Policies and regulations for sustainable building

A comparative study of five European countries

Minna Sunikka

HOUSING AND URBAN POLICY STUDIES 19

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Foreword

This report was written as part of the Sustainable Housing and Management research project. That research project was conducted within the framework of the Delft Interdisciplinary Research Centre, 'The Ecological City', which carries out pioneering research on the Sustainable Built Environment in the Delft University of Technology.

When I first begun working with the theme of sustainable building in Finland, I became involved in developing environmental assessment methods and other activities focused on building-related matters. Gradually, I became more and more convinced that achieving proper results in the environment requires a more extensive perspective, than an inward-focused approach restricted to new construction, and preferably government intervention. The scope of my research began to extend to policy issues. In order to gain a better understanding of the complex concept of sustainability, I decided to examine national strategies for sustainable building, their implementation and their impact in practice. Consequently, this report presents an extensive, up-to-date overview on government policies for sustainable building, environmental building regulations and tools in five European countries. This report also discusses environmental efforts in the social housing sector related to those policy programs.

This research project was conducted in the OTB Research Institute for Housing, Urban and Mobility Studies in Delft, under the outstanding supervision of Professor André Thomsen, engineer, Dr. Geert Vijverberg, engineer, and Ms. Gerda Klunder, engineer. I would also like to thank the following people and institutes for their assistance to this research project:

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Minna Sunikka
Delft, 28 November 2001

Contents

1 Introduction

1.1 Research objective

Sustainable building is an essential factor in achieving sustainable development. The Kyoto Protocol will increase pressure to launch concrete efforts towards reducing the carbon dioxide emissions from buildings, which account in the European Union for over 40% of the total energy consumption, and 30% of CO_2 emissions (CIB, 1999). 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 million tonnes 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).

For this reason, a great deal of research has focused in recent years on sustainable building. However, ambitious policy plans and research findings are adopted very slowly in daily practices in the construction industry, where the concept still remains vague and peculiar. Also, the importance of the existing stock is very slowly recognised, despite the fact that new construction adds annually only around 1% to the total building stock. In fact, both government authorities and the construction industry seem to lack a clear view of the objectives of sustainable building.

The achievement of a sustainable built environment begins with a systematic policy plan. Ideally, that plan should be acceptable to the public *and* private sectors. To offer a better understanding of the entire process involved in launching an effective government policy, this research report describes one chain of actions and impacts: sustainable building policy, its implementation through mandatory building regulations and voluntary tools, and its (potential) impact on the social housing sector. As the most important environmental problems are global, and major environmental issues, such as climate change and the depletion of natural resources, demand an international approach, developments should proceed in an effort to learn from others. This report compares national strategies for sustainable building in the Netherlands, Germany, France, the United Kingdom and Finland.

This report is geared towards everyone interested or involved in sustainable building and offers a broader perspective on the subject. It is based on an inventory drawn up in connection with the Sustainable Housing and Management research project. That project is part of the Delft Interdepartmental Research Centre, The Ecological City, as well as one of the key projects of the Delft University of Technology.

1.2 Research approach

This research project seeks to describe national strategies for sustainable

building in five European countries: the Netherlands, Germany, France, the United Kingdom and Finland. The strategies are presented and compared in relation to three aspects; these are examined in order of decreasing level: the government policy for sustainable building, the policy implementation through building regulations and tools, and the environmental response in the social housing sector.

This research project was based on a descriptive approach. It also takes into account the nature of government programmes and environmental policies in the social housing sector, which usually have qualitative and not quantitative goals. This report does not include any data about the effects of the national programmes, as such information was impossible to compile within the given time frame. Moreover, some of the countries have yet to collect consistent information about the impact of their strategy programmes.

The Netherlands, Germany, France, the United Kingdom and Finland were selected as representatives of the most advanced sustainable building in Europe. This was based on their interesting policies, which use comparable, yet different, approaches. This group of five countries was chosen in a gradual selection process that began with fifteen countries. As members of the European Union, these countries have similar political conditions, and share a certain consensus about the concept of sustainable building that makes consistent comparison possible. They also enjoy economic growth, which has been associated with increased energy consumption, and therefore, makes environmental targets urgent, yet very difficult, to achieve.

