist seem to be formulated with little reference to specific needs, instead of making precise estimations and basing policy measures on detailed sets of requirements and costs (NOVEM, 2002; PRC, 2005).

The aim of the study is twofold. Firstly, based on two case studies in the Netherlands, it aims to describe the benefits and obstacles when implementing energy efficiency improvements in existing housing and using more sustainable energy sources in urban renewal. The first case study focuses on the question: What is the economically feasible energy-saving potential from renovating post-war housing? The second case study addresses the question: What are the obstacles to replacing gas-fired heating with low and zero carbon technologies as part of urban regeneration? Secondly, as the concept of sustainable development used in this research is the institutional one: sustainability is considered as being essentially a problem of governance in the broadest sense (Perman et al., 2003), the paper discusses policy instruments for an effective policy to overcome the obstacles. Policy recommendations focus on the question: What extent is stronger government intervention needed to circumnavigate the barriers, and what policy approach would be effective to improve energy efficiency in the existing housing stock?

5.2 Research method

Case studies can be used for explorative, descriptive, explanatory or illustrative research (Yin, 1993). This study was based on an explorative approach, looking at the feasibility of policy targets in practice. The case studies were taken from the Netherlands because since the mid-1980s it has emerged as an international leader in the environmental field, it has a tradition of effective planning (Cohen, 2000) and an established sustainable building policy (Sunikka, 2001). The projects were selected on the basis of two criteria: they had to involve a late post-war residential district where most of the regeneration operations will be carried out, and they had to include some aspirations and objectives regarding sustainable building.

The 'trias energetica' approach was adopted in the case studies because it is a generally recognised concept in the Netherlands. It sets out three steps to achieving more sustainable energy consumption: avoiding unnecessary energy consumption, using non-finite sources, and clean and efficient use of finite sources (Duijvestein, 1998). The first case study (Hoogvliet, Rotterdam) focused on the first step, avoiding unnecessary energy consumption. The first case study entailed carrying out energy evaluations of the various renovation solutions using the Energy Performance Advice (EPA) tool, a widely-used voluntary method of energy evaluation in the Netherlands. The EPA consists of a collection of input data from a survey of the location, which include building characteristics, heating, hot water and electricity consumption of pumps and fans, an assessment of the Energy Index and energy saving measures, advice and a digital EPA-report and monitoring data (Beerepoot and Sunikka, 2005). Energy savings are based on delivered energy (m^3 gas and kWh electricity) and presented in terms of carbon. The life expectancy of the buildings was 25 years before the next intervention; that of the installations was 15 years before the next intervention. The cycle of 25 years was proposed by the housing associations that participated in the research project so the renovation was assumed to take place once and not enhanced before the next intervention despite the price scenarios. Furthermore, gas prices for average households in the Netherlands have increased from €0.29 to €0.40 per m^3 between 1999 and 2003, including VAT (average annual increase 14%) but this has not generated large-scale investments in energy efficiency in the housing stock. The measures to improve the energy performance of a dwelling presented in this study are incremental, low-cost improvements, focusing on dwelling-related energy consumption, i.e. the consumption influenced by the technical condition of the home, comprising natural gas consumption and part of electricity consumption. The energy used for domestic appliances is beyond the scope of this study. The environmental impact of existing housing was focused on energy efficiency as distinct from energy conservation, which was understood to result from behavioural changes (Boardman, 2004a). However, it was recognised that technical solutions can contribute only a small amount to reducing environmental impact and changing the occupant behaviour is necessary.

It is extremely rare that what is deemed desirable is also feasible in terms of time and money (Van der Voordt and Van Wegen, 2002). The commercial viability of a project was assessed using the Net Present Value (NPV) test, which gives the present value of the Net Cash Flow associated with it. The NPV was conducted from the point of view of the investor, the housing association. The decision rule was to proceed with the project only if NPV $\geq$ 0. The investment level was set low, as similar renovation measures were to be carried out in more than 50 dwellings. These can be criticised as being relatively simple methods of ascertaining financial viability, but they are transparent and adequate when it comes to pointing out the main factors in environmental investment in real estate. All costs were calculated excluding Value Added Tax (VAT). The investment costs were calculated without subsidy, as government energy subsidies in the Netherlands were abolished in 2003. The gas price used was €0.367 per m^3, including Regulatory Energy Tax (REB). The gas price in the Netherlands is commonly expressed as euros per m^3. Cubic meters of natural gas can be converted to kWh or MJ so that 1 m^3 = 9.8 kWh or 1 m^3 = 35.17 MJ (1 m^3=35.31 cubic feet) so that the gas price used was €0.037 per kWh or €0.010 per MJ. The electricity price used was €0.128 per kWh, including REB. The costs were based on inflation rate of 2.9% and an interest rate of 6.5%. Although forecasting entails obvious risks and is complicated by the difficulty of predicting innovations in building products, a number of energy price scenarios were used as a background against which to examine the results.

The second case study (Western Garden Cities, Amsterdam) focused on the second step of the 'trias energetica' approach, using non-finite sources to provide heat and electricity. The second case study was qualitative and focused on the processes. The analysis was based on the key policy documents and interviews among those related with the project.

In this paper, urban renewal is defined as creating conditions for improving the quality of housing, work, production and the environment in and around the cities by taking measures aimed the spatial management of the residential environment. It is mostly a physical intervention with the purpose of upgrading a whole neighbourhood, where renewal of housing is supplemented with improvement of open spaces, traffic regulation and better urban infrastructure (Skifter Andersen and Leather, 1999). The literature provides few definitions for sustainable urban renewal but Bus (2001) defines it as a district-based approach geared to solving existing problems, preventing new problems, improving the quality of local environment and reducing supra-local environmental pollution. Renovation was chosen as the main renewal strategy because renovation-based interventions in the housing stock would appear to be better options from the environmental point of view than consolidation or new build (Klunder, 2005; De Jonge, 2005). In terms of type of tenure, this study focuses on the social housing sector, because in 2000, 36% of all housing in the Netherlands was social housing (Kruythoff and Haars, 2002) and since it is mostly concentrated on urban renewal areas, housing associations have a very central role in the renewal process (Ouwehand and Van Daalen, 2002).

The research was conducted in the framework of the Habiforum programme ‘Innovative Land Use’ (BSIK) an expert network promoting innovations in spatial planning with government funding in the Netherlands, and Corpovenista (Housing Associations Renewing the City, a project running in 2004-2007), a joint venture of Aedes (the branch organisation of Dutch housing associations), a number of Dutch housing associations, the Dutch government and SBR (Stichting Bouwresearch).

5.3 Case study 1: Energy efficiency improvements in the renovation of post-war housing

Hoogvliet, Rotterdam

The area covered by the first case study is Hoogvliet in the Municipality of Rotterdam, part of the Meeuwenplaat housing estate, which consists of around 3,000 dwellings located in similar five-storey blocks built in 1959 (see Fig. 5.1). About 76% of the dwellings are social rented housing, mainly in the lowest rent bands. The case study looked at 26 dwellings with an average surface area of approx. 60m^2. The exterior walls are of cavity construction. Double glazing and external wall insulation (50 mm) was installed in some parts of the façade in an earlier renovation. The floor and loft are not insulated. The energy demand is dominated by the use of natural gas for space heating. Gas

Figure 5.1. Casestudy 1: Hoogvliet, Rotterdam.

is also used for domestic hot water and cooking, and electricity is used for other energy services. The building has natural ventilation. The internal staircase and most of the ground floor are unheated. The dwellings are heated by individual gas-fired systems and domestic hot water is provided by an instantaneous heater in the kitchen. The annual average indoor temperature was around 15°C. This is not the actual temperature in all rooms but the average temperature of the whole apartment during 24 hours. It is relatively low because bedrooms, for example, are not heated during the day in the Netherlands and in other spaces like kitchens the heating is turned off during the night so the temperature can drop low.

The Hoogvliet regeneration project involves demolishing 33% of the total building stock between 1999 and 2020, including all housing in the case study. The decision to demolish and build new homes rather than renovate is based on the market value of and demand for new dwellings, which is much higher than that of a renovated post-war block of flats in most cases. The study was conducted to recognise the energy saving potential in housing renovation.

Analysis

Four renovation solutions to improve energy efficiency were examined in the first case study using the Energy Performance Advice (EPA) tool, based on the National Package for Sustainable Management, a widely-used collection of standard environmental measures in the Netherlands (SBR, 1998a; 1998b). Solution 1 entailed improving the building's thermal performance by adding cavity wall, loft and floor insulation to the thermal envelope. Solution 2 involved installing new extra-high-performance windows in addition to the insulation. Solution 3 added an HR107 boiler for space heating and a heat pump boiler for domestic hot water, with water-saving equipment, to solution 2. The high-efficiency boiler is installed in each flat. HR107 is a label for the most en-

Table 5.1 Energy evaluation in the case study

Options	Reference Existing situation	Solution 1 Insulation	Solution 2 Solution 1 + windows	Solution 3 Solution 2 + installations	Solution 4 Solution 3 + solar boiler
Energy index	1.13	0.86	0.78	0.74	0.66
Space heating (m³ gas)	28,000	13,145	9,332	9,370	9,370
Tap water heating (m³ gas)	15,087	15,260	15,260	0	0
Total gas consumption (m³)	43,887	28,405	24,592	9,370	9,370
Gas savings (m³)	-	15,482	19,295	34,517	34,517
Tap water heating (kWh)	0	0	0	61,184	41,608
Ancillary energy (kWh)	7,929	7,929	7,929	11,091	12,591
Lighting (kWh)	9,181	9,181	9,181	9,181	9,181
Total electricity consumption (kWh)	17,111	17,111	17,111	81,456	63,380
Electricity savings (kWh)	-	0	0	-64,345	-46,270
Expenditure (excl. subsidies and VAT) (€)	-	108,179	168,235	322,404	368,046
Extra expenditure (excl. subsidies and VAT) (€)	-	85,263	119,654	258,519	304,161
Gas costs (excl. VAT) (€)	16,107	10,425	9,025	3,439	3,439
Electricity costs (excl. VAT) (€)	2,194	2,194	2,194	10,443	8,125
Annual receipts in total energy costs (€)	-	5,682	7,082	4,419	6,737
Payback time (years)	-	30	45	-	-
Payback time extra investments (years)	-	21	25	-	-
CO_2 emissions reduction (kg)	-	31,641	40,327	39,562	48,177
MJ Gas for EPL calculations	1,721,614	1,096,444	924,809	390,498	390,498
MJ Electricity for EPL calculations	157,945	157,945	157,945	611,444	470,943
Change in the reference energy index (%)	-	24%	31%	35%	42%

Source: author

ergy efficient condensing boilers has a minimum 107% efficiency factor, considering the heat released in condensation. Solution 4 looked at installing a solar boiler in addition to the previous measures. Collective solar panels are installed on the roof of each building and each flat has its own solar boiler. An installation of a solar boiler is considered to reduce the demand for natural gas with 150-200 m³ in an average household in the Netherlands. The reference level was the current situation, standard maintenance without any environmental measures. The energy evaluation in the case study, looking at one building, is shown in Table 5.1.

The case studies show that there is a potential for carbon reduction at operational level in existing housing. Solution 2 resulted in a CO_2 reduction of 40,327 kg and a 44% reduction in total gas consumption; in terms of the total energy costs the saving was €7,082 (€272 per average dwelling per year). Solution 4 reduced gas consumption by 79% on the current level, although there was a slight increase in electricity consumption, and CO_2 emissions were reduced by 48,177 kg, resulting in an annual cut in energy costs of €6,737 (€259 per average dwelling per year). The CO_2 reduction required a relatively high investment: solution 2 costs €168,235 (€6,471 per average dwelling),

Table 5.2 NPVs of the various investment options for additional expenditure compared to standard renovation, after 25 years

	Solution 1 Insulation	Solution 2 Solution 1 + windows	Solution 3 Solution 2 + installations	Solution 4 Solution 3 + solar boiler
Extra expenditure compared to standard renovation (€)	85,263	119,654	*)655,457	*)771,180
Cumulative receipts in energy costs after 25 years NPV (€)	98,802	123,146	76,840	117,147
NPV after 25 years (€)	13,539	3,492	-578,617	-654,033

** Since the life cycle of installations is 15 years, the investment needs to be made twice during the 25-year life cycle of the dwelling. The second investment takes account of an inflation rate of 2.9%.*

Source: author

and solution 4 €368,046 (€14,156 per average dwelling). If we compare these results with a standard renovation (a zero option where building components and systems are replaced like with like), the additional expenditure was €119,654 for solution 2 and €304,161 for solution 4. Solution 2 would seem to be the most cost-effective measure in the case study as regards cutting CO_2 emissions: compared with a standard renovation it could produce 70% more CO_2 reduction and save 38% more in total energy costs for an additional 29% investment. Similar results were obtained in two similar case studies conducted as part of the research project (Boon and Sunikka, 2004).

A general rule is that only investments with a positive NPV should be made: Table 5.2 thus relates the cumulative returns from the various renovation solutions to the additional costs. Solutions 1 and 2 will have positive NPV after around 20 years from the investment but the NPVs of solutions 3 and 4 will remain negative after 25 years, at the time of the next intervention.

Energy prices are expected to rise because of regulatory measures, government action, implementation of the Kyoto treaty, a more dynamic energy market, pressure to satisfy electricity demand with zero-emission technology and taxes.

Table 5.3 shows the NPVs for the renovation solutions after 25 years based on additional expenditure in relation to three different price scenarios (Jansen et al., 2003). Scenario A is based on the current trend in energy prices with a 2.9% inflation rate. Scenario B is based on the assumption that energy prices will gradually rise 30% by 2012 compared to the level in 2003 and that the Kyoto Protocol will not be implemented. Scenario C is based on the prediction that the Kyoto Protocol will be implemented, causing a real 60% rise in energy prices by 2012 compared to 2003 (corrected for inflation). The results show that if energy prices increase 30% by 2012, the NPV for solutions 1 and 2 will become positive around 16 and 18 years from the investment. If prices increased 60% by 2012, as anticipated in the Kyoto Protocol (Jansen et al., 2003), the NPV will be positive around 13 and 14 years but the NPV for solutions 3 and 4 will still remain negative after 25 years.

Table 5.3 NPVs of the various investment options compared to standard renovation in the case of (A) the current trend in energy prices, (B) an expected 30% increase in energy prices in 2012 compared with 2003 (without Kyoto), and (C) a 60% increase in 2012 compared with 2003 (with Kyoto)

	Standard	Solution 1	Solution 2	Solution 3	Solution 4
	Standard renovation	Insulation	Solution 1 + windows	Solution 2 + installations	Solution 3 + solar boiler
Extra expenditure compared to standard renovation (€)	0	85,263	119,654	*)655,457	*)771,180
Annual receipts in energy costs (€)	160	5,682	7,082	4,419	6,737
A. Current energy price					
Cumulative receipts in energy costs after 25 years NPV (€)	2,782	98,802	123,146	76,840	117,147
NPV after 25 years (€)	-	13,539	3,492	-578,617	-654,033
B. +30% increase in 2012 (without Kyoto)					
Cumulative receipts in energy costs after 25 years NPV (€)	3,951	140,321	174,895	109,130	166,375
NPV after 25 years (€)	-	55,058	55,241	-546,327	-604,805
C. +60% increase in 2012 (with Kyoto)					
Cumulative receipts in energy costs after 25 years NPV (€)	5,790	205,600	256,258	159,899	243,774
NPV after 25 years (€)	-	120,337	136,604	-495,558	-527,406

** Since the life cycle of installations is 15 years, the investment needs to be made twice during the 25-year life cycle of the dwelling. The second investment takes account of an inflation rate of 2.9%.*

Source: author

5.4 Case study 2: Energy supply using low carbon technologies in urban renewal

Western Garden Cities, Amsterdam

This case study looked at the Western Garden Cities in Amsterdam to see what barriers there are to replacing gas-fired heating with low and zero carbon technologies as part of urban renewal. The Western Garden Cities area consists of a number of neighbourhoods – Slotermeer, Slotervaart, Geuzenveld, Osdorp and Overtoomse Veld – built after the war on the western outskirts of Amsterdam (see Fig. 5.2). It has around 130,000 people living in 54,000 dwellings, 10,000 of which are to be demolished as part of the regeneration of the area and replaced by 17,500 new homes by 2015. The energy demand is dominated by the use of natural gas for space heating. Gas is also used for domestic hot water and cooking, and electricity is used for other energy services. There are substantial opportunities for energy-saving in these homes, as a lot of them date back over 40 years and have major heat losses. Previous studies and policy documents estimated that a 34-49% carbon dioxide reduction is feasible as part of the renewal of the Western Garden Cities (Bureau Parkstad, 2001; Ligthart et al., 2000). Half of this reduction would come from improve-

Figure 5.2. Casestudy 2: Western Garden Cities, Amsterdam.

ments in building technology, such as insulation, the other half from a large-scale energy supply.

Analysis

Table 5.4 summarises a number of low and zero carbon technologies. Not all these sources are suitable for urban renewal, however: biomass boilers are likely to remain a special solution for rural areas; wind in urban areas is unpredictable and causes nuisance; and heat pumps are likely to be limited to new build because installing them in existing buildings requires major internal changes. A smaller-scale alternative for heat and electricity supply is micro CHP, domestic Combined Heat and Power. This involves the simultaneous production of heat and power in a single building, using small energy conversion units where the heat produced is used for space and water heating (and possibly for cooling) and the electricity is used within the building or fed into the grid. Various conversion technologies have been developed for domestic applications, e.g. reciprocating engines, Stirling engines, low and high-temperature fuel cells and micro gas turbines, and these are slowly coming onto the market. So far micro CHP systems have relied mainly on natural gas, making them a 'grey' rather than a 'green' energy supply, but they do reduce greenhouse gas emissions and resource consumption, compared to the average energy supply. Solar energy systems, like most current renewable technologies, struggle to pay back during their lifetime, but their current cost-effectiveness is by no means a guide to what it could be in the future. Renewable energy sources are expected to develop by leaps and bounds during the next few decades. In the UK, for example, it is thought that solar water heating will be installed in around two-thirds of homes by 2050, and the cost of PV cells is commonly estimated to halve every ten years (Boardman et al., 2005).

Table 5.4 Sustainable energy sources

	Heat only	Heat and electricity	Electricity only
Low carbon	Heat pumps	Gas fired CHP for district heating Gas-fired micro CHP (Stirling engine) Gas-fired micro CHP (fuel cells)	–
Zero net carbon	Solar hot water Biomass Geothermal	Energy from waste or biomass CHP for district heating Biomass in micro CHP (e.g. Stirling engines)	Photovoltaics Wind

Source: Boardman et al., 2005

A feasibility study of the measures required to achieve the 50% carbon dioxide reduction target in the Western Garden Cities concluded that an energy supply with district heating appeared to be the best way of achieving the target (W/E Adviseurs, 2002). District heating using waste heat from the Afval Energie Centrale (AEC) in the Western Docks Area was finally identified as being economically feasible. Three energy providers were asked to make an offer, and Essent's heat distribution offer was chosen on the grounds that it had the most affordable price. Another offer, based on the use of solar energy, would have been more costly. Later on in the process, however, Essent was not able to meet the requirements, and negotiations began with the Afval Energiebedrijf (AEB). In 2004 the housing estates, the municipality and most of the housing associations took the decision to proceed with the new energy grid for new build homes and major renovations. The network is to be implemented and run by Westpoort Warmte BV (WPW), a joint venture of the AEB and Nuon Warmte. Switching from gas to district heating, provided by industrial waste heat, in 25,000 dwellings in the Western Garden Cities could contribute an annual carbon dioxide reduction of 34 million kilos a year to the city of Amsterdam. It would be the largest heating project in the Netherlands. If a new energy infrastructure is implemented only in new build – which has a lower energy consumption than the existing stock in any case – the carbon reduction is very limited. This option, however, is probably the one that will be adopted.

It should be noted that when a new energy infrastructure is implemented, the carbon saving achieved through district heating is not immediate, as the distribution network takes time to be built and existing homes need to be adapted internally to the new energy system. Replacing the gas network with a new energy distribution network requires kilometres of underground structures. These are usually hidden under existing roads, but constructing them causes nuisance to residents and damage to trees and other vegetation. Under the current plan, from 2005 clusters of housing in the Western Garden Cities will have temporary boilers while the final infrastructure is being built: these also increase the cost of implementation, and the long implementation period makes for greater risk. The energy infrastructure will be completed in 2009-11, when all the homes will be connected to the AEC network and the temporary boilers will be removed. In 2011 most homes in the Western Garden Cities will obtain 100% of their heating from the AEC (cost is the limiting factor that prevents 100% connection to the grid sooner). The carbon reduction will therefore also begin with a delay, but the energy saving target should be feasible in the longer term.

District heating was chosen mainly because it would not cause additional costs to the municipality, the housing associations or the residents. The feasibility of the AEC energy supply is limited by cost, however. EnergieNed, the federation of energy companies in the Netherlands, lays down a maximum annual tariff to consumers for gas in the Netherlands (€17.15 per GJ excluding VAT, or €187.33 per dwelling, in 2003), which must not be exceeded regardless of the energy source. This 'no more than otherwise' (Niet-Meer-dan-Anders, NMDA) principle applies to the Western Garden Cities. A third party makes the investment required in a more sustainable energy source instead of the residents, but the residents pay the same price for the energy they consume as if it came from conventional sources, regardless of whether the residents consume less energy, in order to pay back the investment. The NMDA principle is one option to tackle the capture of benefits but it can have unwanted side effects, as residents do not receive any feedback on their energy consumption.

There are also a number of risks related to future energy prices: the energy market and inflation, the final cost of the new energy infrastructure, the remodelling of streets and open spaces, estimating the right number of dwellings to be connected to the network, the construction rate and the actual cost of installation. The liberalisation of the energy market has produced commercial energy companies that are more interested in market factors and less in the environment.

Current renewal projects in the Netherlands are often administered by policy networks rather than regional government, as is the case in the Western Garden Cities. The introduction of a bigger role for the market mechanism in urban renewal in the national report on housing in 1989 was an important move in the direction of a property-led approach to urban renewal (Verhage, 2005), followed by the operation in 1995 through which the housing associations were made financially independent from the central government, making the risk and reward aspect of renewal projects more important for them. Responsibilities are consequently divided up among a large number of organisations: the energy supplier (the plant), the energy distributor, several departments of the municipal authority, four neighbourhoods, 10-12 housing associations which play an important role in regeneration, and the residents, each with their own interests and economic position, even their own concepts of sustainability. Less governance seems to have both positive and negative effects: on the positive side it has produced more flexibility but it seems also to have led to fragmentation in policy implementation, with no priority being given to environmental considerations; on the negative side there is no body responsible for taking a lead in implementing a comprehensive energy strategy. Traditionally, environmental aspects in spatial planning have focused on green and water, objectives initiated by the Environmental Departments (Dienst Milieu) in municipalities. The Environment Department is a specialist on environmental matters but it is not particularly interested in the costs or the residents. The Housing Departments have to integrate targets for the building sector, which has not been a traditional target group of an environmental policy.

In the case study, two main risks remained after the risk analysis: the risk that the rate of construction and installation (connections to the new energy infrastructure) would be lower than envisaged, and the risk that the price index of heat tariffs would cease to be linked to the price index of inflation. The energy provider and the energy supplier, who bear the financial risk, have no control over the building process. The separation between the heat supply and heat distribution is also a risk: the network needs to be 'future-proof' in case the plant closes down, so that the grid can be switched to a new low carbon fuel.

When the plans for the district heating system in the Western Garden Cities were far enough advanced to be really open to discussion, they faced resistance from the residents, who feared higher energy bills and increased rents and disliked the idea of switching from gas to electricity for cooking. Most residents felt that having their own boiler was something far more tangible than district heating. Many residents of the Western Garden Cities were against demolition, which is one of the main renewal strategies, and some of them assumed that implementing the new energy infrastructure would be used as an argument for demolishing even more homes. The housing associations aimed to offset the residents' main concern (cooking with electricity) by giving them cookers of higher than standard quality. The residents were regarded as being 'not interested in energy efficiency' at the beginning of the renewal process, but they were not given much information on the various different options either.

Efforts in the Western Garden Cities focused on the new energy grid rather than improving the thermal performance of existing dwellings. In the first instance it would be sensible to invest in refurbishing the existing stock to make it more energy-efficient rather than a district heating system. If the homes were upgraded to passive energy homes, connecting them to a grid would not be so urgent. Lower energy consumption reduces vulnerability to energy prices and increases security of supply as well as enhancing comfort; it is also more cost-effective for occupants, as end-users pay 3-5 times as much for power as the price paid to utilities for corresponding new power delivered to the grid (Gether et al., 2005). As an alternative to district heating, solar energy – or in the future micro CHP – could be an interesting alternative in existing dwellings, as it does not require a new infrastructure, the responsibilities are divided to a lesser extent, there is less risk associated with the construction rate, and it does not involve temporary boilers and therefore delayed carbon savings.

5.5 Policy recommendations

Urban regeneration is high on the Dutch political agenda and has resulted in several investment programmes (MVROM, 1997; 1999). The approach adopted is a radical restructuring of the housing stock, adding more expensive dwellings for higher-income households, which entails demolishing, or in some cases renovating or selling, inexpensive, mostly rented, dwellings (Van Kempen and Priemus, 2002), also in the case studies. No official policy, however, has been defined for sustainable urban renewal. In order to facilitate coherent policy for urban renewal the Dutch government has brought together a number of subsidy schemes in the Investment Budget for Urban Regeneration (ISV), a special purpose grant scheme designed to improve the quality of the urban environment. Energy ambitions are reviewed in the ISV applications but energy improvements are not required. In the first case study, the urban renewal policy of the Province of Zuid-Holland does not mention environmental objectives (Provincie Zuid-Holland, 2001). The Energy and Climate Policy Paper for 2000-2010 (Provincie Zuid-Holland, 2000) includes general energy-saving measures for the residential sector but there are no sanctions for non-compliance.

As the building regulations mainly account for new construction (Sunikka, 2001; Beerepoot, 2002) and most energy subsidies were abolished in 2004 due to the proportion of free-riders which was estimated to be as high as 60% (Egmond and Lulofs, 2005), the Dutch policy on energy efficiency in the housing stock has been implemented by voluntary pull measures (agreements, communication tools) and energy prices (Boon and Sunikka, 2004). The Energy Premium Regulation (EPR) scheme, including the Regulatory Energy Tax (REB) that increased energy bills by a third, was introduced in 2000 to encourage households to invest in energy efficiency measures. Energy price increases are needed to persuade users to adopt less polluting patterns of behaviour, given that enormous differences have been noted in the energy consumption of identical houses (Haas et al., 1998), but as seen in the first case study, energy prices would have to at least double to be effective. If prices increased 60% by 2012, as anticipated in the Kyoto Protocol (Jansen et al., 2003), the NPV of renovation solutions 1 and 2 will be positive around 13 and 14 years but the NPV for solutions 3 and 4 will still remain negative after 25 years. Furthermore, research shows that while half the population is aware of the Regulatory Energy Tax in the Netherlands, only 2% take it into account in their electricity use (Van der Waals, 2001).

Due to complexity of the obstacles identified in the case studies and the fact that extra costs and risks compared to a standard renovation are difficult to eliminate, extending the thermal requirements in the building regulations to existing housing seem necessary if energy efficiency is to be implemented in large-scale in urban renewal in the Netherlands. Legislation can also address the high-income households that do not have to react to price signals in their energy consumption behaviour. Regulations cannot be imposed on the existing housing stock overnight, however, since most energy measures are not yet cost-efficient and not all households are in a position to respond to mandatory requirements, or the increased rents. Economic incentives are needed so that a mandatory policy does not cause problems for low-income households and create an ethical conflict with the right to housing but due to the free-rider effect, subsidies should only be targeted for that part which would not be covered by the increased value of the property. As all decisions made at an earlier stage influence further choices, subsidies should be ensured at an early stage of the renewal process, otherwise there is a risk that energy efficiency measures will not be carried out.

It should be considered that compliance with the introduction of thermal regulations for the existing housing stock is especially problematic, as not all renovations require notifying the building authorities, which on the other hand might not want to enforce the building regulations against private owners (Skifter Andersen and Leather, 1999). A property transaction, where an energy certificate will soon be required anyway according to the EC Energy Performance of Buildings Directive (EPBD) may be a good intervention point for controlling and improving, the energy performance of a dwelling (EC, 2003).

Policy approaches based on the current voluntary approach in the Netherlands, and a more mandatory policy to legalise energy savings in the existing housing stock, both have advantages and disadvantages that are discussed in Table 5.5 in terms of communication instruments, negative and affirmative economic incentives and building regulations.

There are some obstacles that need to be addressed at the level of actors instead of a government policy, for example the capture of benefits that is present in both case studies. Housing associations may feel that there are no benefits from making investments in energy efficiency if they are unable to raise rents. On the other hand, tenants may feel that they are not responsible for undertaking investments in energy efficiency, especially if they expect to move out in the short or medium term. Therefore, the landlord should be able to guarantee the benefit of the investment for the tenant, for example if the tenant wants to implement energy efficient improvements on their own, they should be compensated for it when moving out. Different ownership models can also work to overcome this barrier: for example, the energy company could take on the leading role, taking over the existing system and replacing

Table 5.5 Discussion of pros and cons of policy instruments for sustainable housing in relation to two policy approaches

Instrument	Pros	Cons
1. Market-led policy (current approach)		
Negative economic policy incentives	Shorten the payback times of energy investments. Equal compliance, also in rented sector. Can have the same effect on existing buildings and new build without additional administrative cost. Punish ineffective energy use under the EU's polluter-pays principle. Effective coverage. May encourage innovation in the EU. No need for direct government intervention in individual decision-making, support free-market approach.	Equity: hard on low-income households often in energy-inefficient housing, so the weakest are the worst hit. It is unlikely that energy prices in the EU can be increased enough in the short term to make a sufficient difference to attract more investment. Provide no incentive in rented sector as tenant pays the energy bill so could increase fuel poverty in the EU. Can seem complicated to households, the main stakeholders in renovation.
2. Direct regulation (recommended approach)		
Environmental requirements in building regulations for the existing stock	Effective in forcing from attitudes to uncompromising action. Equal compliance, also in rented sector. Shape the environment for usage-related energy saving behaviour. Ensure minimum levels in the housing stock and the environment in the EU. Signal action from the national government.	All households in the EU cannot respond because of economic consideraintions. No incentive to exceed the – often conservative – minimum, do not address all technical/economic feasibility aspects. Supervision is problematic if actions do not require notifying building authorities. Costs will be passed on to occupants. Tend to lock in existing technologies.
Positive economic incentives	Can help to increase the market share of improvements in energy efficiency. Shorten the payback times of energy investments. Trigger purchases and respond to present-day bias. Reward energy efficiency in the EU. Public acceptance and legitimacy. Support the market transformation strategy.	Price incentive needs to be high enough. Not enough to make a project cost-effective in most EU countries. Free-rider effect reported in the Netherlands, not a cost-effective allocation of resources for government. Stopping subsidies can have a bad effect. Do not provide strong market signals from the government and conflict with the EU's polluter-pays principle.
Supporting information (Both approaches)		
Communication tools	Necessary to increase awareness, market demand and WTP for energy efficiency among all actors in the EU and to support compliance with the other policy instruments. Support the market transformation strategy.	Energy certificates: only an indication of energy performance, not self-policing; compliance with and adoption of measures need to be ensured through other policy measures. Risk of slow and imprecise impact if used alone.

Source: author

it with an energy-efficient alternative, which the tenant would lease from the energy company.

Furthermore, as seen in the case studies, the decreasing role of the national government in urban renewal points supervision and monitoring of the new legislation and the national policy at local authorities. Central and local government have less relation while the importance between local authorities and other actors at local level increases (Verhage, 2005). If responsibility is delegated to local governments, they must be guaranteed sufficient resources, funding and multi-disciplinary knowledge to realise the tasks entrusted to them.

5.6 Conclusions

This paper reviewed the state of Dutch urban renewal from an environmental point of view and presented case studies that were undertaken in the context of a consortium research programme in the Netherlands. Using practical examples from two case studies, the paper examined obstacles to the implementation of energy efficiency improvements in existing housing and the use of more sustainable energy sources in urban renewal, and discussed the response of the current policy approach to overcome these obstacles, giving examples for the other countries that are still developing their policy approach.

The estimates of how much savings are possible in existing buildings in Europe vary but a typical value is 30% – 40% improvement in energy efficiency (ECN/RIVM, 1998; Slot et al., 1998). The first case study illustrates that in a renovation a reduction of this scale could be achieved with solution 2 involving installing new extra-high-performance windows and insulation. A household in an average dwelling could save in their total energy costs €272 per year, making the NPV of the investment positive after 20 years. However, even as the result of increased energy prices (Jansen et al., 2003), the NPV of solution 3, which added an HR107 boiler for space heating and a heat pump boiler for domestic hot water to solution 2, and solution 4, which looked at installing a solar boiler in addition to the previous measures, will remain negative even after 25 years, which is considered as the point for the next intervention in the life cycle of the building.

This second case study looked at the Western Garden Cities in Amsterdam to see what barriers there are to replacing gas-fired heating with district heating provided by industrial waste heat, a project that could contribute an annual CO_2 reduction of 34 million kilos a year to the city of Amsterdam. The case study showed that careful consideration should be given to risk management and the preferences of residents when choosing a new energy source for a fuel switch, otherwise the scheme is likely to meet with obstacles to implementation similar to those found in the case study, especially if the renewal is implemented by a policy network. Uncertainties are created by use of temporary boilers until the energy infrastructure will be completed, the final cost of the new energy infrastructure, the number of dwellings to be connected to the network and responsibilities divided to too many parties; the energy provider and the energy supplier, who bear the financial risk, have no control over the building process, and due to the separation between the heat supply and heat distribution, the grid has to be adaptable to be switched to a new low carbon fuel. Not only the role of housing associations has become more commercial and focused on the risk and reward aspects; the liberalisation of the energy market has produced commercial energy companies.

The case studies indicate that although there may be a more sophisticated understanding of different social, environmental and economic factors in urban renewal in the Netherlands, it does not mean the character or the objectives of urban renewal would have been changed in practice, making it far too early to speak about environmentally 'sustainable urban renewal'. Actually, most of the reasons why people did not save energy in buildings in the Netherlands in the 1980s are still familiar today: society in general wastes energy, feedback on energy consumption comes late and is of a general nature, some houses are energy-wasting and cannot be managed in an energy-conscious way, and there is unwillingness to reduce comfort (Van Raaij and Verhallen, 1983). This raises the question whether the government policy on energy efficiency in housing has been disoriented since the eighties. The current voluntary, energy-price based policy in the Netherlands includes a risk that environmental improvements are only considered 'if there are no extra costs' or 'where possible' as identified in the interviews in the case studies (Boon and Sunikka, 2004). There are two main problem groups in a policy based on energy prices: high income households who do not have to react to price signals, and low income households who cannot afford to response to them, and sometimes in the rental sector they are not even allowed to. Owing to costs, risks and lack of leadership, it seems in order for the policy to be effective, energy efficiency in the existing housing needs to be made more mandatory in urban renewal in the Netherlands. Introducing an energy standard by means of the energy certificate, in combination with economic measures for rewarding higher and punishing worse energy performance levels, seems an interesting approach that needs further research.

Many European countries are facing the challenge of urban renewal and pressure to reduce carbon emissions, and there is recognition of the limitations of traditional policy instruments. Every case study in urban renewal differs in terms of location, structure and market demand, and the small number of case studies here calls for caution when interpreting the results, but it was thought to be adequate to show the main obstacles. The EU countries may be assumed to be those to which the resulting recommendations will be applied in the first instance.

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6 The energy certificate system under the Energy Performance of Buildings Directive (EPBD): improving the energy efficiency of the existing housing stock

Sunikka, M., 2006b, **The energy certificate system under the Energy Performance of Buildings Directive (EPBD): improving the energy efficiency of the existing housing stock** (*submitted*). Based on Sunikka, M., 2005, **Energy performance of buildings directive,** Background document J for the 40% House project, Oxford (University of Oxford).

The article discusses the anticipated efficiency and effectiveness of the energy certificate scheme as it will affect existing housing in the UK. It is the third module of the empirical part of the thesis and addresses the research question: what is the anticipated impact of energy certificates under the Energy Performance of Buildings Directive (EPBD) on the existing housing stock in the UK, and how can the impact be maximised?

Abstract

In 2003 the European Commission recognised the importance of energy saving in the housing stock by introducing the Energy Performance of Buildings Directive (EPBD). One of the key elements in the Directive is the introduction of energy certificates in property transactions. This article discusses the anticipated efficiency and effectiveness of the energy certificate scheme as it will affect existing housing in the UK. Although energy certificates for household appliances have proved relatively successful, as a communication instrument targeting housing – as now suggested in the EC Directive – they are not likely to be very effective, since information problems are only one of many market failures in the complex building market. On the basis of these findings we suggest that energy certificates be combined with regulatory or economic policy instruments. Effective results can probably be expected from introducing regulations combined with energy certificate standards, but the approach will need to be rather drastic and it will take time to gain sufficient support.

Keywords: Energy efficiency, housing stock, policy, Energy Performance of Buildings Directive, energy certificate

6.1 Introduction

In early 2003 the European Parliament passed Directive 2002/91/EC on the Energy Performance of Buildings (EPBD), which aims to reduce greenhouse gas emissions and achieve compliance with energy requirements among the Member States (EC, 2003). Article 7, on the introduction of the energy certificate, is the main provision in the Directive that targets the existing building stock; Article 6 suggests the introduction of thermal regulations for major renovations, but the threshold of 1,000 m^2 means that the requirements apply mainly to the tertiary sector and only about a third of multi-family dwellings (Petersdorff et al., 2004). The Member States have to ensure by January 2006 that an energy performance certificate not more than 10 years old provides energy saving advice to prospective purchasers or tenants when a new or existing building is sold or let. In addition to detailing the building's current energy efficiency level the certificate must include recommendations for cost-effective improvements in energy performance. However, in the beginning of 2006 only 10 Member States (Germany, Italy, Portugal, Austria, Denmark, Lithuania, Belgium, Latvia, Poland and the Slovak Republic) had reported full or partial transposition. Only Denmark, that has almost 10 years of experience of mandatory energy certificates, and Bulgaria have finished the legislation on the energy certificates. Even among countries that have transposed the Directive, several have indicated an intention to delay implementation by up to three years.

The European Commission can serve the common interest by basing environmental standards on those found in the most progressive Member States. One state pioneers the new instruments, followed relatively soon by a few emulators and eventually by a larger group of countries, the critical mass (Andersen and Liefferink, 1997). The energy certificate as proposed by the European Commission seems to be similar to the one already in existence in Denmark (Beerepoot and Sunikka, 2005), presented later in this article. The situation where an idea already applied in one Member State is adopted at European level, where it will be followed by all the other Member States, confirms two theories recognised in the policy analysis literature. It illustrates the 'innovation via emulation' approach mentioned by Bennett (1991), i.e. conscious mimicking of one another, borrowing core aspects of what are considered to be the most successful policies. It also resembles the 'ideas dominant' approach as described by Jordan et al. (2000), in which certain ideas and beliefs of the policy-makers drive the search for and selection of policy instruments. This confirms the idea that decisions to choose certain policy instruments are not always based primarily on their anticipated effectiveness but rather on policy-makers' ideas and beliefs (Beerepoot and Sunikka, 2005). Despite the efforts required to implement the energy certificate scheme set out in the EPBD, there has been very little discussion of what impact it will have, whether it is an effective policy instrument to target carbon savings from energy use in the residential sector, and how it should be implemented.

This article examines how the EC energy certificate scheme could improve the energy efficiency of the existing housing stock and how it should be used in combination with regulatory and economic policy instruments to achieve effective results. The question addressed is: How is the energy certificate under the Energy Performance of Buildings Directive (EPBD) expected to be implemented in existing housing, and what ways does it offer of reducing carbon emissions from the residential stock? This will yield insights into policy options that could help the EU Member States to optimise the implementation of the energy certificate when they begin to apply the new Directive nationally.

Section 6.3 presents a qualitative study describing energy certification systems in Denmark and the Netherlands used to select variables and set boundaries for the scenarios in the quantitative analysis. The potential impact of the energy certificate in the UK is examined in a quantitative analysis in section 6.4. Recommendations on policy to optimise the impact are given in section 6.5 and conclusions drawn in section 6.6.

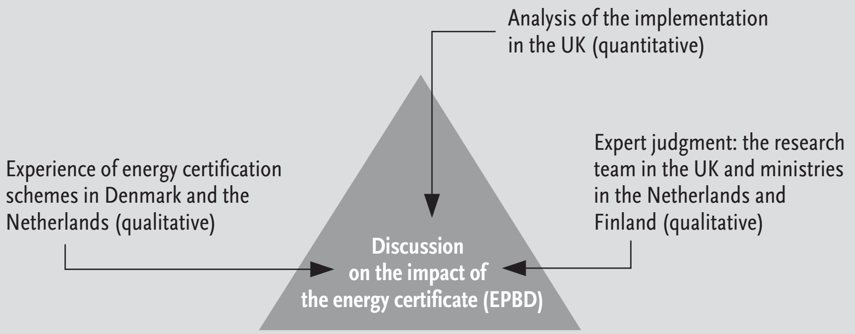
6.2 Research method

In order to discuss the impact of the Directive consistently, this paper addressed the research questions simultaneously from the three points of view, as shown in Fig. 6.1.

The research began with a qualitative analysis of voluntary energy certificate schemes for buildings already in existence in Denmark and the Netherlands, both of them EU countries in a similar climate zone with established policies on sustainable building in the residential sector (Sunikka, 2001). The Danish example was studied here because the energy certificate as proposed by the European Commission appears to be similar to the existing scheme in Denmark. In the Netherlands the energy certificate for existing dwellings is likely to be based on the existing Energy Performance Advice (EPA). Energy certificates for buildings are defined as an instrument for assessing the energy quality of a building, either existing or new, residential or non-residential.

The quantitative analysis focused on projecting the possible future implementation of the energy certificate in the UK by employing a stock model. Actual effects cannot yet be measured, so the focus is on probable consequences. The UK is an interesting case study of domestic energy efficiency, as it has one of the oldest and least energy-efficient housing stocks in Europe, and around 4.3 million households in England are officially designated as 'fuel poor', i.e. unable to obtain adequate energy services, mostly space heating, for 10% of their income (Smith, 2001). In order to place the analysis in a broader

Figure 6.1 Research method



Source: author

context, the research team discussed the implementation of the energy certificate in the UK and officials in the ministries in Finland and the Netherlands responsible for implementing the EPBD were interviewed (Sunikka, 2005).

It should be noted that this study focuses on a discussion of the best way of implementing the energy certificate in existing housing in the UK (Article 7 of the EPBD). It is not an impact assessment of the Energy Performance of Buildings Directive as a whole, nor is it entirely applicable to other countries. The assumptions that we were forced to make in the analysis were based on probabilities and include uncertainties, e.g. any attempts to describe the future. The analysis is not a forecast, as the outcome of the Directive will depend crucially on political commitment and consumer behaviour. We assumed that: households and owners would accept long payback times on investments in energy efficiency; there are no capacity problems in the industries supplying insulation and systems; there are enough contractors to implement the measures; all energy inspections can be carried out; and the energy-saving measures will be implemented in such a way as to enable the planned savings to be made. The approach adopted in the study was technical/scientific. As regards reducing the environmental impact of existing housing, the focus was on energy efficiency as distinct from energy conservation, which is seen to result from behavioural changes (Boardman, 2004). While it was recognised that technical solutions can contribute only a small amount to reducing environmental impact, changing the behaviour of occupants was not within the scope of this study.

This research was carried out at the Environmental Change Institute of the University of Oxford to provide background material for the 40% House research project, the aim of which was to investigate how the UK government's commitment to cutting carbon emissions by 60% could be achieved in the residential sector. The 40% House scenario, with projections to 2050, took as its starting point the best available projections for demographic change and assessed what level of social and technological change would be required to make deep cuts in carbon emissions notwithstanding substantial growth in the total number of dwellings (Boardman et al., 2005). Carbon emissions from the UK residential sector were modelled using the UK Domestic Carbon Model (UKDCM), which examined energy flows in a set of dwelling types (defined by age, region, dwelling type, tenure, construction and number of floors) and tracked changes in the housing stock (the rates of refurbishment, demolition and new construction, installation of technology, changes in internal temperatures) in the context of a changing population (household size) and future variability in the UK climate. The 40% study concluded that over two-thirds of the 2050 housing stock has already been built, highlighting the need to refurbish these dwellings (Boardman et al., 2005). The Energy Performance of Buildings Directive was considered as one policy variable that could facilitate the renovation of the existing housing stock.

6.3 Qualitative study

6.3.1 Experience of energy certification schemes: Denmark

A mandatory energy certification scheme for all existing buildings (Energie Maerkningsordningen) has been in force in Denmark since 1997. The Danish scheme for small buildings, including single-family houses and owner-occupied flats, is based on a standardised energy rating, including information on energy and water consumption and CO_2 emissions in comparison to a similar reference building. An energy plan – proposals for further energy and water savings, an estimation of the investment cost, annual saving and expected economic lifetime of the measures – is also required. When the building is sold, energy certification is carried out by a trained energy consultant. The charge for the evaluation is paid by the seller and amounts to €300-500 for a single-family home, depending on the size, age and type of the building (Vekemans, 2003).

The Danish small buildings scheme was evaluated in 2001. The evaluation shows that the scheme increases energy savings to a small extent, but it was not possible to calculate the energy-saving effect of the scheme, the actual cost of the CO_2 reduction and shadow prices precisely, as the measures implemented in practice are not recorded in the certification scheme database. It does, however, identify a significant potential for energy savings in existing buildings. According to the 2001 evaluation, despite the fact that the Act makes the energy certificate scheme mandatory, only 50-60% of buildings were covered by the scheme, with large regional differences (COWI consult, 2001). Despite the programme's legal status, sanctions have not been imposed. Furthermore, although over 40% of the labelled buildings showed improvements in the first year, a large energy-saving potential remained unused. Acceptance of the scheme was relatively high, but many building owners were not aware of the certification requirements, which tend to get buried under all the paperwork involved when a building is sold (Laustsen, 2001). Home-owners' knowledge of the scheme was very poor, owing more to lack of promotion than to the quality of the information material (COWI consult, 2001). The buyer should receive information on the energy condition of the dwelling before purchase, but competition between potential buyers makes this difficult in practice.

6.3.2 The Energy Performance Advice: the Netherlands

An Energy Performance Advice (EPA) consists of a collection of input data from a survey of the location, including the heating, hot water and electricity consumption of pumps and fans, an assessment of Energy Index performance and energy-saving measures, recommendations, a digital EPA report and monitoring data, as well as building characteristics. It is a voluntary system and costs about €150-200 per dwelling. The Regulating Energy Tax (REB) on energy use should have a positive influence on the payback times of the energy-saving measures proposed in the EPA. An Energy Performance Advice is voluntary. In the beginning the energy audits and some of the suggested improvements were supported by government subsidies, but these were discontinued in 2003 for budgetary reasons and because of the free-rider effect. Once the subsidies were axed, EPA evaluations dried up (Beerepoot and Sunikka, 2005).

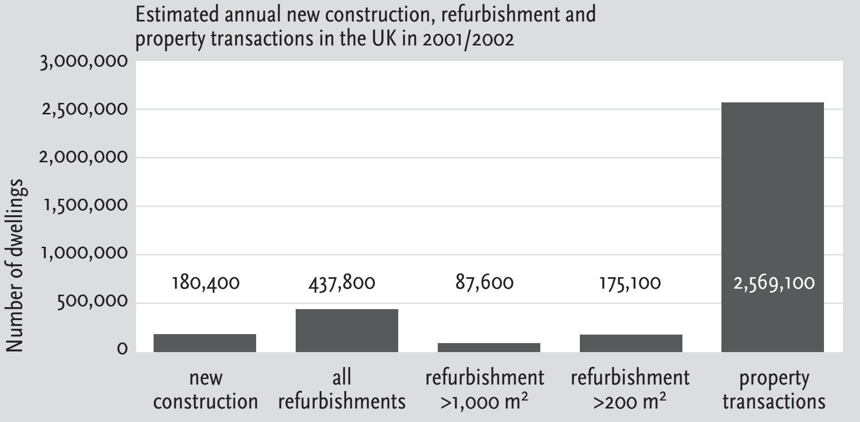
There is uncertainty as to the number of EPAs that will be issued and the amount of energy savings they will achieve, since the instrument is voluntary (Jeeninga et al., 2001). To date some 50,000 EPA evaluations (representing 0.76% of the total housing stock) have been carried out by 500 registered EPA consultants. The general idea behind the EPA is that it should result in additional energy-saving work being done on top of the organic trend in home improvements that would be carried out in any case (e.g. replacing central heating boilers at the end of their lifespan). It is very difficult, however, to say what the additional energy-saving measures are, or what measures would not have been taken without the EPA (Beerepoot and Sunikka, 2004). The Dutch Ministry of Housing, Spatial Planning and the Environment estimates that the EPBD, as it is currently going to be implemented, is unlikely to have a carbon dioxide reduction effect in the Netherlands, although it is likely to increase the effect of existing policy instruments such as the EPA.

6.4 Quantitative analysis: the UK

6.4.1 Data and variables

The stock model used to examine the implementation of the energy certificate consists of seven age classes of residential stock covering the entire UK dwelling stock. It used data from the English Housing Condition Survey

Figure 6.2 Annual rates of new construction, refurbishment (applying Article 6 to renovations exceeding 1,000 m² and 200 m² and all refurbishments) and property transactions in the UK in 2001/2002



Source: National Centre for Social Research, 2003; Petersdorff et al., 2002; Sak and Raponi, 2002

(EHCS) in line with the UKDC model in the 40% House research project. On the basis of the qualitative analysis and the discussion in the research team, suitable variables were selected to examine the potential contribution that energy certificates could make to reducing carbon emissions from the existing housing stock. Four core elements were identified, which are assumed to differ depending on the type of tenure. The principle can be described as follows:

Carbon reduction =
Transactions (t) x Compliance (c) x Adoption of measures (a) x Measures (m)

where: *Transactions (t)* is the number of property transactions in the UK per year (t_1 = owner-occupied sector, t_2 = social rented sector, t_3 = private rented sector).
Compliance (c) is the estimated number of transactions actually labelled in the UK per year (c_1 = owner-occupied sector, c_2 = social rented sector, c_3 = private rented sector).
Adoption of measures (a) is the estimated number of labelled households acting on the recommendations of the energy certificate (a_1 = owner-occupied sector, a_2 = social rented sector, a_3 = private rented sector).
Measures (m) is the average saving in space heating demand (in kWh) resulting from the energy efficiency measures adopted.