The approach to this research focused on sustainable buildings, not on urban planning. To ensure consistency in the descriptions, this report focuses on four generally recognised themes of sustainable building: energy saving, materials and waste management, and water conservation. These research themes, which are also emphasised in building regulations, are important elements in sustainable building. They also have essential environmental impacts, and are measurable and manageable.

However, sustainability involves many aspects. Although this research project recognises the environmental, economic, social and cultural dimensions of sustainable development, it has limited the focus on environmental aspects, as those aspects are already a focus of government policies. Therefore, within these resources, it was not possible to focus equally on softer and descriptive issues of sustainable building, such as spatial quality or flexibility. In some countries, the question of whether or not they belong to the concept of sustainable building is still a topic of debate.

Descriptions of environmental efforts in the social housing sector focus on the state of affairs in sustainable housing management. Housing management includes several activities, such as maintenance, renovation, refurbishment and demolition, as well as new construction. In this research project, sustainable housing management was defined as follows: new construction,

maintenance, renovation, adaptation and demolition of housing, in which the activities involved, the consumption of energy, water and materials, as well as the production of waste and CO_2 emissions, place the least possible strain on the environment.
This report is useful to everyone interested in gaining a wider view of sustainability policy, its application and impacts on one sector. However, it is assumed, that a reader understands the relation between main construction activities and their environmental impacts. Basic environmental impacts are not described in this report.

National strategies for sustainable building
Descriptions of national strategies begin with an explanation of general environmental policy and energy strategy, which serves as the framework for sustainable building policy. For example, energy conservation plans can bear a direct relationship to insulation requirements in building regulations or subsidy criteria for renovations. For this reason, environmental policy has been studied in order to identify what dimensions of sustainable development it recognises, and what contributing role the construction sector has in it. Energy policy is described in terms of primal energy sources and the amount of renewable energy. Certain national characteristics that have a major impact on varied strategies have been introduced within environmental policy.
Next, the public policies for sustainable building, which will be considered in the development of legislation, administrative procedures and action programs, are described. National strategies are examined in relation to national emphasis, concrete objectives and the programme's approach to the environmental improvements in the existing housing stock. This analysis on the national strategies has two main objectives. It aims to highlight certain national features in order to suggest an effective governmental approach, and to point out future challenges for the housing sector. A description has also been included of the approach to policy implementation, be it mandatory or voluntary. After all, this factor may influence the results achieved.
This report focuses on a few key issues regarding the public programmes for sustainable building. By limiting the study on government documents and initiatives, it is possible to maintain consistent information.
The study on national strategies for sustainable building aims to answer the following questions:

1a How is the construction sector related to the national environmental policy and energy strategy?
1b What are the concrete objectives and main approach in the national strategy for sustainable building?
1c Is the strategy also suited to the existing stock?

Implementation of the national strategy

Public policy for sustainable building influences mandatory regulations, and voluntary research activities, such as the development of tools. These two aspects, legislation and tools, are studied as measures for implementing government strategy.

Building regulations are often seen as an efficient way to force current construction towards more sustainable practice. With respect to pushing factors, this research project focuses on regulations instead of such issues as environmental taxes. After all, regulations can have an impact on all new construction. Environmental requirements in legislation are studied, focusing on building-related aspects and the research themes described earlier: energy saving, materials and waste management, and water conservation. The options for environmental benchmarking between countries are also examined.

Tools that evaluate the environmental impact of buildings can support sustainability in decision-making, and are thus conducive to the implementation of government priorities in daily practice. Other pulling factors include subsidy systems and incentives for sustainable building. However, these measures are not discussed extensively in this report.

Tool descriptions are restricted to methods suited to qualitative or quantitative assessments of the environmental qualities of plans, methods than can support sustainable decision-making. These descriptions do not include checklists, design guidelines and the like. Four tools from each country are presented and compared in relation to their area of application, such as development activity or spatial scale. This report also examines their capacity to support sustainability in housing management. The tools selected meet various requirements. For one thing, they are national, were developed or updated recently, and are used in construction practice. Their approaches take account of national priorities for sustainable building. These tools are also useful in identifying areas well covered by regulations and those requiring more attention in the future. This is essential in situations where it is felt necessary to focus on areas not covered by regulations in developing tools.

Each study on regulations and tools concludes with a discussion that examines the relationships between government policy, regulations and tools, as well as the potential impact on the social housing sector.