This gives us the following equation:

$$\text{Carbon reduction} = [(t_1 \times c_1 \times a_1) + (t_2 \times c_2 \times a_2) + (t_3 \times c_3 \times a_3)] \times m$$

Transactions (t)
Since an energy certificate has to be issued when a dwelling is built, sold or

Table 6.1 Annual property transactions in the UK by type of tenure in 2001/2002

Tenure	Annual transactions (UK)	% of all transactions	% of housing stock
Owner-occupied	1,215,550	47.3	6.75
Social rented	447,350	17.4	2.49
Private rented	906,200	35.3	5.03
Total	2,569,100	100	14.27

Source: National Centre for Social Research, 2003

Table 6.2 Estimate of labelled buildings and households taking action in the UK

Scenario	Tenure	Compliance (% of annual transactions in the UK)	Adoption of recommendations made in the certificate (% of compliance)
Scenario 1	Owner-occupied	50.0	5.0
	Social rented	60.0	5.0
	Private rented	30.0	2.0
Scenario 2	Owner-occupied	50.0	30.0
	Social rented	60.0	30.0
	Private rented	30.0	5.0
Scenario 3	Owner-occupied	80.0	60.0
	Social rented	90.0	70.0
	Private rented	70.0	20.0

Source: author

let, the annual number of energy certificates depends on annual property *transactions (t)*. Fig. 6.2 shows the annual rates of new construction, refurbishment and property transactions in the UK in 2001/2. In view of Article 6 of the Directive the renovation rates for thresholds of 200 m^2 and 1,000 m^2 were also examined. Table 6.1 gives an estimate of annual property transactions in the UK in relation to type of tenure and total housing stock.

The figures show that transactions in the UK can cover about 14% of the housing stock per year, although this proportion is not directly representative of annually labelled dwellings, as an energy certificate is valid for 10 years and the average renovation interval for a building is at least 25-30 years, so a household is not going to act each time an energy certificate is obtained. Some properties may also not change hands for a long time.

Compliance (c) and adoption of measures (a)

There is no consensus on what number is appropriate for *compliance (c)* and *adoption (a)* in the analysis of the UK situation, but Table 6.2 gives an esti-

Table 6.3 Comprehensiveness of energy efficiency measures adopted from energy certificates per average dwelling in the stock model (kWh/year)

Measure adopted from recommendations in energy certificate	Saving per average dwelling (kWh/yr)	Measures adopted from recommendations in energy certificate	Saving per average dwelling (kWh/yr)
Double glazing	2,049	Double glazing + cavity wall insulation	7,705
Loft insulation	7,853	Double glazing + loft insulation	9,902
Cavity wall insulation	5,655	Cavity wall insulation + loft insulation	13,508
Non-cavity wall insulation	9,693	Non-cavity wall insulation + loft insulation	17,546
		High performance windows + cavity wall insulation	6,033

Source: Anderson et al., 2002 (weighted averages calculated by author)

mate of the compliance and adoption rates as percentages of annual property transactions. For the purpose of the sensitivity analysis two parameter changes in compliance and three parameter changes in adoption, by type of tenure, were selected. The data was derived from the qualitative analysis (section 3), interviews with officials of the ministries and discussions in the research team of the 40% House project (discussed in section 5). It should be noted that these rates apply to the UK and reflect occupants and owners who are motivated to take action in response to an energy certificate that they would have not taken otherwise. Compliance is likely to be better in countries such as Germany or Finland, where public awareness of energy efficiency is higher than in the UK and there are fewer problems with compliance with building regulations.

Measures (m)
Table 6.3 shows what energy efficiency measures are assumed to be adopted as a result of recommendations in energy certificates. The energy savings resulting from each measure have been calculated per average dwelling, based on the UK stock model (in kWh/year) (Anderson et al., 2002). The saving per measure is a weighted average, taking account of the number of different dwelling types in the stock, using the data from the English Housing Condition Survey. It is assumed that half of the owners or occupants who take action in response to energy certificates will adopt one energy efficiency measure (left column) and half of them will adopt two measures (right column).

In this study the measures focused on building physics, as improving the thermal envelope of the building can increase comfort and it is the necessary first step towards using more sustainable energy sources such as heat pumps. It does not assume building services that complement insulation measures, as, for example, energy-efficient boilers do not pay back in a reasonable time with the resulting reduction in energy costs; their life cycles differ from those of building physics measures; estimates of energy savings from replacing old boilers vary greatly in existing housing, being smaller in a better insulated home than a poorly insulated one; and boilers and air-conditioning systems are dealt with in Articles 8 and 9 of the EPBD. Domestic hot water, electrici-

Table 6.4 Estimate of energy efficiency measures that owners and households are assumed to adopt when renovating in response to energy certificates in the UK in 2006-16 and 2017-50 (%)

Measure adopted from recommendations in energy certificate	In % of renovations 2006-16	2017-50	Measures adopted from the energy certificate	In % of renovations 2006-16	2017-50
Double glazing	40.0	–	Double glazing + cavity wall insulation	30.0	–
Loft insulation	40.0	40.0	Double glazing + loft insulation	40.0	–
Cavity wall insulation	20.0	20.0	Cavity wall insulation + loft insulation	30.0	40.0
Non-cavity wall insulation	–	40.0	Non-cavity wall insulation + loft insulation	–	20.0
			High performance windows + cavity wall insulation	–	40.0

Source: author

ty demand for household appliances and lighting and the use of low and zero carbon technologies for energy supply are beyond the scope of this analysis. Draught proofing was not taken into consideration, as the take-up of double glazing should ensure partial draught proofing and sealing the envelope in other ways is technically complicated and unaffordable. The number of floor insulation measures was assumed to be very small, owing to the complexity and cost of the work. New innovations will probably come onto the market, but owing to their high cost they are not expected to be adopted on a large scale in existing housing in the UK, at least for the time being. If energy prices and willingness-to-pay increase faster than expected, a more optimistic scenario would be valid.

In addition to the renovation work resulting from the recommendations in energy certificates, installation of insulation and double glazing is assumed to continue at the current rate. In 2001 93% of houses in the UK (excluding Northern Ireland) had some kind of loft insulation (but only 56% of them had more than 100 cm of insulation), 32% had cavity wall insulation and 75% had double glazing (52.1% of these dwellings had at least 60% of rooms double-glazed) (Shorrock and Utley, 2003). Business-as-usual installing cavity wall insulation (280,000 installations per year), full double glazing (1,200,000 installations per year) and loft insulation (110,000 installations per year) is estimated to result in a 3.3 Mt annual reduction in carbon emissions from the total housing stock in the UK (DEFRA, 2004). As annual property transactions account for around 10% of the total housing stock in the UK, it is assumed that in the business-as-usual scenario these homes should contribute a 0.33 Mt annual reduction in carbon emissions; this needs to be distinguished from the carbon saving resulting from energy certificates in each scenario.

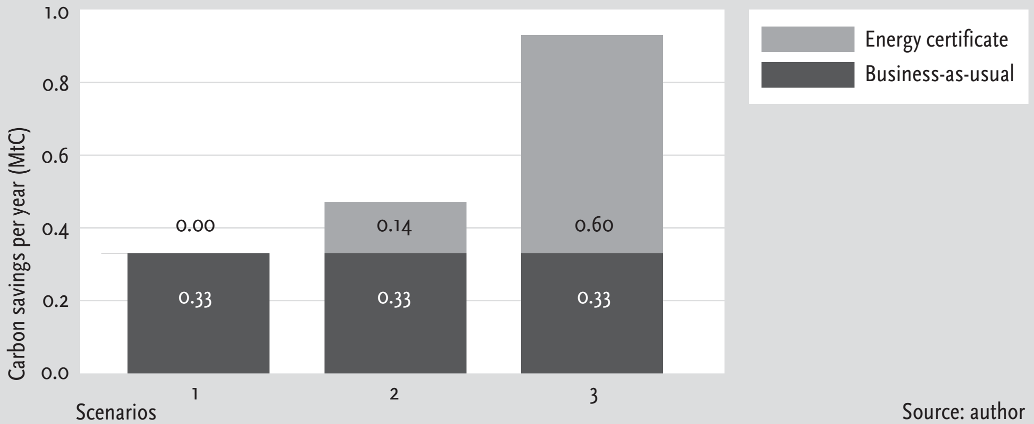
It is assumed that by 2016 most houses will have full double glazing and some level of loft insulation (after which the focus will be on improvements to existing loft insulation), and the amount of solid wall insulation is expected to increase slowly. Most UK dwellings are expected to have cavity wall insulation around 2050 – even sooner if annual take-up increases. Based on these uptakes, Table 6.4 gives an estimate of what insulation measures most households or owners are likely to choose when renovating in response to energy

Table 6.5 Transition from energy (kWh) to carbon savings (kg) by fuel type in the UK

Fuel type	Mix delivered to housing stock (%)	kWh=CO_2 kg	kWh=carbon kg
Gas	69	0.19	0.052
Electricity	20	0.44	0.120
Oil	6	0.26	0.071
Solid fuel	4	0.30	0.082

Source: Shorrock and Utley, 2003; author

Figure 6.3 Sensitivity analysis: annual reductions in carbon emissions (MtC) resulting from energy certificates in existing housing in addition to business-as-usual (0.33 MtC) in the UK



Source: author

certificates in 2006-16 and 2017-50.

Table 6.5 shows the transition from energy savings (in kWh) to carbon dioxide emissions (in kg) and carbon emissions (in kg) given the current mix of fuels delivered to housing stock in the UK.

6.4.2 Analysis

Fig. 6.3 gives estimates of the annual reductions in carbon emissions resulting from adopting energy efficiency measures recommended in energy certificates in three compliance scenarios. The carbon savings resulting from energy certificates are added to the reductions resulting from business-as-usual (0.33 MtC).

The energy demand of UK households is responsible for 41.4 Mt of carbon per year, of which space heating-related demand accounts for 25.6 MtC per year (Shorrock and Utley, 2003). Demand for energy services such as comfort and home entertainment has increased by over 2% a year in the UK in recent years, more than offsetting energy efficiency improvements, so ener-

Table 6.6 Annual reductions in carbon emissions (MtC) in three compliance scenarios in the UK in 2016-26 in relation to annual carbon emissions from total residential energy demand (41.4 MtC) and space heating-related demand (25.6 MtC) in 2003 (in %)

Energy certificate compliance scenarios	Annual reduction in carbon emissions (MtC) in various scenarios in the UK in 2016-26			Reduction in various compliance scenarios in relation to residential carbon emissions per year in the UK in 2003 (%)	
	Reduction in business-as-usual	Reduction due to energy certificates	Total reduction	Reduction in space heating-related emissions (25.6 MtC) (%)	Reduction in total residential energy demand (41.4 MtC) (%)
Scenario 1	0.33	0	0.33	1.29	0.8
Scenario 2	0.33	0.14	0.47	1.85	1.14
Scenario 3	0.33	0.60	0.93	3.63	2.25

Source: Shorrock and Utley, 2003; author

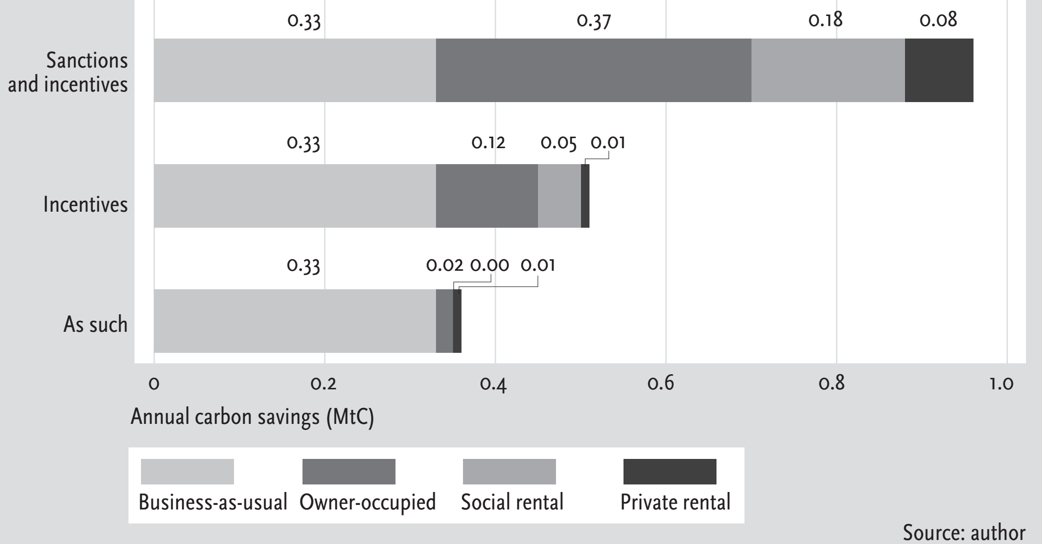
gy consumption has kept on rising, and there is no indication that the service demand trend will fall much below the current rate of around 2% per year. Whether energy consumption rises or falls over the next 20 years will depend on the energy efficiency rate (around 1.5% per year in 2000), and whether it can stay above the service demand trend (DEFRA, 2004). Table 6.6 shows the annual carbon savings resulting from three compliance scenarios in relation to household carbon emissions in the UK.

In scenario 1 the implementation of the energy certificate in the UK supports the current policy but is not adequate to obtain additional carbon reductions on top of business-as-usual. In this scenario energy certificates are issued for 50% of owner-occupied, 60% of social rented and 30% of private rented dwellings when they are sold or let. 5% of owner-occupied and social rented dwellings and 2% of private rented dwellings adopt one or two of the building physics measures recommended in the energy certificate which they would have not taken otherwise.

In scenario 2 energy certificates motivate a 0.14 Mt annual carbon reduction in the UK. This requires energy certificates to be issued when 50% of owner-occupied, 60% of social rented and 30% of private rented dwellings are sold or let. One or two of the energy efficiency measures that would not have been taken otherwise are adopted from the recommendations in energy certificates in 30% of owner-occupied and social rented dwellings and in 5% of private rented dwellings. Combined with business-as-usual this would ensure a 0.47 Mt total carbon reduction per year in carbon emissions from existing housing in the UK. This would account for a 1% reduction in households' annual carbon emissions in the UK, and around a 2% reduction in space heating-related emissions (DEFRA, 2004).

In scenario 3 a 0.60 Mt annual carbon saving in the UK housing stock is achieved as a result of implementing the energy certificate. This requires energy certificates to be issued for 80% of owner-occupied, 90% of social rented and 70% of private rented dwellings when sold or let. 60% of owner-occupied, 70% of social rented and 20% of private rented dwellings adopt one or two of the measures recommended in the energy certificate. Combined with

Figure 6.4 Annual reductions in carbon emissions (in MtC) resulting from energy certificates in the UK housing stock in 2016-26 by type of tenure in three compliance scenarios



Source: author

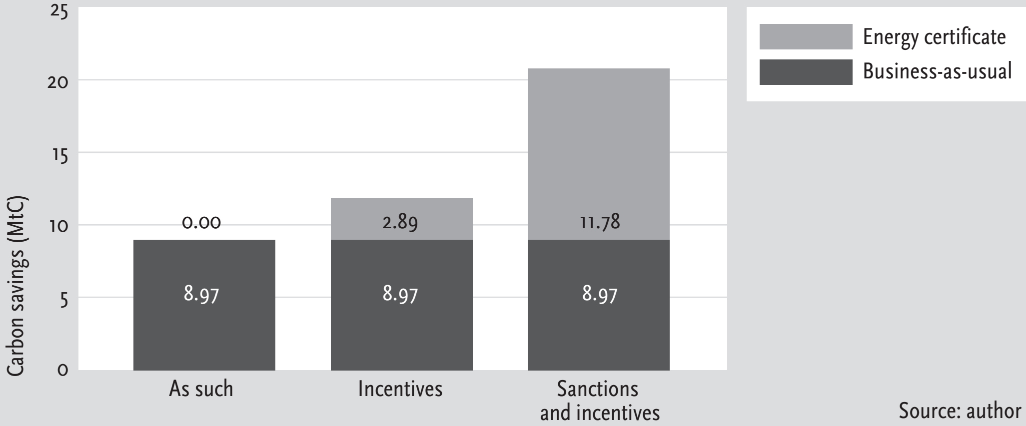
business-as-usual this would ensure a 0.93 Mt total annual carbon reduction in the UK: this represents a 3.6% reduction in carbon emissions related to UK households' space heating demand and a 2% reduction in their carbon emissions. Scenario 3 would therefore be sufficient to stabilise the annual 2% increase in households' energy consumption in the UK (DEFRA, 2004).

Fig. 6.4 shows annual reductions in carbon emissions by type of tenure, indicating that the rented sector has a large capacity for contributing to carbon reductions if compliance is ensured and the adoption of measures made attractive.

If turnover of buildings is slow, achieving the savings will take time once the policy is implemented. Adoption of the energy certificate is assumed to follow an S-curve, increasing gradually from 50% to 100% during the first ten years of implementation (2006-16), as there will be a delay in some households and owners responding to the recommendations in the energy certificates. The impact of the Directive is assumed to peak in 2017-26, and the examination of annual reductions accordingly focuses on this period. On the basis of other European Directives and trends in similar energy audit programmes, it is realistic to presume that the EPBD will be tightened up at some future date. This is provided for in Article 11, which lays down that the Commission shall evaluate this Directive in the light of experience gained during its application and, if necessary, make proposals with respect to complementary measures referring to the renovation in buildings with a total useful area less than 1,000 m^2 and general incentives for further energy efficiency measures in buildings. If it is not revised, adoption of the energy certificate is assumed to decrease gradually from 90% to 10% in 2027-50, as a lot of energy efficiency improvements will already have been carried out in existing housing.

Projecting the implementation of the energy certificate until 2050 entails

Figure 6.5 Cumulative reductions in carbon emissions (in MtC) in the UK housing stock resulting from energy certificates in 2006-50 in three compliance scenarios, in addition to cumulative business-as-usual (8.97 MtC)



Source: author

obvious risks and uncertainties. Fig. 6.5 gives an estimate of the cumulative reductions in carbon emissions resulting from energy certificates by 2050 in three compliance scenarios, in addition to the cumulative business-as-usual scenario (8.97 MtC).

6.5 Maximising the impact of the energy certificate

The problem with implementing the Energy Performance of Buildings Directive (EPBD) is that the savings it could deliver are feared to result in high administrative costs due to the new administrative structures and numbers of qualified inspectors required. In Finland, for example, the total cost of implementing energy certificates is estimated at €240-360 million (around 75% of this for residential buildings), with 400-500 experts to be employed annually. The cost-effectiveness of the energy certificate in terms of CO_2 reduction is estimated to be €120-250/t CO_2 depending on the type of dwelling (YM, 2005). Furthermore, regulation calls for new administrative structures that are often not considered cost-effective by governments, which in most EU countries are drifting towards deregulation: this was the official reason behind the Dutch Ministry of Housing, Spatial Planning and the Environment's decision in August 2005 to delay implementing the EPBD owing to the high administrative cost (MVROM, 2005). Postponing implementation indefinitely does not give a good signal to the market and indicates a certain reluctance to implement the Directive at all.

We argue, however, that despite our caution about the energy certificate as a policy instrument to radically affect energy saving in the residential sector, it needs to be implemented because it is the first step towards influencing consumer preferences, so as to extend energy conservation policy from supply to demand side management, and the first step in the strategy to transform the market in the European Union. It can make energy investments visible when selling or letting homes and help owners and landlords to distinguish between the properties on the market.

If the market worked perfectly, the monetary value of energy efficiency measures would be reflected completely in the resale value of homes (Clinch and Healy, 1999). In the UK, however, there seems to be a structural market failure in supply and demand (demand for housing has exceeded supply for a long time now in most EU countries), and lack of information is only one of a number of market failures. Consumers are probably interested in information on energy consumption, but they are not likely to be able to use it in their purchase decision-making, as they do not have much choice of housing available to them. In Denmark buyers should receive information on the energy condition of the dwelling before purchase, but competition between potential buyers makes this difficult in practice (section 6.3). The Danish experience also indicates that not all buildings are labelled even if the energy certificate is mandatory. The EU-funded research project on Energy Labelling of Existing Buildings (BELAS) concluded on the basis of existing energy labelling systems that purely market-based, non-mandatory systems are little used by individual home-owners, and a successful labelling system for existing buildings needs to be backed up by regulatory measures (BELAS, 2004). This concern was also recognised in the discussions in the research team and interviews with officials of the ministries in the Netherlands and Finland (Sunikka, 2005). In the UK the Home Information Pack (HIP) is the mechanism by which the energy certificate will be implemented in the owner-occupied sector. It requires full information to be provided when the property is first put on the market (ODPM, 2004a). The Pack includes a Home Condition Report (HCR) and Energy Report, providing information on the energy efficiency of the property and making recommendations for improving it which should be compatible with the energy certificate (ODPM, 2004b). The Energy Report will include an energy efficiency rating for the property, entitled Section H: Energy performance certificate. In rental properties, only an Energy Report and not the full HCR will be required. Ensuring compliance with energy certificates is very important because, as the sensitivity analysis shows, the effect soon wears off when not all buildings are labelled. Sale or letting should not be permitted without an energy certificate: in the owner-occupied sector, for example, a sale should not be registered without one. The problem is also that currently local authorities do not have either the staff or the equipment to police building regulations. The Building Research Establishment has shown that 60% of new homes do not conform to existing building regulations in the UK (Brown, 2005).

The energy certificate includes energy recommendations. This assumes that providing information on energy-saving measures will encourage buyers to actually carry out such measures. It is not clear, however, whether information alone will be enough to encourage people to carry out work that they would not have done otherwise. The Energy Saving Trust has tested draft designs of the Energy Report in the Home Information Package (HIP), based on the A-G ratings used in the EU Energy Label for household appliances such as refrigerators. Preliminary research shows that approximately a quarter of householders who were given a Home Energy Report had acted on one or more recommendations for improving the energy efficiency of their new home within 18 months of moving in (Parnell et al., 2002; Darby and Pugh, 2005). This comes close to scenario 2 in the quantitative analysis. A more ambitious scenario is not probable as a result of the fact that, although public awareness is increasing, willingness-to-pay (WTP) for energy efficiency measures is still low in the UK. According to the 1999/2000 English Housing Survey, 51% of households were prepared to pay up to £50 for energy efficiency improvements, 26% between £50-200 and 23% over £200, if an annual saving of £50 in energy costs was to be expected (Bates et al., 2001). These are very low figures. The money a household needs to spend on learning about and administering the renovation options and organising someone to do the work increases the cost and decreases the cost-benefit ratio. In the UK the cost of preparing a Home Condition Report for a typical 1930s semi-detached house in a provincial town is estimated to be around £280 (ODPM, 2004b). If a household decides to renovate, it is more attractive to invest in work that brings immediate pleasure, such as a new kitchen or bathroom (Jensen, 2005), than in technical improvements, which are often invisible once they have been made.

In the rented sector, the owner who should make the investment does not benefit from it in the operating phase. Landlords may feel that the benefits of investing in energy efficiency may not be recouped if they are unable to raise rents. On the other hand, tenants may feel that they are not responsible for undertaking investments in energy efficiency, and it does not make financial sense for tenants to invest if they expect to move out in the short or medium term (Clinch and Healy, 1999). The capture of benefits is emphasised by the fact that some of the least energy-efficient housing in the UK is tenant-occupied (Boardman, 1991), and in the private rental sector managed estates are too small in number to diversify the financial risks resulting from renovation: landlords who had fewer than five lettings in their portfolio owned 43% of the private rented sector in the UK, the median being only seven lettings (Crook, 1998).

The Directive proposes making energy certificates for buildings mandatory when they are sold but does not impose energy standards. The energy certificate will therefore be mainly a communication instrument, since the idea is to try to persuade people to adopt environmentally benign behaviour voluntarily. Communication instruments can be useful when it comes to addressing information problems, but they are generally considered to be supplementary policy instruments, not substitutes for economic or regulatory instruments (Kemp, 2000; Ekelenkamp et al., 2000).

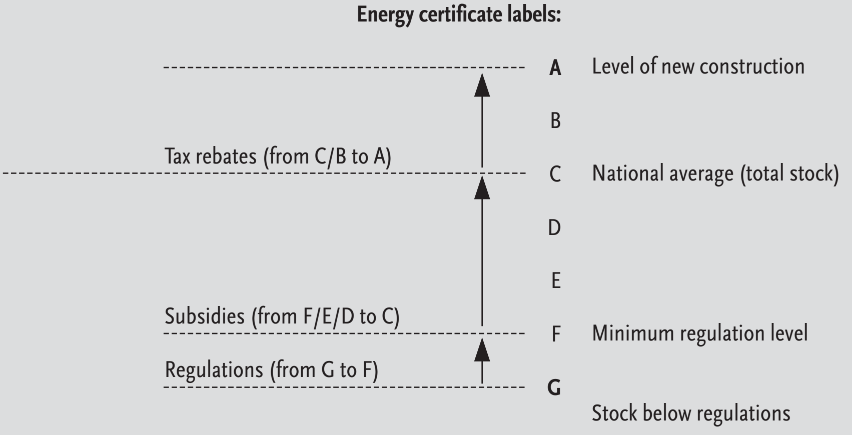
No examples are known of countries with energy certificates for existing buildings that are used as part of direct regulation in order to impose standards (Beerepoot, 2002). In order to reach scenario 3 in the quantitative analysis and to maximise the impact of the energy certificate, effective results can probably be expected from introducing regulations combined with energy certificate standards, e.g. by making level 'B' mandatory in an energy label. If this approach was adopted, a dwelling could not be sold unless its thermal performance was upgraded to an acceptable minimum level or the median energy certificate level set by the government for each type of building and tenure. In the rental sector, landlords could be required to provide minimum energy performance standards. We do not think it is possible at this stage, however, to impose renovations on a large scale, given considerations of cost, inspection and labour intensity and the fact that the occupants of the most energy-inefficient housing are disproportionately low-income households (Clinch and Healy, 1999; Whyley and Callender, 1997). Low-income households are more likely to live in energy-inefficient housing and thus suffer more from taxes, without having the resources or access to low-interest loans to invest in energy efficiency. In Finland the cost of renovating to improve energy efficiency is estimated to be 10-100 times higher than the reduction in running costs that could be achieved from a two-label improvement in the energy certificate (YM, 2005). Positive economic incentives therefore need to be linked to the recommendations in the energy certificate. As a prerequisite for the incentives, given energy certificate levels A/B/C/D/E/F (as in the energy labelling of household appliances), the improvements should raise the dwelling by one level, e.g. from C to D.

Some economic incentives that could be combined with the energy certificate already exist in the UK, e.g. the Landlord's Energy Saving Allowance in the private rented sector, which permits a deduction for income tax purposes of up to a maximum of £1,500 for expenditure on loft, solid-wall or cavity-wall insulation in the property; lower VAT on some energy-saving measures such as heat pumps; and a Green Landlord Scheme that would offer incentives to landlords who invest in energy efficiency measures. Fiscal incentives that could be introduced to support upgrading of energy certificates include:

- Direct subsidies, as in the Dutch EPA (section 6.3).
- Council tax and stamp duty rebates for good energy performance verified by an energy certificate and reduced Value Added Tax (VAT) on renovation materials.
- Earmarked preferential loans and mortgages for the improvements recommended in the energy certificate, so that energy cost savings can be used to repay the loan.

Fig. 6.6 illustrates how each policy instrument supporting the energy certificate should have a different role, depending on the energy performance of

Figure 6.6 Policy instruments to support energy certificates



Source: author

the dwelling and how it relates to the national average, based on the energy performance of all the evaluated dwellings and updated annually. Building regulations are used to deal with the poorest-quality housing stock. Subsidies should only be targeted at low-income households to bring their dwellings up to average level, as they are less interested in energy saving and therefore less active in gathering information on it, and they also make less use of the facilities than the high-income group (Bruel and Hoekstra, 2005). Subsidies are recommended only as a temporary measure, as they do not make projects cost-effective, and evidence from the Netherlands shows there is a risk of a free-rider effect when subsidising home insulation (Beumer et al., 1993; Kemp, 1995). For dwellings that exceed the national average, tax rebates are offered for ongoing improvements. Penalising tax measures need to be devised and applied carefully, since the fuel source has already been taxed once and energy-inefficient households already pay more for their energy. Energy prices would have to at least double before they would be effective in shortening payback times (Boon and Sunikka, 2004), but this would place an unbearable burden on some households, resulting in increased fuel poverty, in conflict with UK government policy that focuses on ensuring reliable energy supplies and low energy prices. To make the financial pressure more equal for those on low incomes, the energy tax should be based on the value of the dwelling or income of the household, i.e. it should be progressive.

If a mandatory approach was adopted and energy saving in the existing housing legalised, then national governments should introduce regulations and combine them with energy certificate standards. In this case, the dilemma of sanctions needs to be addressed. In most Member States home-owners do not have to deal with building regulations and inspections when selling their homes, so it might make more sense to use the notarial transactions involved when selling a house as the legal basis. Requiring a notary to approve an energy certificate as part of the documents necessary for selling a house seems only a small step away from requiring him to check that the energy certificate shows a certain energy standard. Once housing has been made more energy-efficient, energy prices in the European Union can be increased sufficiently and negative economic incentives imposed on households to influence energy consumption behaviour.

6.6 Conclusions

The research summarised in this paper discussed the anticipated application of the energy certificate under Article 7 of the Energy Performance of Buildings Directive (EPBD) to existing housing in the UK. The UK may be assumed to be the country to which the resulting recommendations will be applied first and foremost, but the main conclusions and recommendations can be carefully considered in other EU countries.

The most optimistic application scenario 3 is assumed to produce a 3% annual reduction in total space heating demand (25.6 MtC) from the existing housing stock in the UK and a 2% reduction in households' total energy demand (41.4 MtC). The annual reduction in carbon emissions would be in excess of 0.60 Mt, 0.93 Mt including business-as-usual. The sensitivity of the results to different compliance rates does not alter the finding that, at best, a successful energy certificate scheme could only produce a decrease of a few percent in the total energy demand from households in the UK and stabilise the increase in that demand. This would be a valuable contribution, but given the UK government target of a 60% carbon reduction by 2050 it clearly demonstrates that current European Union policies will make for at best incremental improvements in current practice, not a radical change. Furthermore, on the basis of the following points identified in the qualitative analysis, a scenario somewhere between 1 and 2 would seem to be more probable in the UK, depending on the supporting policy measures. In this case the energy certificate of the Energy Performance of Buildings (EPBD) is used a communication instrument and its carbon saving impact could not be distinguished from business-as-usual.

The policy literature indicates that communication instruments can be useful when it comes to addressing information problems, but they are generally considered to be supplementary, not substitutes for economic or regulatory instruments (Kemp, 2000; Ekelenkamp et al., 2000). On the basis of these considerations we argue that it would be worthwhile to explore ways of combining energy certificates for buildings with regulations or economic incentives. When housing demand exceeds supply it is very difficult to introduce new criteria on the consumer side without government support. In the future, an energy certificate could be set as a prerequisite for positive economic incentives or energy certificates could be combined with minimum energy standards. The question of building control is a very important issue here, since house owners do not currently have to ask permission to carry out work of this kind. The analysis of the UK situation shows that recommendations in energy certificates should carefully consider the ownership of certain energy conservation measures and business-as-usual in order to keep the savings constant. There is an assumption behind most energy labelling schemes that consumers base their decisions on the results of cost-benefit analysis, but their decisions on energy use are often designed less to minimise cost than to improve comfort and convenience (Wilhite et al., 2000). If energy conservation measures would serve two purposes, in most cases a reasonable payback period combined with aesthetic benefits, they could have a better chance of being carried out (Jensen, 2005): solar energy, for example, has a high demonstration value, showing off the residents' energy concerns and the investments they have made.

The question is also to what extent the EU should interfere in Member States' legislation on housing and energy, which have hitherto been purely national policy areas. The European Union has much greater power than a typical international organisation and can force states to accept common policies. EU Directives would seem to be an effective catalyst for national action on building regulation (Sunikka, 2001), but while it may produce administrative action as an output, legislation based on Directives will not necessarily be effective regarding the outcome: in reducing environmental load. The energy performance of the current housing stock, climate and economic conditions vary per country and the Member States are at very different stages as regards the energy performance of their housing stocks (Sunikka, 2001). Setting minimum thermal requirements for new construction will be an improvement in the new Member States, but it will have a very limited impact on countries such as Germany and the Netherlands, which require much more stringent measures. Uniform requirements for the EU building stock cannot really target all the potential that is technically and economically feasible, so implementation at the level of national governments and policy measures to back them up, such as the incentives proposed in this study, are required.

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7 Conclusions

7.1 Introduction

This research focuses on the improvement of government policies rather than on the specific issue of energy efficiency. It proceeds from the assumption that the market's ability to solve environmental problems is limited and that government intervention is needed (Chapter 1). Despite the carbon-saving potential that has been identified in the existing housing stock (Ashford, 1999; Hekkanen et al., 1999; Van der Waals, 2001; Klunder, 2005; Boardman et al., 2005), the environment continues to play a small part in urban renewal, where energy efficiency measures are still not being applied on a large scale (Bus, 2001; Priemus, 2002). This study addresses current policies for sustainable building in the EU Member States, inertia in the realisation of energy-saving potential in the existing housing stock and policy measures that national governments could use to circumnavigate barriers in order to improve their policies for increasing carbon reductions in the existing housing stock. Given that policies that conform to accepted practices and rules are most likely to be adopted (Jordan et al., 2003), the research focuses on incremental improvements of current policies and energy efficiency measures that can be adopted by a majority of stakeholders, instead of new technologies.

The study is based on an institutional understanding of the concept of sustainable development: sustainability is considered essentially a problem of governance in the broadest sense (Perman et al., 2003). As the research focuses on energy efficiency, the concept of sustainable building is related to the energy conservation impact. Most studies determine energy saving potential in existing buildings between 30-40% (ECN/RIVM, 1998; EC, 1999; Van der Waals, 2001). This improvement of energy efficiency is taken as a basis for a comparison at a building level. A distinction is made between energy conservation, which was seen to result from behavioural changes and energy efficiency, which requires improvement in the thermal performance of a product (in this research, a building). Assessing the impact of policies, the reference level is adopted from the anticipated stabilisation of energy consumption. In the UK, for example, demand for energy services such as comfort and home entertainment has increased by over 2% a year in recent years, more than offsetting energy efficiency improvements, so energy consumption has kept on rising, and there is no indication that the service demand trend will fall much below the current rate of around 2% per year. Whether energy consumption rises or falls over the next 20 years will depend on the energy efficiency rate (around 1.5% per year in 2000), and whether it can stay above the service demand trend (DEFRA, 2004).

The problem is formulated as follows:

What is the current policy approach that is being used in the EU Member States for reducing CO_2 *emissions from energy use in the housing sector, and how has this approach been implemented in national building regulations and economic instruments? What actions have been taken in response to government policy in the social housing sector in the Netherlands, and what are the main factors that have contributed to inertia in the effort to realise improvements in energy efficiency? To what extent is stronger government intervention possible and necessary for circumnavigating the barriers? What policy approach could be an effective, cost-efficient and legitimate response strategy for improving energy efficiency in the existing housing stock without causing negative side-effects, and what role could the EC Energy Performance of Buildings Directive (EPBD) play in such a strategy? What would provide a good indicator of response in the context of reducing global greenhouse gas emissions in the housing sector in the Pressure-State-Response model (OECD, 1993)?*

The problem was broken down into three primary questions and eleven subsidiary questions, which were addressed in Chapters 2 through 7:

1. What is the current policy in EU Member States for reducing CO_2 emissions from energy use in the housing sector as a societal response to global warming and the depletion of natural resources, and how do these policies relate to the existing housing?
   - 1.1. What are the possibilities for energy-efficient upgrading in housing renovation (Chapter 2)?
   - 1.2. What approach has been adopted in the national sustainable building strategies of the Netherlands, Germany, France, Finland and the UK in terms of policy, implementation and response (Chapter 2)?
   - 1.3 What sustainable building requirements are specified in the building regulations in the Netherlands, Germany, France, Finland and the UK (Chapter 2)?
   - 1.4 How are negative and positive fiscal incentives applied in sustainable housing policies within the enlarged European Union (Chapter 3)?
2. What actions are being taken in response to government policies on sustainable housing, and what are the main obstacles to achieving carbon savings in the existing housing stock, using the Netherlands and the UK as examples?
   - 2.1 What environmental efforts have been made with regard to sustainable management in the Dutch social-housing sector in response to the Sustainable Building Agreement in 1998 and government policy (Chapter 4)?
   - 2.2 What factors (technical, economic and with regard to implementation)

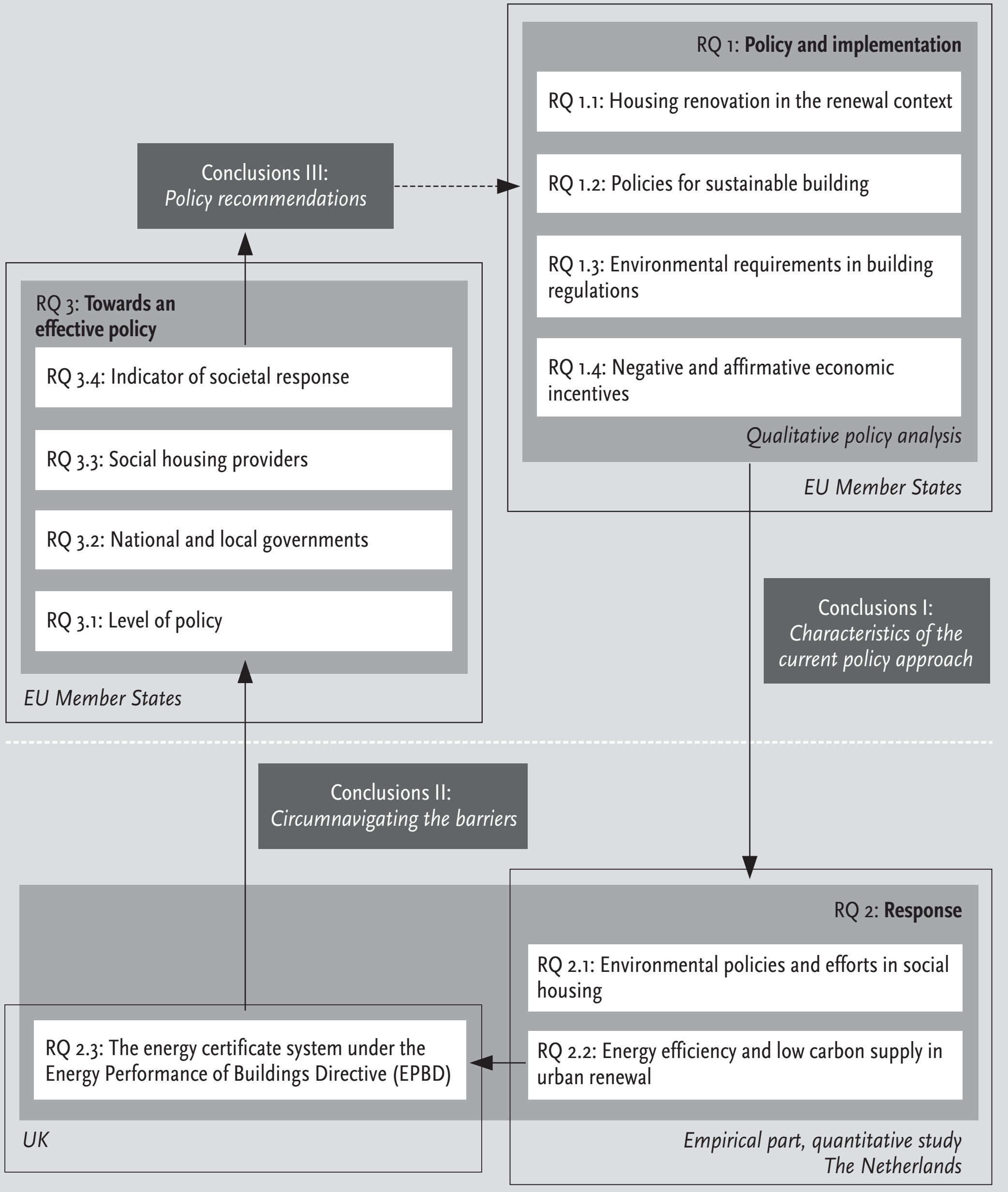
lie behind the inertia regarding energy efficiency and low carbon supply in urban renewal in the Netherlands (Chapter 5)?

   2.3 What is the anticipated impact of energy certificates under the Energy Performance of Buildings Directive (EPBD) on the existing housing stock in the UK, and how can the impact be maximised (Chapter 6)?

3. Is stronger government intervention possible and necessary for improving energy efficiency in the existing housing stock in the EU, and what policy approach would be likely to produce and effective, cost-efficient and legitimate response strategy for reducing global greenhouse gas emissions in the housing sector?
   3.1 How can the European Union contribute to the improvement of energy efficiency in the housing sector, beyond the efforts that are being made by the Member States (Chapter 7)?
   3.2 How should the national and local governments in the EU use legislation, fiscal instruments and information in their policies for reducing carbon emissions in the existing housing stock, and what role could the EC Energy Performance of Buildings Directive (EPBD) play in it (Chapter 7)?
   3.3 How can social housing providers in the EU improve their energy-efficiency policies to reduce global greenhouse emissions in the existing housing stock (Chapter 7)?
   3.4 What would be a good indicator of a societal response to reducing carbon emissions in the housing sector (Chapter 7)?

To answer the first question (policy and implementation), current sustainable housing policies, regulations and fiscal instruments in the European Union countries were identified and analysed in an ‘as is’ policy analysis (Chapters 2-3). The second research question (response) was addressed in the empirical part of the thesis, which was broken down into three modules: a survey of sustainable housing management in the Dutch social housing sector (Chapter 4), case studies on energy efficiency and low carbon supply in urban renewal in the Netherlands (Chapter 5) and an analysis of the anticipated carbon-saving impact of energy certificates of the EC Energy Performance of Buildings Directive (EPBD) in the existing housing stock in the UK (Chapter 6). According to the research path (Fig. 7.1), policy recommendations (response strategies) focus on the implications for national and local governments and social housing providers in the European Union (Chapter 7).

Figure 7.1 Outline of the thesis in relation to the research questions



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7.2 Policies and implementation

Question 1: *What is the current policy in EU Member States for reducing CO_2 emissions from energy use in the housing sector as a societal response to global warming and the depletion of natural resources, and how do these policies relate to the existing housing?*

7.2.1 Housing renovation in the renewal context

Question 1.1: *What are the possibilities for energy-efficient upgrading in housing renovation (Chapter 2)?*

Policies for sustainable building (Chapters 2-3) tend to ignore the fact that housing management is a question of financial choices. In situations in which there is no evidence that energy efficiency has yet become a market factor, comfort, environmental benefits and other co-benefits may still play a small role in the actual decision-making process (Chapters 4-5). To decrease costs, energy-efficient improvements should be integrated into the maintenance cycle. During its economic service life, a building should create a positive cash flow such that the gross annual rent exceeds the costs of running and operating the building (Chapter 2). As discussed in Chapter 5, the actual service life may be shortened if the price that the owner of the building would obtain for selling or using the site for redevelopment comes to exceed the value of the existing building in current use. Policies should consider the fact that realising of energy-saving gains requires time, due to slow turnover in buildings. The feasibility of policy targets is important, as the political cycle requires governments to present positive results at the end of the election cycle. On the other hand, the long life cycle of buildings is an advantage: once energy-saving measures have been implemented, they continue to deliver for a long time.

The market structure of the construction sector is fragmented. Compared to new construction, renovation is often carried out by non-professionals, particularly in the owner-occupied and private rental sectors. They tend to rely on their own informal repair diagnoses or those made by relatives or friends, who are not necessarily aware of energy matters and who are not involved in transactions or renovation decisions often enough to learn from them. Policies should therefore target not only the construction industry as the main stakeholder (Chapter 2), but also the Do-It-Yourself (DIY) market. In addition to policies, practical assistance and information about loans may be necessary. Without this information, the active group may be smaller than those that the policies aim to address. The capital costs of improving energy performance in housing renovation are high in comparison to those of similar improvements in appliances. In addition to purchasing the actual energy efficiency measures, high transaction costs occur before households can actually react to policies. These costs are related to acquiring technical information, preparing and negotiating contracts and arranging for financing.

One obstacle to the choice of renovation over maintenance is that low-income households are disproportionately represented among the occupants of the most energy-inefficient housing in the European Union (Whyley and Callender, 1997; Clinch and Healy, 1999). One of the effects of this distribution is that special taxes (Chapter 3) are difficult to impose fairly on the housing sector. The energy supply is already taxed, and the imposition of further taxes would punish the least affluent households, for whom energy is already expensive. Low-income households are also less likely to have funds available for investing in energy efficiency, and they are more likely to suffer from higher interest rates because of their financial instability.

Although estimates of the energy/saving potential of buildings in Europe vary, energy-efficiency improvements of between 30% and 40% are typically projected (MVROM, 1996; ECN/RIVM, 1998; Slot et al., 1998; Boardman et al., 2005). Many studies on the energy-saving potential of buildings are imprecise and uncertain, however, due to the diversity of buildings. The future development of the EU building stock is surrounded by fundamental uncertainties, including the number of buildings that will be demolished or renovated, demographic developments (e.g., household size), innovation in construction products and technology diffusion, learning curves, developments in the price of energy and housing markets, which have a major impact on energy demand in the residential sector. Housing surveys have traditionally been used for these purposes; in contrast to the prediction of demand in new construction, however, few reliable data are available concerning renovation and demolition rates (Kohler and Hassler, 2002). In addition to recognising qualitative differences between new construction and renovation, quantitative data concerning the building stock are important for developing and evaluating anticipatory policy.

7.2.2 Policies on sustainable building

Question 1.2: *What approach has been adopted in the national sustainable building strategies of the Netherlands, Germany, France, Finland and the UK in terms of policy, implementation and response (Chapter 2)?*

In the Netherlands, Finland and the UK governments have laid down environmental objectives for the construction sector in sustainable building programmes (MVROM, 1997, 1999; DETR, 2000; YM, 1998), which were discussed in Chapter 2. In recent years, policies on sustainable building have become more fragmented in all five countries studied: the construction sector is included in national climate strategies and addressed in various policy documents (Chapter 2). The study defines sustainable building as aiming to reduce harmful environmental impacts caused by construction, buildings and the built environment (MVROM, 1990); government policies emphasise the importance of energy conservation and energy efficiency, reducing CO_2 emissions, waste prevention and reuse, life cycle analyses (LCA), a healthy indoor environment and efficient land use. The construction industry is considered as the main stakeholder. The German government has not set out a separate action plan for the construction sector but it has integrated environmental targets into an extensive system of building regulations, standards and fiscal incentives. Notwithstanding other initiatives, in particular the High Environmental Quality (HQE) scheme (Association HQE, 2000), France has not produced an action plan for sustainable building. Governments have begun to recognise the importance of the existing housing stock, although they have not addressed the differences between renovation and new construction, or the ethical aspects relating to low-income households (7.2.1), and they have not linked sustainable housing policies to urban renewal (Chapter 2).

The strongest driving forces to make vague sustainable building aims more specific have been the Kyoto Protocol, which legally binds the Annex 1 countries that have signed the Protocol to cutting their greenhouse gas emissions (FCCC, 1997), and the European Union Directives, which place pressure on governments to achieve measurable energy savings and reductions in waste in the EU (Chapter 2). These provide a reference to which environmental targets in national energy policies and the tightening-up of building regulations identified in Chapter 2 can refer to, thus increasing the legitimacy of national policies. The UK government has set the target of reducing carbon emissions by 60% by 2050 (DTI, 2003), and the other countries have similar targets (MVROM, 1999; BMU, 2000). Fifty years is too far off to motivate changes in current behaviour now however, and there seldom are thematic strategies for meeting the targets in a particular sector, or sanctions for not meeting them.

The five countries' policies on sustainable building in Chapter 2 seem optimistic, confident and naïve, considering that most EU Member States have not succeeded in reducing the dangers of climate change (EC, 1999; 2005; EEA, 2005). Current policies in the EU seem to assume a business-as-usual scenario that does not recognise the energy crisis or the implications of climate change so far (King, 2004). On the other hand, those same policies are conservative and pessimistic in their expectations of technologies and markets for sustainable energy sources that are not yet mature. It would seem that the governments of the five countries studied tend to trivialise the scale of the environmental problems and do not respond to threats not regarded as imminent, reinforcing the presumption that until natural disasters resulting from environmental instability take place, environmental objectives on the EU countries' political agendas will continue to be compromised by economic, social and military priorities. The current policy approach in the Netherlands, Germany, France, Finland and the UK (Chapters 2-3) is based on input-driven legitimacy, the arguments being supplied by those who are required to comply with the rules. Unlike Germany, which adopts a more stringent policy, the Netherlands, France, the UK and Finland have adopted a voluntary approach to sustainable building, relying heavily on the environmental conscience of private operators, with the result that communication tools and voluntary long-term agreements (LTAs) have played an important role in the implementation of policy in those countries (Chapter 2). Legitimacy and effectiveness of a policy instrument depends on the national building culture: in Finland, LTAs have been relatively effective as a policy instrument (Heikkilä et al., 2005), whereas in the Netherlands, they have not resulted in higher priority being given to investing in energy saving in the sectors involved, and they are less effective and efficient than the government anticipated (Harmelink et al., 2005). The voluntary approach is in tune with the most EU governments' penchant for deregulation, regarding the free market as a tool to steer environmental improvements. More regulation could require new administrative structures that the government does not consider to be cost-effective: high administrative cost was the reason behind the Dutch Ministry for Housing, Spatial Planning and the Environment's decision in August 2005 to delay the implementation of the EPBD, indicating a reluctance to implement the Directive at all (Chapter 6). A market-led policy and input-driven legitimacy (Chapters 2-3) are risky, however, in that most private operators will focus exclusively on what they stand to gain.