The study on regulations and tools seeks to answer the following questions:

2a What principal requirements are formulated in the building regulations in order to support the national strategy regarding energy saving, materials and waste management, and water conservation?

2b What are the characteristics of the four national tools for environmental impact assessment in relation to the national strategy and sustainable housing management?

Social housing sector

Environmental efforts in the social housing sector were studied with a view to gaining a better understanding of the potential impact of government strategy in practice. Social housing was selected as a focal sector because of its great potential to offer environmental benefits: the government can push social housing towards sustainability, using such means as subsidies. Moreover, in theory, environmental improvements in such a large segment of housing would make it possible to achieve remarkable results. As new construction adds only about 1% annually to the total building stock, the real potential for sustainable building lies in stock management, an area left largely ignored in current research and development activities.

This report focuses on environmental policies in the umbrella organisations contacted for further information. The characteristics of social housing, volume and the nature of the umbrella organisations in each country are presented first. This is followed by a discussion of environmental efforts, such as covenants, and the research and renovation strategies undertaken in the umbrella organisations. A number of tools are presented in relation to the environmental policy. However, these are not compared in any detail since they were intended for very specific users and often focus on economic - rather than wider sustainability - aspects. All in all, this study does not present a consistent comparative study, but highlights a few environmental activities.

The study on the social housing sector aims to answer the following questions:

3a What environmental policies relevant to public strategy for sustainable building do the umbrella organisations have as regarding social housing providers?

3b Has the social housing sector established any environmental agreements with the government and has it engaged in research & development in the field of sustainability?

Comparative analysis and conclusions

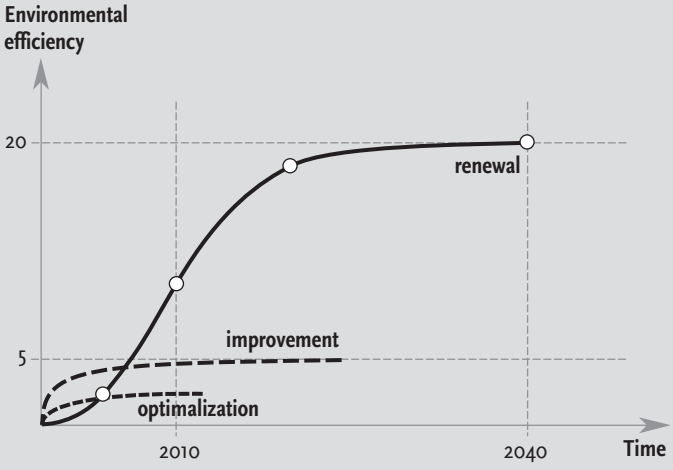
This report concludes with a comparative analysis of the Netherlands, Germany, France, the United Kingdom and Finland. This analysis focuses on identifying measures conducive to effective policy. The comparison, conclusions and following recommendations are based on the same structure of policy, implementation and impact on social housing sector, as the country descriptions.

In addition to the previous research questions, the conclusions aim to address these questions:

4a What can we learn from these public policies and regulations for sustainable building in terms of developing an effective approach?

4b What measures for sustainable housing management should we adopt in

Figure 1.1 Development levels with respect to environment efficiency in time



Source: DTO, 1997, edited by OTB, 2000

light of the experiences in the social housing sectors of the Netherlands, Germany, France, the United Kingdom and Finland?

This research project focused in on government programs, building regulations and a number of other key publications that describe national approaches to sustainable building. The main sources of information regarding the social housing sector were the umbrella organisations for social housing providers in each country.

The inventory presented here was compiled in connection with a research project on Sustainable Housing Management. This project is being carried out by the Delft Interdepartmental Research Centre, 'The Ecological City', an interdisciplinary research programme at the Delft University of Technology. The Ecological City aims at minimising input (e.g. primary energy, materials and water) and output (e.g. emissions, waste, public nuisance and dilapidation), in urban areas, striving to improve environmental efficiency with the Factor 20 by 2040. The environmental burden per unit of welfare must be reduced with an average factor of 20 in order to keep the burden on the environment within the biosphere's capacity to supply essential raw materials, to absorb environmental pollution and to ensure an acceptable quality of life (Teunissen, 1999).