7.2.3 Environmental requirements in building regulations

Question 1.3: *What sustainable building requirements are specified in the building regulations in the Netherlands, Germany, France, Finland and the UK (Chapter 2)?*

Based on the national policies on sustainable building, environmental legislation related to the building industry in the Netherlands, Germany, France, the UK and Finland focuses on energy, indoor air quality, waste management and emissions of hazardous substances. In all five countries the thermal legislation has been recently tightened up to support national climate strategies (Chapter 2) and the implementation of the Energy Performance of Buildings Directive (EPBD) in 2006 (EC, 2003) (Chapter 6). The 2004 version of the Finnish building regulations stepped up the thermal requirements by 30% and made heat recovery from exhaust air compulsory. If the governmental change in the end of 2005 will not change the German policies in this respect, with the 2002 thermal regulations also setting requirements for existing buildings, Germany will come up to and even surpass the Scandinavian standards. In France new regulations should bring up to a 60% saving in energy consumption from new housing, compared to the majority of dwellings built before 1975, when the first thermal requirements came into force. None of the EU countries lays down any requirements for the use of renewable energy sources in existing housing; Article 5 of the EPBD deals with the use of renewable energy sources, but the requirement only applies to buildings exceeding 1,000 m^2.

Current building regulations deal mainly with new construction (Chapter 2). The Energy Performance of Buildings Directive (EPBD) addresses requirements for major renovations (Article 6), but the threshold of 1,000 m^2 excludes most of the housing stock, and implementation of the recommendations in the energy certificate (Article 7) is voluntary. Lately England and Germany have imposed minimum insulation requirements for replacement building components in existing housing and efficiency requirements for replacement boilers. In Germany, when more than 20% of the area of a component has to be changed, it has to be replaced in line with the requirements for new construction. Based on installations, annual window renovation rates are estimated to range from 1.8% in Germany to 2.9% in the UK (ENPER-TEBUC, 2004).

People are more likely to act under constraint (Chapters 5-6), and legislation can provide a strong signal from the government that action is needed, especially given that housing is usually not a commodity that can be moved to another country in order to avoid the new legislation. As the new construction rate is half or a third of the renovation rate in the five countries, if regulations similar to those for new construction were to be applied even just to window renovations, this could have a significant impact on the energy efficiency of the existing housing stock. Legislation, however, does not encourage projects that exceed the -often conservative- regulation level, hence the minimum easily becomes the maximum (Chapter 4) and the entire economic and technical potential is not addressed.

7.2.4 The use of negative and positive economic incentives

Question 1.4: *How are negative and positive fiscal incentives applied in sustainable housing policies within the enlarged European Union (Chapter 3)?*

The discussion of fiscal incentives used in sustainable housing policies in the EU in Chapter 3 shows that most EU countries have taken the first step towards Environmental Tax Reform, which aims to shift taxes from labour onto the environment, Germany being the most advanced. In the Netherlands the landfill tax reduced the amount of waste going into landfill from 49.7% in 1985 to 4.6% in 2000 and increased recycling from 49.5% in 1985 to 94.3% in 2000 (Hasegawa, 2002). Energy taxes are unpopular with the electorate in general and industry in particular, so whether they can be set at an adequate level depends very much on the political context. In practice, the impact of environmental taxes in the EU is still slight (EEA, 2002), and few of them apply to the housing sector. The case studies illustrate the relatively small impact of energy prices on shortening payback time, e.g. from 14 to 10 years, and the capture of benefits: energy taxes do not necessarily provide an incentive to invest in energy efficiency in the rental sector, as it is the tenant who pays the energy bill (Chapter 5). Regulatory Energy Tax (REB), imposed on Dutch households in 2001, increased energy bills by a third, but only half the population are aware of it and only 2% take it into account in their use of electricity (Van der Waals, 2001).

Most of the 25 EU countries have introduced subsidies for sustainable housing in some form, focusing on measures to improve energy efficiency. There is evidence of the risk of a free-rider effect from subsidising home insulation in the Netherlands (Beumer et al., 1993; Kemp, 1995), especially if the measures supported are normal building practice. Only a few countries have subsidies that cover the wider aspects of sustainable housing, such as the Green Investment scheme in the Netherlands (Chapter 3).

Chapter 3 found that, compared to punitive tax measures, sustainable housing policies make less use of tax rebates to support energy efficiency on general taxes such as property tax or stamp duty, or specific taxes such as council tax in the UK. Green electricity is tax-exempt in the Netherlands, making it more competitive, and as a result 13% of Dutch households bought green electricity in 2001 (Chapter 3). Some EU countries such as France and the UK apply a reduced VAT rate to renovations so as to encourage maintenance of the existing stock, especially in the social housing sector. Encouragement is also provided by the availability of preferential loans earmarked for energy improvements, possibly linked directly to a mortgage, so that the savings in energy costs can be used to repay the loan. Under the climate protection programme for existing buildings the Federal Investment Bank (KfW) in Germany has offered loans at 3% below market interest rates for measures to reduce emissions with a minimum CO_2 reduction of 40 kg per m^2 per year. An allocation of around 3.2 billion has thus enabled 166,600 dwellings to be renovated (BMVBW, 2004).

In practice, policy instruments are often combined: the money collected from Regulatory Energy Tax (REB) in the Netherlands was redistributed to consumers through grants, the Energy Premium Scheme (EPR) and tax reductions for producers of renewable energy sources. The Energy Premium Scheme also promoted Energy Performance Advice (EPAs) (Chapter 6). Grants were awarded under the Scheme for specified measures (the energy companies handled applications and distribution), but these were halted for the most part in 2003 because of problems of verifiability and cutbacks in government spending. The work entailed in administering positive economic incentives can result in relatively small gains for high administrative costs: the average cost to the government of the Energy Premium Scheme (EPR) in the Netherlands worked out at 300 per tonne of CO_2 reduction. The administrative cost of handling the applications was high, with each application leading to a relatively small energy saving (Harmelink et al., 2005). Stopping the subsidy can have a negative impact: after EPR subsidies were cut in the Netherlands, the number of EPA evaluations dried up, for one thing because the results of EPA energy assessments varied depending on the consultant (Chapter 3).

Energy price increases and negative economic incentives are needed to persuade occupants to adopt less polluting patterns of behaviour, given that enormous differences have been noted in the energy consumption of identical houses (Haas et al., 1998). Taxation enables the external costs of environmental damage to be internalised, thus implementing the polluter-pays principle adopted by the EU (Chapter 3). However, taxes can seem complicated to households, the main stakeholders in policy on the EU's existing housing stock (subsection 7.2.1), and price signals have not notably affected car use, for example (Uusitalo and Djerf, 1983). Unlike building regulations, taxation does not define exact emission levels: the aggregate amount of pollution cannot be predicted, as it depends on the forces of supply and demand. Carbon tax may have to be progressive otherwise it punishes low-income households in most energy inefficient housing.

Since some environmental technologies are still undeveloped, subsidies could increase the market share of energy improvements in the EU and address the problem of present-day bias, whereby future utility is valued less than current utility (Brocas et al., 2004): consumers prefer to invest in a new kitchen now instead of insulation that will bring benefits later. On their own, however, subsidies do not make a project cost-efficient, as they do not implement the polluter-pays principle and they constitute a barrier to competition, in conflict with EU principles (Chapter 3). Clear lines need to be laid down on what to expect from future policy, as some investors might wait for grants to go up.

7.2.5 Characteristics of the current policy approach

If preventative policy measures are intended to prevent new construction from deteriorating, and curative measures tend to focus on providing a few subsidies for updating the existing stock in order to improve energy efficiency then current policy measures observed in Chapters 2-3 can be characterised as preventive, not curative. Qualitative analysis implies that the current policy approach in the EU Member States is characterised by a market-led approach, which presumes that energy-efficient improvements will increase the property values. Energy prices and indirect regulation, supplemented by voluntary agreements and information dissemination, play an important role in the implementation of the policy. This process is attuned to the free market, as it requires no direct government intervention into individual decision-making on projects. Voluntary, market-led policies for sustainable building, however, involve the risk that only those who are most motivated will act.

7.3 Response

Question 2: *What actions are being taken in response to government policies on sustainable housing, and what are the main obstacles to achieving carbon savings in the existing housing stock, using the Netherlands and the UK as examples?*

7.3.1 Sustainable management in the Dutch social housing sector

Question 2.1: *What environmental efforts have been made with regard to sustainable management in the Dutch social-housing sector in response to the Sustainable Building Agreement in 1998 and government policy (Chapter 4)?*

The survey of the Sustainable Building Agreement, drawn up between the Dutch social housing sector, the Dutch government and a number of third parties in 1998, indicates that one-third of the Dutch social housing associations had formulated an environmental policy in 2000 (Chapter 4). This suggests that attitudes towards sustainable management are positive in the Dutch social housing sector, there is an intention to act sustainably. Other positive developments are the use of environmental impact assessment tools, in particular the Energy Performance Report (EPA) (Chapter 6), and the practice of drawing up environmental agreements with third parties: over 50% of the housing associations say they have entered into sustainable building agreements with municipalities, and 40% with energy companies.

In the comparison of the qualitative and quantitative survey results in Chapter 4, however, it emerges that the 'energy measures' are based more on building regulations than initiatives to invest in experimental measures. Energy Performance Coefficients (EPCs) below the current building regulation level (Chapter 2) are uncommon in new dwellings, even though the housing associations like to cite energy saving as a priority in their environmental policies. Solar panels are still rare, and solar boilers were installed in 8% of new dwellings in the Dutch social housing sector in 2000.

Comparison of the 2000 survey and the 1998 survey and the results of research into sustainable housing management in 1993 (Quist and Van den Broeke, 1994) show that, notwithstanding the national policy initiatives on sustainable building like the Regulatory Energy Tax (REB) or the subsidised Energy Performance Advice (EPA) (Chapters 2-3), there has been little growth in sustainable management in Dutch housing associations since 1993, and none at all since 1998. In 2000 the Dutch housing associations spent an average of 2,964 per dwelling on sustainable building measures in new build, and 71 per dwelling in the existing stock. Compared to 1998, the investment decreased by 25% in 2000, not taking inflation into account (Chapter 4).

Chapter 4 indicates that, notwithstanding the housing associations' environmental policies and the use of tools like the National Package for Sustainable Management or the Energy Performance Advice, in practice the building regulation level is not often exceeded in the social housing sector in the Netherlands. Firstly, this supports the findings of other research, that the voluntary agreements have not resulted in higher priority being given to investing in energy saving in the sectors involved, and they are less effective and efficient than the government anticipated (Harmelink et al., 2005). This indicates the ineffectiveness of the Dutch government's voluntary approach to sustainable building (Chapter 2). Secondly, the cross-analyses show that housing associations that have an environmental policy are not necessarily more active in implementing measures than those that do not (Chapter 4). This raises the question: what is the point of an environmental policy if it does not include an implementation strategy? Thirdly, as regards the Pressure-State-Response model used in the research (Chapter 1), the discrepancy observed between the qualitative and quantitative data from the survey suggests we need to measure progress towards sustainable building in the EU by quantitative rather than qualitative data: as a policy measure, the Sustainable Building Agreement in the Dutch social housing sector would seem to be a positive response to the state of the environment, but the resulting actions have not been so substantial (see subsection 7.5.2). Chapter 4 thus illustrates the discrepancy between government policy and stakeholders' environmental policies and the effectivity of measures actually taken in practice.

7.3.2 Obstacles to energy efficiency in urban renewal in the Netherlands

Question 2.2: *What obstacles (technical, economic and with regard to implementation) lie behind the inertia regarding energy efficiency and low carbon supply in urban renewal in the Netherlands (Chapter 5)?*

The discrepancy between the absence of action and the impression given by the Dutch housing associations that they are aware of energy efficiency and sustainable management (Chapter 4) was attributed to technical (A), economic (B) and implementation (C) obstacles identified in two case studies in Chapter 5. The case studies, undertaken in the context of a consortium research programme in the Netherlands, reviewed the state of Dutch urban renewal from an environmental point of view and examined obstacles to the implementation of energy efficiency improvements in existing housing and the use of more sustainable energy sources in urban renewal.

A. Technical obstacles
The technical condition of housing is a precondition for improvements in energy efficiency. One technical obstacle could be unwillingness to use more unconventional technologies because of the anticipated risk of technical failure or discomfort. The study regarded technical obstacles as barriers to achieving the CO_2 reduction anticipated in policy targets (Chapter 2) within a certain time frame. The second case study in Chapter 5 looked at the Western Garden Cities in Amsterdam, where switching 25,000 dwellings from gas to district heating provided by industrial waste heat from the AEC (Afval Energie

Centrale, formerly AVI-West) in the Western Docks area could contribute an annual CO_2 reduction of 34 million kilos a year to the city of Amsterdam. The carbon savings achieved by replacing gas with district heating as part of the renewal process are not immediate, however, because the distribution network takes time to be built. Clusters of housing will need temporary boilers, which also increase the implementation cost; the long implementation period increases the risks while the final infrastructure is being built; and connecting all the homes to the grid sooner is ruled out by cost considerations. There will therefore be an initial delay in the carbon reduction. These long response times, resulting from the nature of renovation in the housing sector (7.2.1), are often ignored when setting CO_2 reduction targets for the construction sector (Chapter 2).

B. Economic obstacles

As the profitability of energy investment in buildings in the EU is still low, measures that are technically feasible may not be economically attractive. One of the aims of the first case study in Chapter 5 (Hoogvliet in Rotterdam) was to reject renovation options that were not viable, hence renovation solutions were compared in terms of net discount present value and cumulative Net Present Value (NPV). A general rule is that only investments with a positive NPV should be made. Solutions 1 (insulation) and 2 (insulation and double glazing) will have positive NPV after around 20 years from the investment but the NPVs of solutions 3 (a high-efficiency boiler in addition to solution 2) and 4 (a solar boiler in addition to solution 2) will remain negative after 25 years, at the time of the next intervention. If energy prices increased 60% by 2012, as anticipated in the Kyoto Protocol (Jansen et al., 2003), the NPV will be positive around 13 and 14 years but the NPV for solutions 3 and 4 will still remain negative after 25 years. Furthermore, housing associations feel that there are no benefits from making investments in energy efficiency if they are unable to raise rents. Tenants may feel that they are not responsible for undertaking investments in energy efficiency, especially if they expect to move out in the short or medium term, as may be the case in the rented sector. This illustrates the capture of benefits that is needed if energy efficiency is to be implemented in the rented sector in the EU.

The second case study (the implementation of district heating as part of the renewal process in the Western Garden Cities in Amsterdam), identified a number of financial risks (Chapter 5). Some of them are related to costs: future energy prices, the use of more sustainable energy sources in urban renewal, and general factors such as the energy market and inflation. Other risks are related to the implementation of a district heating network in particular: the final cost of the new energy infrastructure and systems, the rearrangement of streets and open spaces required, the construction rate and estimating the right number of dwellings to be connected to the new grid.

Current policies in the Netherlands (Chapters 2-3) would seem to be inadequate to provide long-term security in relation to these risks. In the current situation it costs more to save energy than to use it (Boardman, 2004).

C. Obstacles to implementation

The second case study in Chapter 5 (implementing district heating in the Western Garden Cities in Amsterdam) found that two main risks remained after the risk analysis: the risk that the rate of construction and installation (connections to the new energy infrastructure) would be lower, or fewer dwellings would be connected, than envisaged, and the risk that the price index of heat tariffs would cease to be linked to the price index of inflation. The energy provider and the energy supplier, who bear the financial risk, have no control over the building process. The case study also found that the separation between heat supply and heat distribution was a risk factor, and the network needs to be 'future-proof' in case the plant closes down, so that the grid can be switched to a new low carbon fuel. The case studies in Chapter 5, being current renewal projects in the Netherlands, involve a policy network consisting of housing associations, developers and a municipality who all share the responsibility, rather than one party taking the lead. Policy analysts see the growth of policy networks as further complicating accountability, which can disappear in a web of institutions consisting of authorities, private-sector providers and voluntary organisations, where defining who did what is no longer straightforward (Rhodes, 2000). On the positive side it has produced more flexibility, but in practice no priority is given to environmental considerations. Responsibilities are divided up among a large number of actors in the Western Garden Cities: the energy supplier (the power plant), the energy distributor, several departments of the municipal authority, the housing associations and the occupants, each with their own interests and economic benefits, even their own concepts of sustainability. The Municipality of Amsterdam's Environment Department is not particularly interested in the cost to, or impact on, occupants. The liberalisation of the energy market in the EU seems to have produced commercial energy companies that are more interested in market gains and less in the environment. As a result there was no body with prime responsibility and a comprehensive energy vision that took a lead in implementation in the case studies. These divided responsibilities illustrate the problems due to the fragmentation of stakeholders in policy on the existing housing stock in the EU.

When the implementation of the district heating system was really opened up to public debate it engendered resistance from the occupants – the major stakeholders and the people who would ultimately pay for the renewal process – who fear higher energy bills and increased rents, disliked switching from gas to electricity for cooking, and assume that implementing the new energy infrastructure would be used as an argument for demolishing even more homes, demolition being one of the main renewal strategies in the Western Garden Cities in Amsterdam (Chapter 5). The occupants were regarded as being 'not interested in energy efficiency' at the beginning of the renewal process, but if they have no information on energy-efficient systems they cannot be expected to demand them or judge the various options imposed on them.

Urban regeneration is high on the Dutch political agenda and has resulted in several investment programmes (MVROM, 1997; 1999) although no official policy has been defined for sustainable urban renewal. In the first case study, the urban renewal policy of the Province of Zuid-Holland does not mention environmental objectives (Provincie Zuid-Holland, 2001). The Energy and Climate Policy Paper for 2000-2010 (Provincie Zuid-Holland, 2000) includes general energy-saving measures for the residential sector but there are no sanctions for non-compliance. The adopted urban renewal approach is a radical restructuring of the housing stock, adding more expensive dwellings for higher-income households, which entails demolishing, or in some cases renovating or selling, inexpensive, mostly rented, dwellings (Van Kempen and Priemus, 2002), also in the case studies. The case studies indicate that although there may be a more sophisticated understanding of different social, environmental and economic factors in urban renewal in the Netherlands, it does not mean the objectives of urban renewal would have been changed, making it far too early to speak about environmentally sustainable urban renewal. Owing to costs, risks and lack of leadership, it seems in order for the policy to be effective, energy efficiency in the existing housing needs to be made more mandatory in urban renewal in the Netherlands.

7.3.3 EPBD energy certificates in the UK

Question 2.3: *What is the anticipated impact of energy certificates under the Energy Performance of Buildings Directive (EPBD) on the existing housing stock in the UK, and how can the impact be maximised (Chapter 6)?*

In 2003 the European Commission recognised the importance of energy saving in the housing stock by introducing the Energy Performance of Buildings Directive (EPBD). One of the key elements in the Directive is the introduction of energy certificates in property transactions. Chapter 6 discussed the anticipated efficiency and effectiveness of the energy certificate scheme as it will affect existing housing in the UK. The discussion indicates that property transactions would seem to provide an effective intervention point in the existing housing stock: in the UK, for example, annual property transactions can cover around 14% of the total housing stock. Energy certificates are not self-policing, however; without sanctions not all transactions are likely to include an energy certificate -a concern recognised in Chapter 6, based on the qualitative analysis of similar energy certification systems in the Netherlands and Denmark. In the UK the Home Information Pack (HIP) is the mechanism by which the energy certificate will be implemented in the owner-occupied sector. The Pack includes a Home Condition Report (HCR) and Energy Report, providing information on the energy efficiency of the property and making recommendations for improving it which should be compatible with the energy certificate (ODPM, 2004b). In rental properties, only an Energy Report and not the full HCR will be required. It should be noted that energy certificates as such have no impact on energy efficiency in the EU's existing housing stock, only the actions that result from them. This is complicated by the fact that the urban housing market in the EU is not in equilibrium: in countries such as the UK and the Netherlands demand far exceeds supply, at least at present, so there is a lack of free choice and affordability (Chapter 6). This makes it difficult to introduce new purchasing criteria such as energy performance on the consumer side without government support. Willingness to pay (WTP) for energy efficiency measures remains low, e.g. in the UK (Bates et al., 2001). As it is not possible to foresee actual compliance with the energy certificate in the UK, a sensitivity analysis of three compliance scenarios was carried out, based on the qualitative analysis, discussions in the research team, the English Housing Condition Survey (EHCS, National Centre for Social Research, 2003) and the UK Domestic Carbon Model in the 40% House project (Boardman et al., 2005). Four core elements were identified in the UK, which are assumed to differ depending on the type of tenure:

Carbon reduction =
Transactions (t) x Compliance (c) x Adoption of measures (a) x Measures (m)

In the most optimistic scenario 3, energy certificates are issued for 80% of owner-occupied, 90% of social rented and 70% of private rented dwellings when they are sold or let; 60% of owner-occupied, 70% of social rented and 20% of private rented dwellings adopt one or two of the measures recommended in the energy certificate. This could make an annual contribution of 3% to reducing the space heating demand of 25.6 MtC in the UK and a 2% reduction in households' total energy demand of 41.4 MtC, assuming business-as-usual (Chapter 6). This would be a valuable contribution, but given the UK government target of a 60% carbon reduction by 2050 it clearly demonstrates that current European Union policies will make for at best incremental improvements in current practice, not a radical change. The analysis in Chapter 6 shows that, although energy certificates for household appliances have proved relatively successful, they will not be so effective in the EU housing sector because of the different nature of the sector (Chapter 2) and the obstacles to energy efficient renovation identified (Chapters 4-6). Furthermore, on the basis of the following points identified in the qualitative analysis, a scenario somewhere between 1 and 2 would seem to be more probable in the UK, depending on the supporting policy measures. In this case energy certificates are used a communication instrument and its carbon saving impact could not be distinguished from business-as-usual. Chapter 6 recommends that the energy certificate scheme be implemented, however, as good energy performance, as attested by the certificate, can make energy investments visible when selling or renting a house, thus singling out the property in the market.

When housing demand exceeds supply it is very difficult to introduce new criteria on the consumer side without government support. The policy literature indicates that communication instruments can be useful when it comes to addressing information problems, but they are generally considered to be supplementary, not substitutes for economic or regulatory instruments (Kemp, 2000; Ekelenkamp et al., 2000). Therefore, Chapter 6 argues that it would be worthwhile to explore ways of combining energy certificates for buildings with regulations or economic incentives. In the future, an energy certificate could be set as a prerequisite for positive economic incentives or energy certificates could be combined with minimum energy standards (subsection 7.4.2).

7.3.4 Circumnavigating the barriers

The empirical part of the study suggests that, despite environmental policies and the positive attitudes of housing associations, the current policy approach, which is based on voluntary pull measures and energy prices (Chapters 2-3), has had only limited success in encouraging sustainable housing management in the Dutch social housing sector (Chapters 4-5). Most of the energy-efficiency measures in existing housing are not yet cost-effective (Chapter 5). In fact, most of the reasons why people did not save energy in buildings in the Netherlands in the 1980s are apparently still valid: society in general tends to waste energy, feedback on energy consumption is delayed and general; in addition, some houses waste energy and cannot be managed in an energy-conscious way (Van Raaij and Verhallen, 1983). A newly introduced policy instrument, the energy certificates of the EC Energy Performance of Buildings Directive (EPBD), does not indicate the carbon-saving impact of the new policy relative to the current situation (Chapter 6). Considering the obstacles, a policy approach that involves a combination of hierarchy (power based on administrative orders) and network (power based on co-operation) is likely to be more effective than a market approach (power based on resources) would be for addressing the current inertia with regard to energy efficiency in existing housing.

7.4 Response strategies

Question 3: *Is stronger government intervention possible and necessary for improving energy efficiency in the existing housing stock in the EU, and what policy approach would be likely to produce and effective, cost-efficient and legitimate response strategy for reducing global greenhouse gas emissions in the housing sector?*

7.4.1 Level of policy

Question 3.1: *How can the European Union contribute to the improvement of energy efficiency in the housing sector, beyond the efforts that are being made by the Member States (Chapter 7)?*

The capacity of the European Union to solve environmental problems should be considered in the light of the fact that the EU is primarily a trading union whose aim is growth (sustainable, if possible). The objectives of economic growth and trade liberalisation that drive EU integration are actually quite unsustainable and can conflict with environmental policy (Chapter 3). The idea of removing the link between economic growth and environmental load is appealing. In reality, however, it is not easy to resolve conflicts between national economic interests and the state of the environment. For example, the EU energy policy aims to ensure secure supplies of energy at reasonable prices; this is likely to act as a disincentive for Member States to save energy.

First, there are limits to what the European Commission can do. In the EU, fiscal matters are subject to unanimity rule, and the diversity of energy taxes and subsidies among the Member States impedes the adoption of a fixed tax. In 1994, the Council determined that no carbon energy tax would be set at the European level; the Member States were encouraged to develop their own carbon energy taxes (Haigh, 1996). The EU's mandatory policy is presented in the form of Directives. These Directives are binding with regard to the results that must be achieved. They require national legislation in order to become effective, however, and Member States retain the choice of how to implement them. In practice, therefore, adherence to the Directives varies, as does the time that is taken to fulfil them.

Second, the bureaucratic elements of EU policies can render the processes of setting, implementing and monitoring the policy both time-consuming and costly, particularly when implementation and coordination must be repeated in the national institutions. Directives seem to be an effective catalyst for national action on building regulation (Chapter 2). Although administrative action may be one output of this type of instrument, however, legislation that is based on Directives is not necessarily effective with regard to the desired outcome of reducing the environmental load (Chapter 6).

Third, wide national variation among the Member States complicates the implementation of a uniform policy for energy efficiency in the existing housing stock (Chapter 2). Large-scale renovation in Europe often takes place within the context of urban renewal. Renewal policies vary widely between countries, as urban problems occur within specific geographical, economic and political contexts, while policies are linked to current policy administration, general housing policy and characteristics of the housing market (Skifter Andersen and Leather, 1999). The energy performance of the current housing stock also varies by country. Uniform requirements for the EU building stock can hardly address the entire technically and economically feasible potential of existing housing, particularly considering the variation in demands for the thermal performance of dwellings due to climatic differences (e.g., between the Mediterranean and Scandinavian regions). While the introduction of new policies that are directed toward energy efficiency can have an impact in the new Member States, the policies are likely to have less influence in countries like Germany and the Netherlands, which have already introduced stringent measures. Differences in economic wealth, especially since the enlargement of the EU, imply that it is not feasible to demand a uniform level of all countries and that the implications of these policies for low-income households must be examined at the national level. The national energy and housing policies of the Member States differ. For example, EU energy policy must address energy supply, which varies between the Member States. Some countries have their own energy sources, while others do not. Some countries (e.g., France) depend on nuclear power; some (e.g., Finland) are building more nuclear plants, while others (e.g., Germany and the Netherlands) are phasing out their nuclear power, despite the fact that they may import nuclear energy (Chapter 2).

Energy import is nonetheless a common concern in all Member States. The contribution that the EC can add to the efforts of the Member States to promote energy self-sufficiency and combat climate change can be oriented more toward strategy than it is toward implementation, with a focus on setting targets and monitoring the progress towards achieving them. The ‘monitoring mechanism’ is one important EU function that contributes to both the UN FCCC and the stabilisation targets of the EC (Haigh, 1996). This mechanism requires Member States to submit annual reports to the Commission concerning greenhouse gas emissions, in order to allow the evaluation of national programmes. Responsibility for devising national measures, however, is subsequently returned to the Member States.

The EU has considerable potential for transferring knowledge (e.g., with regard to European best practices), and it has used research and information dissemination as an important part of its policy for energy-efficient housing. Prominent examples include SAVE (for energy efficiency) and ALTENER (for renewable energy sources), as well as a range of research and development programmes focused on JOULE and THERMIE. The EU can also provide effective direction for European research and development activities by establishing criteria for research funding.

The EU integrated product policy can serve as a starting point for addressing unsustainable consumption patterns. The European Commission can set standards for trade, which could be applied for installations and appliances, in order to remove energy-consuming products from the market. One example of this approach is the Japanese Top Runner programme, which identifies the most energy-efficient appliance on the market and requires all manufacturers to make their products equally efficient within a few years, in an effort to create market competition for environmental solutions (Von Weizsäcker, 2005). Because of the diversity in the housing and systems of different countries, however, the feasibility of uniform criteria must be examined carefully, even with regard to products.

7.4.2 National governments

Question 3.2: *How should the national and local governments in the EU use legislation, fiscal instruments and information in their policies for reducing carbon emissions in the existing housing stock, and what role could the EC Energy Performance of Buildings Directive (EPBD) play in this process (Chapter 7)?*

During the study, two main approaches to promote energy efficiency were recognised: a mandatory policy based on direct regulation (government-led) and a voluntary (market-led) approach, which uses energy prices and the dissemination of information to direct investments. These two types of policy are not absolute, and approaches that lie between them are possible. The policy options were nonetheless divided into two main categories in order to structure the characteristics of each approach. The relative advantages and disadvantages of the two policy approaches with regard to building regulations, negative and positive economic incentives and communication tools were summarised in Table 5.5 (Chapter 5). The current policy approach for sustainable building in the EU Member States is voluntary and thus market-led (Chapters 2), with modest negative economic incentives constituting the main policy instrument for steering energy investments and behaviour (Chapter 3). For the construction industry, however, new construction is more profitable and less risky than renovation is; quite simply, many renovations are very small. The research shows that although efforts to promote sustainable building through market-led measures and price signals may affect energy-consuming behaviour, they seem inadequate to attract investments and improve the energy efficiency of the existing housing stock (Chapters 4-5).

With few exceptions (e.g., Germany), few countries have had much experience with the government-led approach, which implies mandatory requirements for existing housing (Chapter 2). According to the new German building regulations, when more than 20% of the area of a component has to be changed, it has to be replaced in line with the requirements for new construction. The legislation of energy-saving measures in the existing housing stock would shift the basis of the policy approach to sustainable building in the EU countries from input to output-driven legitimacy. Output-driven legitimacy is based on the effectiveness of rules in producing tangible results. Legislation could produce particular policy outcomes if compliance and legitimacy are ensured, if the behaviour of occupants does not create rebound effects and if the dilemma of low-income households is addressed. The combination of building-regulation standards with the energy-certificate levels of the EC Energy Performance of Buildings Directive (EPBD) (Chapter 6) is an interesting approach that merits further research. The adoption of this approach would imply that a dwelling could not be sold unless its thermal performance was upgraded to an acceptable minimum level (or to the median energy-certificate level set by the government) for each type of building and tenure. In the rental sector, property owners could be required to meet minimum energy-performance standards.

Compliance with building regulations remains a key issue in the European Union, where the energy performance of new buildings regularly fails to meet the standards that are specified in the regulations (Warren 2005; ENPERTEBEC, 2004), partly because authorities are reluctant to force them on private owners (Skifter Andersen and Leather, 1999). Compliance with the introduction of thermal regulations for the existing housing stock is especially problematic, as not all renovation work requires notifying the building authorities. Public information campaigns may increase compliance, as could efforts to keep the regulations and the number of exemptions as simple as possible. To ensure legitimacy and awareness of the new regulations, pressure groups and influential members of the target group should be involved in the implementation of the policy. Self-regulation could be used to assign partial responsibility for the success of the policy to the target group. Because fines, expropriation and restrictions on use are drastic measures to impose on households, the issue of sanctions for non-compliance calls for further research. Because homeowners in most Member States are not required to deal with building regulations and inspections when selling their homes, the notarial transactions that are involved in the sale of houses could form a more logical legal basis. A property transaction is one intervention point for mandatory regulations, as such transactions allow the opportunity to connect inspections to legal and administrative procedures (Chapter 6); the possibility that this could increase transaction costs, however, should also be considered.

Regulations cannot be imposed on the existing housing stock overnight, as most energy measures are not yet cost-efficient (Chapter 5) and not all households are in a position to comply with mandatory standards. Imposing thermal regulations on new buildings has been a lengthy process in the EU Member States. Because such regulations have existed for only a few decades in some countries (e.g., France), implementing them in the more complex existing dwellings will take time. Economic incentives are needed in order to ensure that mandatory policies do not cause problems for low-income households or create an ethical conflict with the right to housing. Furthermore, it should be considered that building regulations never address all the technical – or economic – potential so incentives to go beyond the (often conservative) standards need to be ensured. Some of the economic policy instruments that have been described in this research (e.g., preferential loans, tax rebates, mortgage arrangements or compensation for energy improvements in land prices; see Chapters 3 and 6) can already offer examples of how such issues can be addressed. It may be possible to combine these measures with the energy certificates, such that the certificate levels A/B/C/D/E/F/G (as in the energy labelling of household appliances) would be a prerequisite for the incentives, specifying that the improvements should raise the dwelling by one level (e.g., from C to D; see Chapter 6), or alternatively a concrete CO_2 reduction target per m^2 should be determined, as in the KfW program of the Federal Investment Bank in Germany which is offering loans at 3% points below market interest rates for four different combination packages with a minimum CO_2 reduction of 40 kg per m^2, instead of a list of specific products to be subsidised. Fiscal incentives should be targeted only to that portion of the costs that is not compensated by increased property value of the property (Chapter 3). Because of the path of dependency in urban renewal, in which decisions made at earlier stages influence further choices, incentives should be ensured at an early stage of the renewal process. Not doing so increases the risk that the measures will not be carried out (Chapter 5). Fiscal incentives should be selective in terms of the people that they support; although middle-income groups need technical advice and access to loans, they do not necessarily need direct subsidies. Costs as a barrier is often related to a lack of upfront money rather than actual cost of investment. Therefore, loan systems and financing arrangements (such as energy service contract where an outside party installs energy measures and charges for them over time out of the energy savings realised by the investments) can be more effective than subsidies especially in those countries with experience and awareness in energy efficiency. Reducing the VAT on renovation, as in France, or on energy-efficient products, as in the UK (Chapter 3), can be used as a supporting measure. In the rental sector, the benefit of an energy efficiency investment flows to the tenant (in the form of lower energy bills) instead of the landlord (who has to make the investment). In order to overcome this barrier programs like the UK Government's Green Landlord Scheme could be introduced to provide private landlords with upfront relief on capital expenditure for energy investments in residential property that they rent. Governments have to pay for positive economic incentives. Because households account for over half of the energy tax revenue (e.g., in Finland; see Awano, 2005), however, using environmental programmes that are targeted toward households to return these taxes (which are paid by households) to households would be one way of reducing the negative distributive impact.

Governments can also give non-financial benefits to building owners or developers who voluntarily comply with high energy performance level. One non-fiscal incentive that has been tried (e.g., in Germany, Switzerland), and one which can be very effective in certain locations, is to provide more construction right specifically for environmentally friendly buildings. Another potential benefit would be to give a beneficial treatment (e.g., priority processing) to building permit applications if the building would be meet a certain energy performance level. The technical condition of a building, including its thermal performance, could be used as a condition for insurance. In countries that have this system (e.g., the Netherlands), energy performance (using an energy certificate as a key quality indicator) could be linked to a maximum permitted rent or rent increase. Implementation barriers are neglected in policies and organisational support deserves more attention. Energy audits provide owners with a detailed overview of the realistic energy efficiency potential of their building and what needs to be done to achieve this. Programs such as the German Chance EnergiePass Partner public-private partnership, which consists of an Internet tool that can be used both by professional landlords and Do-It-Yourself -stores for advice to their customers on energy rating and advice for energy improvements, can facilitate the implementation of the energy efficiency potential identified in an energy audit and address the complexity of a renovation process. Information dissemination is needed as a supporting measure, as the connection between personal energy consumption and climate change is still not being made in practice (Darby, 2003) and consumers' willingness-to-pay (WTP) for environmental improvements in buildings remains low in the EU (SBR, 2001; Baumann et al., 2002).

The decreasing role of the government in urban renewal points responsibility for the supervision and monitoring of new legislation onto local authorities. These authorities have therefore become important actors in urban renewal and the implementation of the government policy; although they have greater freedom to decide which dwellings should be renewed, they must also pay a greater share of the costs (Skifter Andersen and Leather, 1999; Verhage, 2005). Local governmental coordination is also needed for renewal initiatives that are implemented within policy networks (Chapter 5); as all actors have an interest in promoting their own agendas, and environmental aspects therefore receive little if any priority. If responsibility is to be delegated to local governments, as is the trend in many countries, these governments must be guaranteed sufficient resources, funding and knowledge to realise the tasks that are entrusted to them, but they should also have incentives to save government money. To work effectively, public authorities should adopt a more multi-disciplinary policy approach to sustainable urban renewal, and one that can take the environmental, social and economic aspects of the process into consideration.

7.4.3 Social housing providers

Question 3.3: *How can social housing providers in the EU improve their energy-efficiency policies to reduce global greenhouse emissions in the existing housing stock (Chapter 7)?*

Chapter 2 shows that the umbrella organisations for the social housing providers in the five countries have defined environmental policies and tools have been developed to support sustainability in decision-making. However, it would be highly exaggerated to claim that sustainable housing management has taken root at housing association level (Chapter 4), while social housing providers face the ever-growing challenge of coping in a market where they are not allowed to operate at a loss. The recommendations for social housing providers to improve their policy for sustainable housing management and energy saving in the existing housing stock are discussed in relation to two themes: measures to internalise environmental knowledge in their own organisation and measures to influence occupant behaviour towards energy saving patterns.

According to Chapter 4, several housing associations were planning to adopt an environmental policy in the next few years. Successful examples of such policies can serve to aid these associations in achieving this objective. In larger housing associations, standardised environmental management systems, such as ISO 14001 or EMAS (Chapter 2), can ensure an effective policy. What is more, these systems have a marketing value. If internal evaluation for the EPBD energy certificate (Chapter 6) is made available to professional landlords, as discussed in the Netherlands, social housing providers should take this opportunity to internalise their environmental knowledge, since lack of knowledge was cited as an obstacle to sustainable management in the Dutch social housing sector (Chapter 4). Costs of improving energy efficiency should be compared to that of standard renovation or maintenance, a 'zero option' where building components and systems are replaced like-with-like similar, not with a do-nothing situation (Chapter 5), rather than with the current situation, as some renovation measures would have to be undertaken anyway. In order to address the capture of benefits that is needed if energy efficiency is to be implemented in the rented sector in the EU, a landlord should be able to guarantee the benefit of a investment for a tenant; if a tenant wants to implement energy efficient improvements on their own, they should get compensation for it when moving out. Different ownership models can also work to overcome this barrier: an energy company, for example, could take on the leading role, taking over the existing system and replacing it with an energy-efficient alternative, which a tenant would lease from the energy company (Novem, 2002).

Follow-up with feedback appears to be the best single way of combining monitoring and teaching and extending the effectiveness of energy advice programmes (Darby, 2003). As tenants are often less interested in environmental impact than in cutting costs, monthly feedback should be given both in physical and monetary terms, related to the effects of certain behaviour and combined with information on investing in energy efficiency. At project level, social housing providers should equip all housing with thermostats and systems that enable tenants to control the level and the costs of heating themselves. Social housing providers should provide environmental education material to their tenants more than they do now (Chapter 4), making use of existing material from energy agencies, ministries and the EU (Chapter 2). The information provided should be clear and captivating interest. Information is also needed to address the rebound effect: the money saved from more energy-efficient housing may be spent on purchasing new appliances, e.g. air-conditioners that consume more electricity.

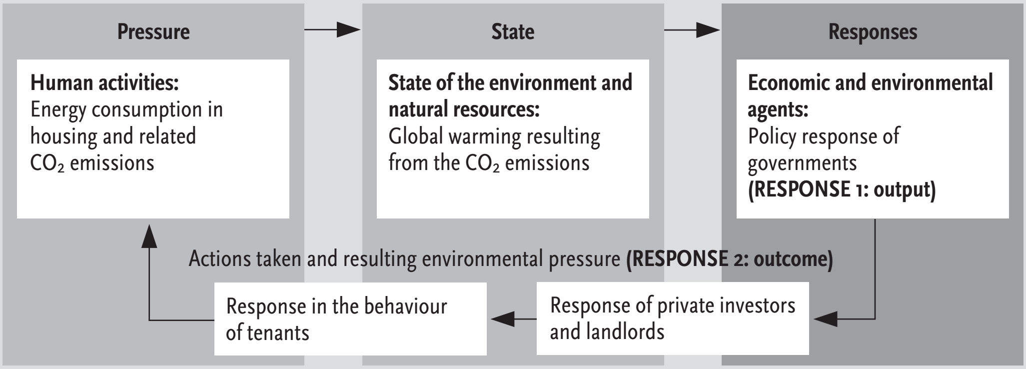
7.4.4 Indicator of societal response

Question 3.4: *What would be a good indicator of a societal response to reducing carbon emissions in the housing sector (Chapter 7)?*

The first stage of the study looked at sustainable building policies as a societal response to the state of the environment (global warming) in the Pressure-State-Response model (Fig. 7.2) (OECD, 1993). The Pressure-State-Response model therefore identifies two kinds of response: policies (response 1) and actions taken as a result of these policies (response 2). Internal effectiveness is related to response 1 (output) and external effectiveness to response 2 (outcome). During the research Fig. 7.2 was elaborated from Fig 1.1 to reflect better the situation in the rental sector where environmental pressure is determined by the actions (response 2) of landlords as well as the behaviour of tenants; tenants can only maximise their energy saving behaviour if landlords invest in energy efficiency measures first, or create conditions for the tenants to do that.

The study illustrates the discrepancy in the EU between policies (response 1), addressed in Chapters 2-3, and actions (response 2), addressed in Chapters 4-6: positive attitudes in terms of policies have not fully materialised in energy efficiency improvements in the renovation of the social housing sector in the Netherlands. As an indicator of societal response (Chapter 1), policies can also be assessed in terms of their internal and external effectiveness. A useful policy will be implemented: it is internally effective. External effectiveness refers to the impact of the policy: notwithstanding the internal effectiveness

Figure 7.2 Residential energy consumption in terms of the Pressure-State-Response model



Source: OECD, 1993a; modified by author

of the Energy Performance of Buildings Directive (EPBD), its effect on carbon savings is estimated to be small (Chapter 6). The discussion of the EPBD in Chapter 6, which included a collection of data on the existing housing stock, showed also that the state of the art in actual new construction in the UK is less impressive than might be expected given the UK government's ambitions as examined in the policy analysis (Chapter 2). In the Netherlands, information dissemination has been successful in the form of the National Package for Sustainable Building (SBR, 1998a, 1998b), a collection of common measures and recommendations to achieve sustainability, available for housing since 1995. As Chapter 2 concluded, however, the average reduction in the environmental load to be achieved by adopting these measures is still fairly small (Blaauw and Klunder, 1999).

It is important to look at quantitative outcome as an indicator (annual investment in energy efficiency, energy consumption grouped by type of housing, or CO_2 savings obtained in relation to investment), not only qualitative outcome (implementation of 'energy measures'), because what is considered as an environmental measure depends on the actor (Chapter 4). Monitoring of energy efficiency measures should, therefore, be based on a reference level, e.g. the thermal requirements in the building regulations.

Not all housing is built in compliance with the building regulations in the EU (Warren 2005; ENPER-TEBEC, 2004), so the energy requirement (U-value or equivalent) does not represent the actual thermal performance of a building; energy-saving calculations based on design drawings can be overestimated. The annual number of systems installed or insulation measures does not reflect actual energy consumption, as it depends on the building physics and user behaviour (Fig. 7.2), the real outcome of a policy. Although this is time-consuming, collecting actual energy consumption data to measure action is recommended.

The indicator should take account of business-as-usual, e.g. the normal rate of window renovations or energy-efficient boiler installations. The business-as-usual growth in insulation and double glazing is getting large for example in the Netherlands and in the UK (Chapters 4-6), so a more targeted set of measures, such as building-integrated renewable energy sources or appliances, would be a better starting point than investigating thermal performance in general in countries that have experience with sustainable building. The study again found that it is difficult to determine what is the impact of a particular policy or instrument (Chapter 1) and what is a result of an organic trend in the housing market or a combination of measures (Chapter 6): was the impact a consequence or a coincidence? As regards indicators, the response indicator for the housing sector needs to consider the project (micro-economic) level, but the environmental pressure that is being responded to is of a global (macro-economic/societal) nature.

If it is to be effective in reducing the environmental pressure, the societal response in the model should be not only reactive but also anticipatory of the state of the environment (Chapter 1). The state of the environment, however, is linked to socio-economic driving forces, many of which are interlinked. The political context, the housing market, interest rates for loans and even the state of the environment are constantly changing, and how we shall respond to the environmental problems is difficult to predict: this is as much a political question as a scientific one. Mandatory requirements can reduce the uncertainty of a policy outcome but not eliminate it.

7.5 Conclusions

This research has aimed to describe and evaluate the policy response of the European Union Member States to the challenges of reducing CO_2 in the residential sector. Energy efficiency in buildings has been a topic of debate since the 1970s. Although the literature on the effectiveness of environmental policies is increasing, the housing sector has received less attention, and very few studies on the energy-saving potential of buildings have addressed either feasibility or the associated costs.

The first part of the problem definition addressed current sustainable building policies: what they are and how they work (Chapters 2-3). The policy analysis shows that governments in the EU Member States have slowly begun to recognise the importance of the existing housing stock to the reduction of CO_2 emissions (Chapter 2). Environmental measures that are implemented in building regulations (Chapter 2), however, are apparently based on preventive (new construction) rather than on curative measures (the existing stock), and the same applies to negative and affirmative economic incentives (Chapter 3). Most governments in Europe do find it necessary to subsidise and regulate the processes of urban renewal, but is apparently not the case with regard to improving the environmental performance and energy efficiency of existing housing, where they feel inclined to take action. All European countries have adopted a voluntary approach to improving energy efficiency in existing housing. This approach relies on increases in energy prices, comfort and the value of homes to promote energy efficiency in housing (Chapter 2). In addition, the energy certificates of the EC Energy Performance of Building Directive (EPBD) and other new policy instruments (Chapter 6) rely heavily on the environmental conscience of private operators. This is consistent with the preference of most EU governments for deregulation. Such preferences are based on the perception of the free market as a tool for steering environmental improvements, even if market dynamics appear to be absent and even if large-scale energy improvements in existing housing are not particularly attractive to investment.

The second part of the problem definition addressed actions that have been taken in response to the current governmental policy approach and the main causes of the inertia, using the Netherlands and the UK as examples (Chapters 4-6). Response to environmental policies usually takes place in so many areas and is so multidisciplinary in nature that it is difficult to judge its relative success or failure. As indicated in Chapter 4, however, energy measures in the Dutch social housing sector rarely exceed the level that is specified in building regulations, the Sustainable Building Agreement, the national policy developments (Chapters 2-3) and the environmental policies of housing association notwithstanding. Sustainable management within these associations has developed little since 1993 and hardly at all since 1998 (Chapter 4). Economic obstacles to energy efficiency and low carbon supply illustrate the limited impact of the use of taxes as a policy instrument. Despite energy price increases, the NPV of investments remains negative until the next intervention for several energy efficiency measures (Chapter 5). Consequently, environmental improvements are considered only 'if there are no extra costs' or 'where possible', as identified in the interviews in the case studies that are presented in Chapter 5. In the second case study, the fuel switch from gas to district heating is complicated by the fragmentation of stakeholders and the divided responsibilities in a policy network. Related to the barriers that are identified in Chapter 5, the impact analysis on the implementation of the EC Energy Performance of Buildings Directive (EPBD) shows that, although energy certificates for household appliances have proved relatively successful, they will not be as effective in the existing housing (Chapter 6). If the energy certificates of the EPBD are used only as communication instruments, their carbon-saving impact is not likely to exceed that of the current situation. The most optimistic application in Scenario 3 is assumed to produce a 3% annual reduction in total space-heating demand (25.6 MtC) from the existing housing stock in the UK and a 2% reduction in the total energy demand of households (41.4 MtC). This would be a valuable contribution. As the UK government's target of achieving a 60% reduction in carbon by 2050 clearly demonstrates, however, in practice, current policies are likely to produce incremental improvements at best, and are unlikely to lead to radical change.

The empirical part of the study (Chapters 4-6) addresses the question of the extent to which stronger government intervention is possible and necessary for circumnavigating barriers and the policy approaches that are likely to be feasible, effective, cost-efficient and legitimate for improving the energy efficiency of the existing housing stock (Chapter 7). Considering the nature of the inertia with regard to energy efficiency in existing housing, national and local governments should take an active role in promoting sustainable building, rather than leaving these efforts to the discretion of profit-seeking market forces. In the current situation, in which housing demand exceeds supply, it is difficult to introduce new criteria on the consumer side without government support. A relatively drastic approach is required, however, and gaining sufficient support will take time. Effective results can probably be expected from the introduction of regulations combined with energy certificate standards (Chapter 6). However, mandatory requirements on existing housing stock cannot be imposed overnight, as most energy measures are not yet cost-efficient (Chapter 5). In addition, not all households are in a position to comply with mandatory standards. The fact that low-income households constitute a disproportionate majority of the occupants of the most energy-inefficient housing in the European Union (Whyley and Callender, 1997; Clinch and Healy, 1999) underlies the main precondition for a feasible energy efficiency policy in the existing housing. Improvements in energy efficiency, as verified by the energy certificates, could be set as a prerequisite for targeted subsidies for low-income households.

Because of national differences in housing stock and policies, it was recommended that the contribution of the EU to the policies of national governments should be strategic rather than operational. Local governments play an important role in the implementation of energy-efficiency policies, as special attention should be paid to assistance, access to loans and the facilitation of implementation. If these aspects are ignored, many households will be unable to comply. In addition, the economic service life of a building (and therefore the economic feasibility of energy-efficiency improvements) depends on location and housing demand. Further research is necessary to deepen the existing knowledge concerning the legislation of energy saving in the existing housing stock, the ability to overcome the dilemmas for the low-income households, the question of building control and sanctions for non-compliance.

The last part of the problem definition sought to identify a good indicator of response in the context of reducing global greenhouse gas emissions in the housing sector, particularly in the Pressure-State-Response model (OECD, 1993), as a societal response to global warming (energy as an environmental problem) and energy self-sufficiency (energy as an economic problem). The research illustrates the discrepancy between policies (response 1 – output), as addressed in the qualitative analysis in Chapters 2 and 3, and actions that have been taken in response to these policies (response 2 – outcome), as addressed in Chapters 4 through 6. Furthermore, tenants can maximise their energy-saving behaviour only if property owners first invest in energy-efficiency measures and improve the thermal performance of their properties. User behaviour is the ultimate determinant of environmental pressure. This emphasises the importance of finding an indicator that can assess the quantitative outcomes (i.e., annual investment in energy efficiency in monetary terms, with energy consumption grouped by type of housing and CO_2 savings obtained in relation to investment) of policies, in addition to the qualitative outputs (e.g., the formulation of environmental policies, the implementation of 'energy measures' with no reference level, such as the requirements that are specified in building regulations). Because the content of a policy tells very little about its actual implementation and impact, hence also this research should have focused more on the quantitative impact rather than simply describing current policies, as was considered necessary at the start of the study.

The political dimension of energy saving in buildings became more apparent during the course of this research in several ways. First, decisions for adequate carbon-reduction scenarios are central to governmental and economic decisions. Measures to restrict or regulate construction (e.g., to support renovation) have an impact on the national economy and are thus not always favoured by the government. Second, political cycles and approaching elections can lead to the postponement of new (costly) policies, as was the case with the EPBD in the Netherlands (Chapter 6). Third, international commitments (e.g., the Kyoto Protocol), which were also considered among the objectives of this research (Chapter 1), are subject to political bargaining, and governments may not have enough political or economic incentives to exceed these modest goals. It is a generally recognised fact that any international convention sets only a limited target for action, with usually modest amendments being made in the ensuing negotiations (Jäger and O'Riodan, 1996). This is certainly applicable in the housing sector as well. There is tension between environmental and political targets of energy efficiency. To be effective, energy efficiency should be integrated into policies, regulations and fiscal structures, but this involves a risk that the results can be regarded as resulting from political bias instead of being neutral. The policy recommendations in this research are based on incremental improvements; at best, they will result in the stabilisation of (and a reduction in) energy demand in the EU housing sector (contributing to the concept of weak sustainability, as discussed in Chapter 1). Considering the scale of the environmental problems (Hillman and Fawcett, 2004; King, 2004), however, and the projected economic growth in the developing countries, inability of stabilising energy consumption to achieve self-sufficiency in energy in the EU (EC, 2001, 2005) and very costly energy-saving targets in other sectors (e.g., transport), a more radical reorientation of policies is required if truly sustainable development (UN, 1992) is to be achieved. It is important to recognise this necessary change if we are to achieve environmentally sustainable building. At present, the legislation of energy-saving measures for existing housing may seem a complex issue, as the introduction of new regulations is not politically attractive. National governments have a political mandate to do so, however, and it may soon become necessary to discuss the implementation of this mandate, especially if public awareness about environmental problems and climate change increases and becomes more politically articulated.

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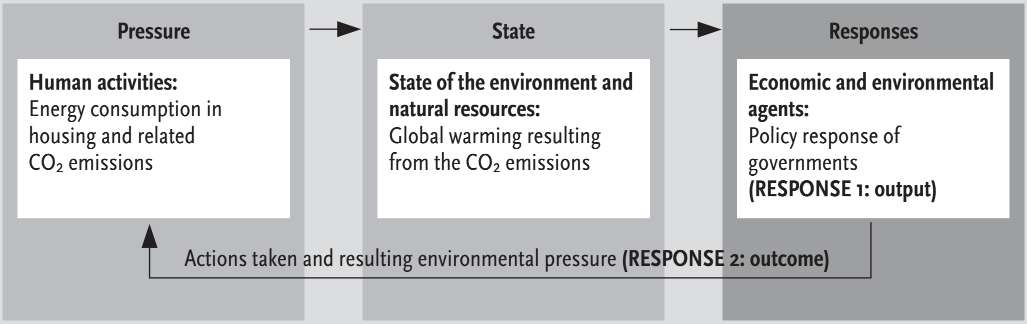
Summary
Policies for improving energy efficiency in the European housing stock
Minna Marjaana Sunikka

Introduction

Many argue that anthropogenic interference in the carbon cycle is the most serious of all the sustainability issues facing the world in general and the industrialised countries in particular (IPCC, 2001a; King, 2004; Conisbee and Simms, 2003; EEA, 2005). The scale of the challenges, both in relation to Kyoto and beyond, is illustrated by a study by the Royal Commission on Environmental Pollution in the UK, which has recommended that UK carbon dioxide emissions should be reduced by 60% on the 2003 level by 2050 (RCEP, 2000). We tend not to think about heating our buildings as an environmental problem. There is a clear link, however, between domestic energy consumption and carbon emissions that are causing climate change (Lowe, 2005). In the European Union, buildings account for over 40% of total current energy consumption and 30% of all CO_2 emissions (Bourdeau, 1999; EC, 2005). Notwithstanding the carbon saving potential identified in the existing housing stock (Van der Waals, 2001; Klunder, 2005; Boardman et al., 2005) the environment continues to play a small part in urban renewal, where energy efficiency measures are still not being applied on a large scale (Bus, 2001; Priemus, 2002). Current policy measures and budgets seem to be decided with little reference to the specific needs of renovation in the housing sector (Van Hal, 1999; NOVEM, 2002; Murakami et al., 2002a; Hasegawa, 2002 and 2003; Thomsen, 2003; OECD, 2004; Awano, 2005) instead of making precise estimations and basing policy measures on detailed sets of requirements and actual costs.

If the market worked effectively and with the right cost-benefit ratio, the monetary value of energy efficiency measures would be reflected in the resale value of homes (Clinch and Healy, 1999), but there seems to be insufficient market demand for sustainable building (SBR, 2001; Baumann et al., 2002). The study focuses on government policy, based on the assumption that the market's ability to solve environmental problems is limited and government intervention is needed. The concept of sustainable development used here is the institutional one: sustainability is considered as being essentially a problem of governance in the broadest sense (Perman et al., 2003). The aim of the study is twofold. Firstly, it aims to provide information for national governments in the EU on how to improve their sustainable building policies so as to increase carbon reductions in the existing housing stock. Policies are considered as not only reacting to but also anticipating problems, as once the environmental problems are bad enough the reaction could come too late. Sec-

Energy consumption in the residential sector in terms of the Pressure-State-Response model



Source: OECD, 1993a; modified by author

ondly, the research tries to contribute to a discussion on a good indicator of response in the context of reducing carbon emissions in the housing sector in the Pressure-State-Response model (OECD, 1993a) because a good indicator is seen important in the implementation and evaluation of an anticipating policy. In order to identify the right indicator it considers both government policy (the societal response) and the actions taken as result of that policy (see Figure above).

The problem is formulated as follows:
What is the current policy approach that is being used in the EU Member States for reducing CO_2 emissions from energy use in the housing sector, and how has this approach been implemented in national building regulations and economic instruments? What actions have been taken in response to government policy in the social housing sector in the Netherlands, and what are the main factors that have contributed to inertia in the effort to realise improvements in energy efficiency? To what extent is stronger government intervention possible and necessary for circumnavigating the barriers? What policy approach could be an effective, cost-efficient and legitimate response strategy for improving energy efficiency in the existing housing stock without causing negative side-effects, and what role could the EC Energy Performance of Buildings Directive (EPBD) play in such a strategy? What would provide a good indicator of response in the context of reducing global greenhouse gas emissions in the housing sector in the Pressure-State-Response model (OECD, 1993a)?

The problem is broken down into three primary questions and eleven subsidiary questions, which are addressed in Chapters 2 through 7:

1 What is the current policy in EU Member States for reducing CO_2 emissions from energy use in the housing sector as a societal response to global warming and the depletion of natural resources, and how do these policies relate to the existing housing?

1.1 What are the possibilities for energy-efficient upgrading in housing renovation (Chapter 2)?

1.2 What approach has been adopted in the national sustainable building strategies of the Netherlands, Germany, France, Finland and the UK in terms of policy, implementation and response (Chapter 2)?

1.3 What sustainable building requirements are specified in the building regulations in the Netherlands, Germany, France, Finland and the UK (Chapter 2)?
1.4 How are negative and positive fiscal incentives applied in sustainable housing policies within the enlarged European Union (Chapter 3)?
2 What actions are being taken in response to government policies on sustainable housing, and what are the main obstacles to achieving carbon savings in the existing housing stock, using the Netherlands and the UK as examples?
2.1 What environmental efforts have been made under the heading of sustainable management in the social housing sector in the Netherlands in response to the Sustainable Building Agreement in 1998 and government policy (Chapter 4)?
2.2 What factors (technical, economic and with regard to implementation) lie behind the inertia regarding energy efficiency and low carbon supply in urban renewal in the Netherlands (Chapter 5)?
2.3 What is the anticipated impact of energy certificates under the Energy Performance of Buildings Directive (EPBD) on the existing housing stock in the UK, and how can the impact be maximised (Chapter 6)?
3 Is stronger government intervention possible and necessary for improving energy efficiency in the existing housing stock in the EU, and what policy approach would be likely to produce and effective, cost-efficient and legitimate response strategy for reducing global greenhouse gas emissions in the housing sector?
3.1 How can the European Union contribute to the improvement of energy efficiency in the housing sector, beyond the efforts that are being made by the Member States (Chapter 7)?
3.2 How should the national and local governments in the EU use legislation, fiscal instruments and information in their policies for reducing carbon emissions in the existing housing stock, and what role could the EC Energy Performance of Buildings Directive (EPBD) play in it (Chapter 7)?
3.3 How can social housing providers in the EU improve their energy-efficiency policies to reduce global greenhouse emissions in the existing housing stock (Chapter 7)?
3.4 What would be a good indicator of a societal response to reducing carbon emissions in the housing sector (Chapter 7)?

Research approach
Based on the research questions, the study consists of three main themes: policy and implementation (RQ1 – policies), response (RQ2 – actions) and policy recommendations (RQ3 – response strategies). The first theme is qualitative, the second one quantitative. In order to answer the first question on policy, current sustainable housing policies and regulations and fiscal in-

struments in the European Union countries are identified in an 'as is' policy analysis, based on a description and explanation of current policies (Chapter 2). This is a synthesis of a case study and a comparative analysis. The analysis focuses on content, as processes vary from one country to another. *Implementation* focuses on the policy instruments used (Chapters 2-3). The study is based on the most common classification of policy instruments into three types: direct regulation, economic tools and communication tools (Kemp, 2000; Driessen and Glasbergen, 2000; Murakami et al., 2002a). The data on policies and implementation is taken from key policy documents, expert interviews and literature from the selected EU countries, preceded by interviews and a wider survey (of the baseline years 2000-2005). Question 2 on *response* is discussed in the empirical part of the thesis, a quantitative study of the actions that current policies generate (Chapters 4-6). The empirical part of the thesis is broken down into three modules: a management survey in Chapter 4, two urban renewal case studies in Chapter 5 and an analysis of the anticipated impact of the Energy Performance of Buildings Directive (EPBD) (EC, 2003) in Chapter 6. The first module of the empirical part focuses on housing management in the Dutch policy context (Chapter 2). The evaluation of the response to the Sustainable Building Agreement drawn up with the Dutch social housing sector, the government and third parties in 1998 (Sunikka and Boon, 2002) is based on the data from the surveys of the Agreement. The second module of the empirical part presents two case studies of urban renewal in the Netherlands. Inertia when it comes to carbon reduction is examined in terms of the technical, economic and implementational obstacles. The 'energy triad' approach is adopted because it is a generally recognised concept (Duijvestein, 1998). The first case study (Hoogvliet, Rotterdam) focused on the first step, avoiding unnecessary energy consumption. The second (Western Garden Cities, Amsterdam) focused on the second step, using non-finite sources to provide heat and electricity. The third module of the empirical part is the forward-looking part of the thesis and focuses on the EC Energy Performance of Buildings Directive (EPBD), which was introduced in 2003 as the main policy instrument to address energy saving in buildings in the EU and has to be implemented in all the Member States by 2006 (EC, 2003; Beerepoot and Sunikka, 2005; Sunikka, 2005). Chapter 6 examines the implementation of the EPBD energy certificate system in the UK in a qualitative study, a quantitative analysis and a discussion of the most probable, and the preferred, impact scenario in the UK.

The policy recommendations focus on the implications for national governments in Chapter 7. Given the focus of the study, the EU countries may be assumed to be those to which the resulting recommendations will be applied in the first instance. The study is based on some fundamental assumptions that should be taken into account when considering the findings. Neo-classical economists define two notions of sustainability in terms of natural capital:

weak sustainability and strong sustainability. Strong sustainability requires that any losses of natural capital in public investment projects are compensated for by shadow projects that create natural capital of equal value, so that the stock of natural capital is kept constant or allowed to increase (Bowers, 1997). Weak sustainability occurs when all the environmental impacts of private decisions are internalised through taxes and public investment satisfies a cost-benefit test when environmental effects are given a monetary value. Incremental improvements suggested in this study refer to weak sustainability. The study looks at sustainable development from an anthropological rather than ecological point of view. It seeks a balance between human needs and environmental load. In the built environment this is associated with the concept that building quality should be related to its environmental impact (Murakami et al., 2002b). Sustainable building is defined as aiming to reduce harmful environmental impacts caused by construction, buildings and the built environment (MVROM, 1990). Considering embodied energy in buildings and materials, maximisation of energy supply from renewable sources, improving thermal performance of the building envelope and energy efficient equipment, this research focuses on improving the thermal performance of the building envelope as it is considered as a necessary first step towards using more sustainable energy sources such as heat pumps while also increasing comfort. Electricity demand for household appliances is beyond the scope of this analysis because as products their application is assumed to differ from buildings.

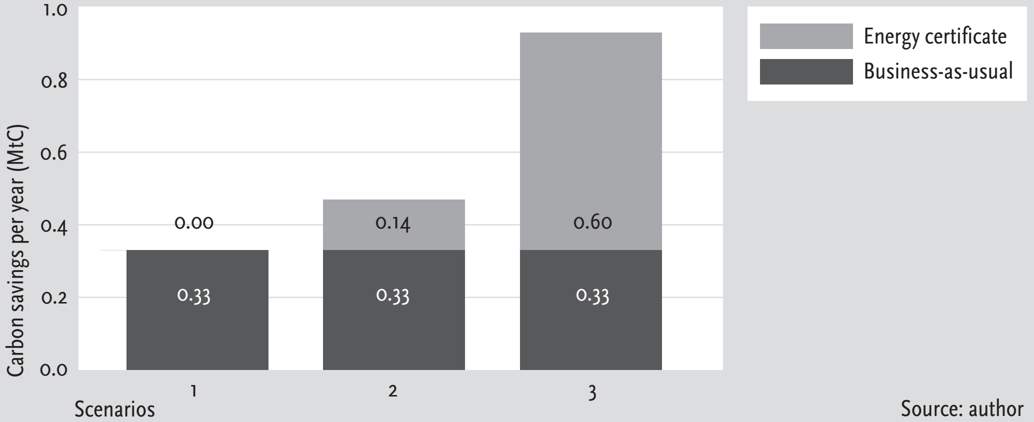
Conclusions

The first part of the problem definition addressed current sustainable building policies: what they are and how they work (Chapters 2-3). The policy analysis shows that governments in the EU Member States have slowly begun to recognise the importance of the existing housing stock to the reduction of CO_2 emissions (Chapter 2). If preventative policy measures are intended to prevent new construction from deteriorating, and curative measures tend to focus on providing a few subsidies for updating the existing stock in order to improve energy efficiency then current policy measures observed in Chapters 2-3 can be characterised as preventive, not curative. Most governments in Europe do find it necessary to subsidise and regulate the processes of urban renewal, but is apparently not the case with regard to improving the environmental performance and energy efficiency of existing housing, where they feel inclined to take action. The current policy approach in the EU Member States is characterised by a market-led approach, which presumes that energy-efficient improvements will increase the property values. Also the energy certificates of the EC Energy Performance of Building Directive (EPBD) and other new policy instruments (Chapter 6) rely heavily on the environmental conscience of private operators. This process is attuned to the free market, as it requires no direct government intervention into individual decision-making on projects. This is consistent with the preference of most EU governments for deregulation. Such preferences are based on the perception of the free market as a tool for steering environmental improvements, even if market dynamics appear to be absent and even if large-scale energy improvements in existing housing are not particularly attractive to investment. Voluntary, market-led policies for sustainable building, however, involve the risk that only those who are most motivated will act.

The second part of the problem definition addressed actions that have been taken in response to the current governmental policy approach and the main causes of the inertia, using the Netherlands and the UK as examples (Chapters 4-6). The empirical part of the study suggests that, despite environmental policies and the positive attitudes of housing associations, the current policy approach, which is based on voluntary pull measures and energy prices (Chapters 2-3), has had only limited success in encouraging sustainable housing management in the Dutch social housing sector which rarely exceeds the level that is specified in building regulations (Chapters 4-5). Sustainable management within these associations has developed little since 1993 and hardly at all since 1998 (Chapter 4). Environmental improvements are considered only ‘if there are no extra costs’ or ‘where possible’, as identified in the interviews in the case studies that are presented in Chapter 5. Economic obstacles to energy efficiency and low carbon supply illustrate the limited impact of the use of taxes as a policy instrument. Despite energy price increases, the NPV of investments remains negative until the next intervention for several energy efficiency measures (Chapter 5). In the second case study, the fuel switch from gas to district heating is complicated by the fragmentation of stakeholders and the divided responsibilities in a policy network. Related to the barriers that are identified in Chapter 5, the impact analysis on the implementation of the EC Energy Performance of Buildings Directive (EPBD) shows that, although energy certificates for household appliances have proved relatively successful, they will not be as effective in the existing housing (Chapter 6). If the energy certificates of the EPBD are used only as communication instruments, their carbon-saving impact is not likely to exceed that of the current situation. The most optimistic application in Scenario 3 is assumed to produce a 3% annual reduction in total space-heating demand (25.6 MtC) from the existing housing stock in the UK and a 2% reduction in the total energy demand of households (41.4 MtC) (see figure on next page). This would be a valuable contribution. As the UK government’s target of achieving a 60% reduction in carbon by 2050 clearly demonstrates, however, in practice, current policies are likely to produce incremental improvements at best, and are unlikely to lead to radical (or adequate) change.

Considering the obstacles (Chapters 4-6), a policy approach that involves a combination of hierarchy (power based on administrative orders) and net-

Sensitivity analysis: annual reductions in carbon emissions (MtC) resulting from energy certificates in existing housing in addition to business-as-usual (0.33 MtC) in the UK



Source: author

work (power based on co-operation) is likely to be more effective than a market approach (power based on resources) would be for addressing the current inertia with regard to energy efficiency in existing housing. Because of national differences in housing stock and policies, it was recommended that the contribution of the EU to the policies of national governments should be strategic rather than operational. Considering the nature of the inertia with regard to energy efficiency in existing housing, national and local governments should take an active role in promoting sustainable building, rather than leaving these efforts to the discretion of profit-seeking market forces. Effective results can probably be expected from the introduction of regulations combined with energy certificate standards (Chapter 6). A property transaction is one intervention point for mandatory regulations, as such transactions allow the opportunity to connect inspections to legal and administrative procedures; the possibility that this could increase transaction costs, however, should also be considered. However, mandatory requirements on existing housing stock cannot be imposed overnight, as most energy measures are not yet cost-efficient (Chapter 5). The fact that low-income households constitute a disproportionate majority of the occupants of the most energy-inefficient housing in the European Union (Whyley and Callender, 1997; Clinch and Healy, 1999) underlies the main precondition for a feasible energy efficiency policy in the existing housing. Economic incentives are needed in order to ensure that mandatory policies do not cause problems for low-income households or create an ethical conflict with the right to housing. Some of the policy instruments that have been described in this research (e.g., preferential loans, tax rebates, mortgage arrangements or compensation for energy improvements in land prices; see Chapters 3 and 6) can already offer examples of how such issues can be addressed. It may be possible to combine these measures with the energy certificates, such that the certificate levels A/B/C/D/E/F (as in the energy labelling of household appliances) would be a prerequisite for the incentives, specifying that the improvements should raise the dwelling by one level (e.g., from C to D; see Chapter 6). Compliance with the introduction of thermal regulations for the existing housing stock is especially problematic, as not all renovation work requires notifying the building authorities and the issue of sanctions for non-compliance calls for further research. Local governments play an important role in the implementation of energy-efficiency policies, as special attention should be paid to assistance, access to loans and the facilitation of implementation.

The last part of the problem definition sought to identify a good indicator of response in the context of reducing global greenhouse gas emissions in the housing sector, particularly in the Pressure-State-Response model (OECD, 1993a), as a societal response to global warming (energy as an environmental problem) and energy self-sufficiency (energy as an economic problem). The research illustrates the discrepancy between policies (response 1 – output), as addressed in the qualitative analysis in Chapters 2 and 3, and actions that have been taken in response to these policies (response 2 – outcome), as addressed in Chapters 4 through 6. User behaviour is the ultimate determinant of environmental pressure. This emphasises the importance of finding an indicator that can assess the quantitative outcomes (i.e., annual investment in energy efficiency in monetary terms, with energy consumption grouped by type of housing and CO_2 savings obtained in relation to investment) of policies, in addition to the qualitative outputs (e.g., the formulation of environmental policies, the implementation of 'energy measures' with no reference level, such as the requirements that are specified in building regulations).

Samenvatting Beleid voor het verbeteren van de energieprestaties van de Europese woningvoorraad

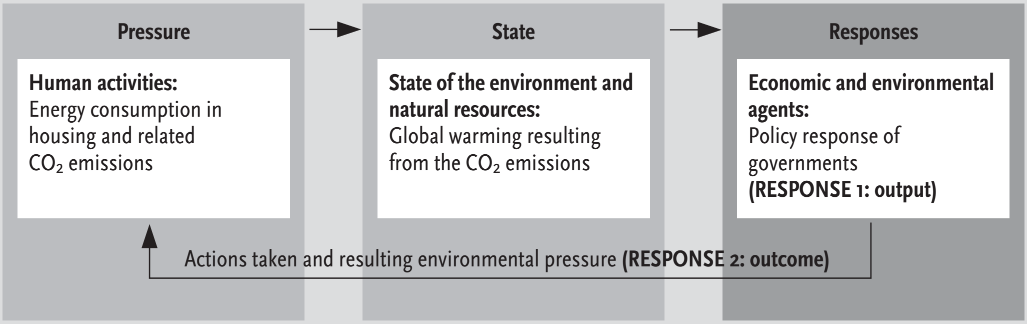
Minna Marjaana Sunikka

Inleiding

Velen zijn van mening dat antropogene verstoring van de koolstofcyclus de zwaarst wegende factor op het gebied van duurzaamheid is waarmee de wereld in het algemeen, en de geïndustrialiseerde landen in het bijzonder, wordt geconfronteerd (IPCC, 2001a; King, 2004; Conisbee en Simms, 2003; EEA, 2005). De schaal van deze problematiek, zowel met betrekking tot Kyoto als op grotere schaal, komt duidelijk naar voren uit een onderzoek van de Royal Commission on Environmental Pollution van het Verenigd Koninkrijk, waarin werd aanbevolen om ernaar te streven de CO_2-uitstoot in het Verenigd Koninkrijk in 2050 met 60% te hebben verlaagd ten opzichte van het niveau in 2003 (RCEP, 2000). We beschouwen de verwarming van gebouwen niet als een milieuprobleem. Er bestaat echter een duidelijk verband tussen huishoudelijk energieverbruik en de CO_2-uitstoot die klimaatverandering veroorzaakt (Lowe, 2005). Binnen de Europese Unie zijn gebouwen goed voor 40% van het totale energieverbruik en 30% van alle CO_2-uitstoot (Bourdeau, 1999; EC, 2005). Ondanks de potentiële CO_2-vermindering die in het bestaande woningaanbod is aangetoond (Van der Waals, 2001; Klunder, 2005; Boardman et al., 2005), blijft het milieu slechts een kleine rol spelen bij stadsvernieuwing, waarbij nog altijd maar weinig maatregelen op het gebied van energiezuinigheid op grote schaal worden toegepast (Bus, 2001; Priemus, 2002). De huidige beleidsmaatregelen en budgetten lijken te zijn vastgesteld zonder dat er veel aandacht is besteed aan de specifieke renovatiebehoeftes binnen de woningsector (Van Hal, 1999; NOVEM, 2002; Murakami et al., 2002a; Hasegawa, 2002 en 2003; Thomsen, 2003; OECD, 2004; Awano, 2005), zonder precieze schattingen te hanteren of beleidsmaatregelen te baseren op nauwkeurig gedefinieerde eisen en daadwerkelijke kosten.

Als de markt effectief functioneerde, met de juiste verhouding van kosten en baten, zou de monetaire waarde van energiezuinige maatregelen worden weerspiegeld in de verkoopwaarde van een woning (Clinch en Healy, 1999), maar er lijkt te weinig vraag binnen de markt naar duurzame bouw (SBR, 2001; Baumann et al., 2002). Het onderzoek heeft zich voornamelijk beziggehouden met het overheidsbeleid, uitgaande van de aanname dat de markt slechts beperkte mogelijkheden biedt om milieuproblemen op te lossen en ingrijpen van overheidswege noodzakelijk is. Het hier gehanteerde concept van duurzame bouw is het institutionele concept: duurzaamheid wordt vooral beschouwd als een kwestie van bestuur in de breedste betekenis van het

Energy consumption in the residential sector in terms of the Pressure-State-Response model



Source: OECD, 1993a; modified by author

woord (Perman et al., 2003). Het onderzoek heeft twee doelen. In de eerste plaats wordt ernaar gestreefd de nationale overheden in de EU informatie te verstrekken voor het verbeteren van hun beleid voor duurzame bouw teneinde de CO_2-uitstoot van bestaande woningen te verminderen. Het beleid moet niet alleen op problemen inspelen, maar deze tevens anticiperen, want zodra de milieuproblematiek eenmaal ernstig genoeg is, is een reactie soms al te laat. In de tweede plaats probeert dit onderzoek een bijdrage te leveren aan de discussie over een goede responsindicator binnen de context van het verminderen van de CO_2-uitstoot vanuit de woningmarkt binnen het 'Pressure-State-Response'-model (OECD, 1993a), omdat een goede indicator als belangrijk wordt beschouwd voor de implementatie en evaluatie van een anticiperend beleid. Teneinde de juiste indicator te vinden worden zowel het overheidsbeleid (de maatschappelijke respons) als de in het kader van dat beleid uitgevoerde handelingen (zie figuur boven) onderzocht.

De probleemstelling is als volgt geformuleerd:
Wat voor benadering wordt momenteel in de lidstaten van de EU gevolgd om de CO_2-uitstoot ten gevolge van energiegebruik in de woningsector te verminderen, en hoe is deze benadering geïmplementeerd in de vorm van nationale bouwvoorschriften en economische instrumenten? Wat voor actie is er binnen de Nederlandse sociale woningbouw ondernomen als reactie op het overheidsbeleid, en wat zijn de belangrijkste factoren die hebben bijgedragen aan het gebrek aan doortastendheid om de energiezuinigheid te verbeteren? In hoeverre is ingrijpender interventie door de overheid mogelijk en noodzakelijk voor het overwinnen van obstakels? Welke beleidsbenadering zou een effectieve, rendabele en legitieme responsstrategie kunnen zijn voor het verbeteren van de energiezuinigheid van bestaande woningen zonder negatieve bijwerkingen, en welke rol kan De Europese Richtlijn voor Energieprestatie van Gebouwen (EPBD) binnen een dergelijke strategie spelen? Wat zou een goede indicator zijn van de respons binnen de context van het verminderen van de wereldwijde uitstoot van broeikasgassen binnen de woningsector volgens het 'Pressure-State-Response'-model (OECD, 1993a)?

De probleemstelling is onderverdeeld in drie hoofdvragen en elf subvragen, die aan bod komen in hoofdstuk 2 tot en met 7:

1. Wat is het huidige beleid in de lidstaten van de EU voor het verminde-

ren van de CO_2-uitstoot als gevolg van het energiegebruik in de woningsector als maatschappelijke respons op klimaatverandering en het uitgeput raken van natuurlijke bronnen, en hoe verhoudt dit beleid zich tot bestaande woningen?

1.1 Welke mogelijkheden zijn er voor energiezuinige verbeteringen bij woningrenovatie (hoofdstuk 2)?

1.2 Welke benadering wordt er gehanteerd voor de nationale strategie voor duurzame woningbouw in Nederland, Duitsland, Frankrijk, Finland en het Verenigd Koninkrijk wat betreft beleid, implementatie en respons (hoofdstuk 2)?

1.3 Wat voor eisen op het gebied van duurzame woningbouw worden er gespecificeerd in de bouwvoorschriften in Nederland, Duitsland, Frankrijk, Finland en het Verenigd Koninkrijk (hoofdstuk 2)?

1.4 Hoe worden negatieve en positieve fiscale stimulansen gebruikt binnen het beleid voor duurzame woningbouw binnen de uitgebreide Europese Unie (hoofdstuk 3)?

2. Wat voor actie wordt er ondernomen als reactie op het overheidsbeleid voor duurzame woningbouw, en wat zijn de voornaamste obstakels die het verminderen van de CO_2-uitstoot door bestaande woningen in de weg staan, met Nederland en het Verenigd Koninkrijk als voorbeeld?

2.1 Welke milieumaatregelen zijn er genomen in het kader van duurzaam beheer in de sociale woningbouw in Nederland als reactie op Het Nationaal Convenant Duurzam Bouwen van 1998 en het overheidsbeleid (hoofdstuk 4)?

2.2 Welke technische, economische en implementatietechnische factoren spelen een rol bij het gebrek aan doortastendheid bij het streven naar energiezuinigheid en een lage CO_2-uitstoot bij stadsvernieuwing in Nederland (hoofdstuk 5)?

2.3 Wat zullen naar verwachting de gevolgen zijn van energiecertificaten in het kader van De Europese Richtlijn voor Energieprestatie van Gebouwen (EPBD) op de bestaande woningen in het Verenigd Koninkrijk, en hoe kunnen deze gevolgen worden gemaximaliseerd (hoofdstuk 6)?

3. Is ingrijpender interventie door de overheid mogelijk en noodzakelijk voor het verbeteren van de energiezuinigheid van de bestaande woningen in de EU, en welke benadering zou het meest waarschijnlijkst resulteren in een effectieve, rendabele en legitieme responsstrategie voor het verminderen van de wereldwijde uitstoot van broeikasgassen binnen de woningsector?

3.1 Hoe kan de Europese Unie een bijdrage leveren aan het vergroten van de energiezuinigheid binnen de woningbouwsector, aanvullend op de maatregelen van de lidstaten zelf (hoofdstuk 7)?

3.2 Hoe moeten nationale en lokale overheden in de EU wetgeving, fiscale instrumenten en informatie gebruiken binnen hun beleid voor het verminderen van CO_2-uitstoot vanuit bestaande woningen, en welke rol kan De Europese Richtlijn voor Energieprestatie van Gebouwen (EPBD) daarbij spelen (hoofdstuk 7)?

3.3 Hoe kunnen eigenaren van sociale huurwoningen in de EU hun bestaande beleid voor energiezuinigheid verbeteren om de wereldwijde uitstoot van broeikasgassen vanuit bestaande woningen te verminderen (hoofdstuk 7)?

3.4 Wat zou een goede indicator zijn van een maatschappelijke respons op de vermindering van CO_2-uitstoot binnen de woningbouwsector (hoofdstuk 7)?

Aanpak van het onderzoek

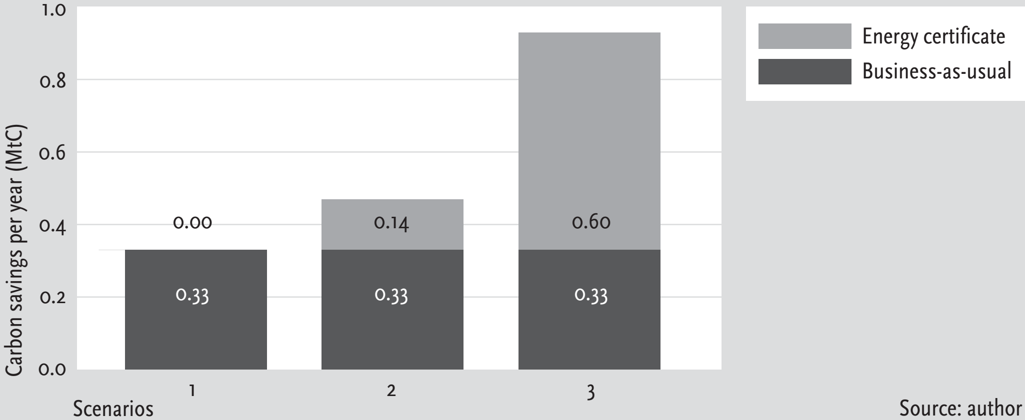
Op basis van de vraagstelling is het onderzoek onderverdeeld in drie hoofdthema's: beleid en implementatie (vraag 1: beleid), respons (vraag 2: actie) en aanbevelingen voor het beleid (vraag 3: responsstrategieën). Het eerste thema is kwalitatief van aard, het tweede kwantitatief. Om de eerste vraag over het beleid te beantwoorden, worden het huidige beleid, de regelgeving en de fiscale instrumenten binnen de EU-landen geïdentificeerd tijdens een analyse van de beleidsvoering in de praktijk op basis van een omschrijving en uitleg van het huidige beleid (hoofdstuk 2). Het betreft hier een synthese van casestudy en vergelijkende analyse. De nadruk ligt bij de analyse op inhoudelijke aspecten, aangezien processen per land verschillen. De nadruk ligt bij de implementatie op de gebruikte beleidsinstrumenten (hoofdstuk 2 en 3). Het onderzoek is gebaseerd op de meest gehanteerde onderverdeling van beleidsinstrumenten in drie verschillende soorten: directe wet- en regelgeving, economische hulpmiddelen en communicatiehulpmiddelen (Kemp, 2000; Driessen en Glasbergen, 2000; Murakami et al., 2002a). De gegevens over beleid en implementatie zijn afkomstig uit de belangrijkste beleidsdocumenten, interviews met experts en literatuur uit de betreffende EU-landen, voorafgegaan door interviews en een breder onderzoek (naar de vergelijkingsjaren 2000-2005). Vraag 2, over respons, komt aan bod in het empirische gedeelte van het onderzoek: een kwantitatief onderzoek naar de handelingen die het huidige beleid genereert (hoofdstuk 4-6). Het empirische gedeelte van het onderzoek is onderverdeeld in drie modules: een managementonderzoek in hoofdstuk 4, twee casestudy's over stadsvernieuwing in hoofdstuk 5 en een analyse van de verwachte gevolgen van De Europese Richtlijn voor Energieprestatie van Gebouwen (EPBD) (EC, 2003) in hoofdstuk 6. De eerste module van het empirische gedeelte behandelt duurzaam woningbeheer in de context van het Nederlandse beleid (hoofdstuk 2). De evaluatie van de respons op de in 1998 door de Nederlandse sociale-woningbouwsector, regering en overige partijen aangegane Het Nationaal Convenant Duurzam Bouwen (Sunikka en Boon, 2002) is gebaseerd op gegevens uit het onderzoek voor deze overeenkomst. In de tweede module van het empirische gedeelte worden twee casestudy's van stadsvernieuwing in Nederland gepresenteerd. Er wordt onderzocht welke technische, economische en implementatietechnische obstakels een rol spelen bij het gebrek aan doortastendheid bij het verminderen van de CO2-uitstoot. Hierbij wordt de benadering op basis van de 'energietriade' gehanteerd, aangezien dit concept grote bekendheid geniet (Duijvestein, 1998). Bij de eerste casestudy (Hoogvliet, Rotterdam) lag de nadruk op de eerste stap – het voorkomen van overbodig energieverbruik. Bij de tweede (Westelijke Tuinsteden, Amsterdam) lag de nadruk op de tweede stap – het gebruik van niet-eindige bronnen voor warmte en elektriciteit. De derde module van het empirische gedeelte is het vooruitblikkende onderdeel van het onderzoek, waarbij de nadruk ligt op De Europese Richtlijn voor Energieprestatie van Gebouwen (EPBD), dat in 2003 is geïntroduceerd als het belangrijkste beleidsinstrument voor energiezuinige woningbouw in de EU en in 2006 in alle lidstaten moet zijn geïmplementeerd (EC, 2003; Beerepoot en Sunikka, 2005; Sunikka, 2005). In hoofdstuk 6 wordt de implementatie onderzocht van een systeem van EPBD-energiecertificaten in het Verenigd Koninkrijk door middel van een kwalitatief onderzoek, een kwantitatieve analyse en een bespreking van de meest waarschijnlijke – alsmede de meest wenselijke – gevolgen in het Verenigd Koninkrijk.

Bij de beleidsadviezen in hoofdstuk 7 ligt de nadruk op de gevolgen voor nationale overheden. Gezien de aard van het onderzoek zullen de gedane aanbevelingen naar alle waarschijnlijkheid in eerste instantie worden toegepast op de EU-landen. Het onderzoek gaat uit van een aantal fundamentele aannames, waarmee tijdens het beoordelen van de resultaten rekening moet worden gehouden. Neoklassieke economen hanteren twee definities van duurzaamheid wat betreft natuurlijk kapitaal: zwakke duurzaamheid en sterke duurzaamheid. Sterke duurzaamheid wil zeggen dat ieder verlies aan natuurlijk kapitaal dat voortvloeit uit met gemeenschappelijke middelen gefinancierde projecten wordt gecompenseerd door schaduwprojecten die natuurlijk kapitaal van gelijke waarde creëren, zodat het totaal aan natuurlijk kapitaal constant blijft of de mogelijkheid heeft om te groeien (Bowers, 1997). Zwakke duurzaamheid wil zeggen dat de milieugevolgen van particuliere beslissingen worden geïnternaliseerd door middel van belastingen en de publieke investering, wanneer aan de milieueffecten een monetaire waarde wordt toegekend, een kosten-batenanalyse kan doorstaan. De in dit onderzoek aanbevolen incrementele verbeteringen hebben allemaal verband met zwakke duurzaamheid. Bij het onderzoek wordt duurzame ontwikkeling bekeken vanuit een antropologische in plaats van ecologische invalshoek. Er wordt gestreefd naar een balans tussen menselijke behoeften en de belasting van het milieu. In een bebouwde omgeving hangt deze samen met het idee dat de bouwkwaliteit in verhouding moet staan met de gevolgen voor het milieu (Murakami et al., 2002b). Duurzaam bouwen wordt gedefinieerd als het streven om de schadelijke milieugevolgen te verminderen die voortvloeien uit de bouw, de gebouwen en de bebouwde omgeving (MVROM, 1990). In plaats van veel aandacht te besteden aan de potentiële energie die ligt opgesloten in gebouwen en bouwmaterialen, een maximaal gebruik van energie uit duurzame bronnen, of energiezuinige apparatuur, ligt bij dit onderzoek de nadruk op het verbeteren van de thermische prestaties van het gebouw zelf, aangezien dat als essentiële eerste stap wordt beschouwd in de richting van gebruik van duurzamere energiebronnen, zoals warmtepompen, waarbij tegelijk het wooncomfort wordt vergroot. Het verbruik van elektriciteit door huishoudelijke apparatuur valt buiten het kader van deze analyse, aangezien het verbruik van producten niet kan worden vergeleken met het verbruik van een gebouw.

Conclusies

Het eerste deel van de probleemdefinitie is gewijd aan het huidige beleid voor duurzame bouw: wat is dit, en hoe werkt het (hoofdstuk 2 en 3)? Uit de beleidsanalyse komt naar voren dat overheden in de lidstaten van de EU langzaam de belangrijke rol beginnen te erkennen die bestaande woningen spelen bij het verminderen van CO_2-uitstoot (hoofdstuk 2). Als preventieve beleidsmaatregelen erop zijn gericht om nieuwe constructies te beschermen tegen verval, terwijl bij herstellende maatregelen de nadruk juist ligt op het verstrekken van subsidies voor het bijwerken van bestaande woningen teneinde de energiezuinigheid te verbeteren, dan kunnen de in hoofdstuk 2 en 3 beschreven beleidsmaatregelen worden beschouwd als preventief in plaats van herstellend. De meeste Europese overheden vinden het weliswaar niet noodzakelijk om het stadsvernieuwingsproces te subsidiëren en reguleren, maar dat geldt kennelijk niet voor het verbeteren van de milieuprestaties en energiezuinigheid van bestaande woningen, waarvoor zij doorgaans wél actie ondernemen. De huidige benadering van het beleid in de lidstaten van de EU wordt gekenmerkt door de sturende rol van de markt, waar men ervan uitgaat dat energiezuinige verbeteringen de waarde van onroerende goederen verhoogt. Daarnaast wordt voor de energiecertificaten van het Energy Performance of Building Directive (EPBD) van de Europese Gemeenschap alsmede andere nieuwe beleidsinstrumenten (hoofdstuk 6) grotendeels vertrouwd op de begaanheid met het milieu van particuliere partijen. Dit proces is afgestemd op de vrije markt, aangezien er geen ingrijpen van de overheid nodig is in de individuele besluitvorming bij projecten. Dit is in overeenstemming met de voorkeur van de meeste EU-overheden voor deregulering. Dergelijke voorkeuren zijn gebaseerd op de perceptie van de vrije markt als hulpmiddel voor het aansturen van milieutechnische verbeteringen, zelfs al ontbreekt het kennelijk aan marktdynamiek en zelfs al zijn grootschalige verbeteringen aan het energieverbruik van het bestaande woningaanbod niet bepaald aantrekkelijk voor investeerders. Een beleid voor duurzame bouw op basis van vrijwilligheid en de vrije markt brengt echter het risico met zich mee dat alleen sterk gemotiveerde personen actie zullen ondernemen.

Sensitivity analysis: annual reductions in carbon emissions (MtC) resulting from energy certificates in existing housing in addition to business-as-usual (0.33 MtC) in the UK



Source: author

In het tweede deel van de probleemstelling komen de maatregelen aan bod die zijn genomen als respons op de huidige benadering van het overheidsbeleid en de voornaamste oorzaken voor het gebrek aan doortastend optreden, waarbij Nederland en het Verenigd Koninkrijk als voorbeeld worden gebruikt (hoofdstuk 4-6). Uit het empirische gedeelte van het onderzoek lijkt naar voren te komen dat – ondanks het milieubeleid en de positieve houding van woningbouwverenigingen – de huidige benadering van het beleid, die is gebaseerd op vrijwillige maatregelen en de energieprijzen (hoofdstuk 2 en 3), slechts in beperkte mate succesvol is gebleken bij het stimuleren van duurzaam woningmanagement binnen de Nederlandse sociale woningbouw, dat zelden boven het niveau uitkomt dat is gespecificeerd in de bouwvoorschriften (hoofdstuk 4 en 5). Sinds 1993 heeft het duurzaamheidsmanagement van deze verenigingen zich maar beperkt doorontwikkeld, en na 1998 zelfs nauwelijks meer (hoofdstuk 4). Uit de interviews uit de in hoofdstuk 5 gepresenteerde casestudy's komt naar voren dat milieutechnische verbeteringen alleen worden overwogen 'mits er geen extra kosten zijn' of 'indien mogelijk'. Het feit dat er economische obstakels zijn voor het vergroten van de energiezuinigheid en het verminderen van de CO_2-uitstoot, wijst op een beperkt gebruik van belastingen als beleidsinstrument. Ondanks stijgende energieprijzen blijft de netto actuele waarde van investeringen negatief tot aan de volgende interventie voor energiezuinige maatregelen (hoofdstuk 5). Bij de tweede casestudy werd de overstap van aardgas naar districtverwarming bemoeilijkt door de fragmentatie van de belanghebbenden en de verdeelde verantwoordelijkheden binnen een beleidsnetwerk. Wat betreft de in hoofdstuk 5 geïdentificeerde obstakels blijkt uit de gevolgenanalyse van de implementatie van De Europese Richtlijn voor Energieprestatie van Gebouwen (EPBD) dat energiecertificaten voor huishoudelijke apparaten, hoewel deze relatief succesvol zijn gebleken, minder effectief zullen zijn in bestaande woningen (hoofdstuk 6). Als de energiecertificaten van het EPBD slechts als communicatiemiddel worden gebruikt, zal de CO_2-beperking het huidige niveau naar alle waarschijnlijkheid niet ontstijgen. De meest optimistische toepassing in scenario 3 zal naar verwachting op jaarbasis een vermindering van 3% opleveren van de totale vraag naar de verwarming van ruimtes (25,6 MtC) in bestaande woningen in het Verenigd Koninkrijk, en een vermindering van 2% van de totale vraag naar energie van huishoudens (41,4 MtC) (zie figuur op voorgaande pagina). Dat zou een waardevolle bijdrage betekenen. Uit het streven van de overheid van het Verenigd Koninkrijk om de CO_2-uitstoot in 2050 met 60% te hebben teruggedrongen blijkt echter duidelijk dat de huidige beleidsvormen hoogstens een incrementele verbetering zullen opleveren en naar alle waarschijnlijkheid niet zullen leiden tot radicale (of adequate) verandering.

Gezien de obstakels (hoofdstuk 4-6) zal een beleidsbenadering op basis van een combinatie van hiërarchie (macht die voortvloeit uit regeringsbevelen) en netwerken (macht die voortvloeit uit samenwerking) zeer waarschijnlijk effectiever zijn dan een benadering op basis van de markt (macht die voortvloeit uit bronnen) voor het aanpakken van het huidige gebrek aan doortastendheid wat betreft de energiezuinigheid van bestaande woningen. Gezien de verschillen qua woningaanbod en beleid per land wordt geadviseerd de bijdrage die de EU levert aan het beleid van de nationale overheden strategisch van aard te laten zijn in plaats van operationeel. Gezien het gebrek aan doortastendheid wat betreft de energiezuinigheid van bestaande woningen, moeten nationale en lokale overheden een actieve rol gaan spelen bij het stimuleren van duurzame bouw, en dergelijke zaken niet overlaten aan marktpartijen met winstoogmerk. Er mogen waarschijnlijk goede resultaten worden verwacht van nieuwe regelgeving in combinatie met standaards voor energiecertificaten (hoofdstuk 6). Een onroerend-goedtransactie is een mogelijk interventiepunt voor regelgeving, aangezien een dergelijke transactie gelegenheid biedt om inspecties te koppelen aan juridische en wettelijke procedures. Daarbij moet echter in ogenschouw worden genomen dat dit kan leiden tot een stijging van de transactiekosten. Er kunnen echter niet zomaar nieuwe regels worden toegepast op het bestaande woningaanbod, aangezien de meeste energiebesparende maatregelen nog niet rendabel zijn (hoofdstuk 5). Het feit dat huishoudens met een laag inkomen een buitenproportionele meerderheid vormen van de bewoners van de minst energiezuinige woningen in de Europese Unie (Whyley en Callender, 1997; Clinch en Healy, 1999) geeft al aan wat de eerste voorwaarde is voor een haalbaar energiezuinigheidsbeleid voor het bestaande woningaanbod. Er zijn economische stimulansen nodig om ervoor te zorgen dat regelgeving geen problemen veroorzaakt voor huishoudens met een laag inkomen of ethisch in strijd is met het recht op huisvesting. Sommige van de in dit onderzoek beschreven beleidsinstrumenten (bijvoorbeeld preferent krediet, belastingaftrek, hypotheekregelingen of compensatie van grondprijzen bij energiezuinige verbeteringen – zie hoofdstuk 3 en 6) kunnen mogelijk een oplossing vormen voor dergelijke kwesties. Het is wellicht mogelijk om deze maatregelen te combineren met energiecertificaten, zodat de certificaatniveaus A/B/C/D/E/F (analoog aan de energieclassificatie van huishoudelijke apparatuur) elk een stimulans opleveren, op voorwaarde dat een verbetering de energiezuinigheid van de woning met één niveau verhoogt (bijvoorbeeld van C naar D – zie hoofdstuk 6). De naleving van nieuwe regelgeving voor de thermische prestaties van bestaande woningen is met name een probleem, aangezien de autoriteiten niet van alle renovaties op de hoogte hoeven worden gesteld, en de kwestie van sancties bij het niet naleven van de regels vraagt om nader onderzoek. Lokale overheden spelen een belangrijke rol bij de implementatie van beleid voor energiezuinigheid, aangezien daarbij veel aandacht moet worden besteed aan steun, de beschikbaarheid van leningen en het faciliteren van de implementatie.

Het laatste gedeelte van de probleemstelling handelde over de behoefte aan een goede responsindicator binnen de context van het verminderen van de uitstoot van broeikasgassen vanuit woningen – met name binnen het 'Pressure-State-Response'-model (OECD, 1993a) – als maatschappelijke respons op klimaatverandering (energie als milieuprobleem) en zucht naar onafhankelijkheid (energie als economisch probleem). Uit het onderzoek blijkt de discrepantie tussen het beleid (respons 1: output), zoals besproken tijdens de kwalitatieve analyse in hoofdstuk 2 en 3, en de actie die is ondernomen als respons op dat beleid (respons 2: resultaten), zoals besproken in hoofdstuk 4 tot en met 6. Het gedrag van de gebruiker bepaalt uiteindelijk de belasting van het milieu. Hieruit blijkt hoe belangrijk het is om een indicator te vinden om de kwantitatieve resultaten van het beleid te evalueren (met andere woorden, de jaarlijkse investering in energiezuinigheid in monetaire termen, met de energieconsumptie ingedeeld naar type woning en de CO_2-verminderingen die als gevolg van de investering zijn gerealiseerd), evenals de kwalitatieve output (dat wil zeggen, de formulering van milieubeleid, de implementatie van 'energiemaatregelen' zonder referentieniveau, zoals de vereisten vermeld in bouwvoorschriften).

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Minna Marjaana Sunikka was born on August 8th, 1972 in Espoo, Finland. She studied architecture at Tampere University of Technology (TTY) and Institut Supérieur d'Architecture Saint-Luc de Bruxelles (ISASLB) and worked as an intern at offices in Switzerland, Finland and Hungary. She received her Masters in Architecture in 1998. After graduation she was employed by VTT Building and Transport in Finland where she focused on Environmental Impact Assessment and the management of environmental properties in real estate management. In 2000, she moved to the Netherlands to do policy-oriented research and consultancy on energy efficiency in buildings at OTB Research Institute for Housing, Urban and Mobility Studies, Department of Sustainable Housing Management and Quality Assurance. She did her doctoral studies at Delft University of Technology (TUDelft) in 2000-2006, involving a research period at the Environmental Change Institute (ECI) at the University of Oxford, and spent much of her time travelling in Australia, Asia and Europe. Her ideas on reducing energy consumption in buildings have resulted in a design and construction of an energy efficient house in Finland and consulting the building industry on environmental policy developments in Europe. After completing her PhD research in September 2006, she accepted a post as University Lecturer at the University of Cambridge Department of Architecture and a Fellowship in Architecture at Churchill College.

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According to EC forecasts, if energy efficiency could be increased 1% annually until 2010, two-thirds of the potential energy saving in the EU could be achieved. This would comply with 40% of the EU's Kyoto obligation to reduce greenhouse gas emissions by 8% on the 1990 level by 2010-12, by cutting 200 million tonnes of CO_2 emissions per year. Improving energy efficiency in existing buildings is often considered to be one of the most cost-effective ways of cutting carbon emissions. Current policy measures, however, seem to be decided with little reference to the specific needs of renovation in the housing sector instead of basing policy measures on detailed sets of requirements and actual costs. The research provides information for national governments in the EU on how to improve their sustainable building policies so as to increase carbon reductions in the existing housing stock. It addresses the question of the extent to which stronger government intervention is possible and necessary for circumnavigating barriers and the policy approaches that are likely to be feasible, effective, cost-efficient and legitimate.

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