1.3 Contents

As members of the European Union, the Netherlands, Germany, France, the United Kingdom and Finland are committed to the same international policies. Chapter 2 of this report presents the most important international agreements on sustainable development. These same agreements lie at the foundations of – and are referred to throughout – national policies. Chapters 3-7 present the national strategies for sustainable building. The country overviews are similar in structure. Each chapter begins with a section concerning environmental policy, which is presented as background information. This first section seeks to answer research question 1a (see 1.2). The next section describes national strategies for sustainable building in terms of political measures and concrete objectives; its focus lies on addressing questions 1b and 1c.

The third section discusses strategy implementation. This section begins by presenting the environmental requirements in the building regulations and four tools to support sustainability in decision-making. The focus then shifts to the relationships between government strategy, building regulations and tools, and the impact on the social housing sector. This section aims to answer research questions 2a and 2b.
Finally, examples of environmental efforts in the social housing sector are discussed in light of the environmental policies of the national umbrella organisations. National differences in social housing are examined in this regard. This section focuses in on research questions 3a and 3b.
Country-specific conclusions are formulated at the end of each chapter.
Chapter 8 is an integration of the country chapters. It presents a comparative analysis with much the same structure as that described above. This analysis focuses in on public policies for sustainable building, environmental building regulations and tools, and environmental policies in the social housing sector.
Conclusions and recommendations are presented in chapter 9. This chapter aims to draw conclusions, based on the country descriptions, regarding measures for an effective policy. It also introduces a number of issues for future consideration. Chapter 9 addresses research questions 4a and 4b.

2 Common background for sustainable development

2.1 Introduction

National environmental policies cannot be developed in isolation. This chapter touches briefly on a few international environmental initiatives. These initiatives lie at the foundations of the national strategies and have had a major impact on their policies and politics. As European Union members, the Netherlands, Germany, France, the United Kingdom and Finland, are committed to the same policy of sustainable development (as defined in Agenda 21), and to the implementation of international agreements, such as the Kyoto Protocol. Agenda 21 is described in section 2.2, and the Kyoto Protocol in section 2.3. These countries are also required to implement the European Union directives in their national legislation. The European Union's environmental policy is described in section 2.4. Conclusions are presented in section 2.5.

2.2 Agenda 21

One important milestone in the development of environmental policy was a report entitled *Our Common Future* by the World Commission on Environment and Development in 1987. As called the Brundtland report, this report introduced the concept of sustainable development and established a clear link between poverty, illiteracy, sluggish economic development and environmental problems, including climate change and depletion of the ozone layer. The Brundtland report defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCDE, 1987).
During the United Nations Rio Summit in 1992, *Agenda 21*, an action program was formulated for the 21st century. Agenda 21 established a common agreement about the concept of sustainable development between different countries, and made that agreement known. According to its definition, sustainable development has social, economical and institutional dimensions. Agenda 21 contains principles to tackle both the development and the environmental problem (UN, 1992). However, it is a very general document, and has, therefore, been interpreted in several local and sectoral agendas with more concrete objectives. In 1996, the construction sector was linked to Agenda 21 with the establishment of the *Habitat II Agenda*, which was defined in the United Nations Conference in Istanbul. The Habitat II Agenda includes several sections that deal specifically with the construction industry and describes how governments should encourage the industry to behave (UNCHS, 1996).
In order to support sustainable development, the CIB, the International Council for Research and Building Innovation, published its *Agenda 21 on Sustainable Construction* in 1999. This Agenda aims to provide a framework that defines links between the general concept of sustainable development and

the construction sector. As regarding the promotion of sustainable building, it sees the following as major concerns and challenges: managerial and organisational aspects, product and building-related issues, resource consumption, the impacts of construction on sustainable urban development, the environmental burden and social, cultural and economic issues. Regulation, energy pricing, enabling and support mechanisms, incentives and demonstrations, measures to change market demand, and research themes are introduced as possible strategies (Bourdeau, 1999).
The concept of sustainable development is still relatively new, but the United Nations considers important that the progress towards, or away from it, it is regularly monitored. The Rio +10 Conference, which is being held in Johannesburg in 2002, will review the results achieved in sustainable development following the establishment of Agenda 21. Most countries have already begun preparing their national reports and have developed a set of national sustainability indicators. The Johannesburg conference is not being held to revise Agenda 21, but aims to seek consensus on the assessment of current conditions and further priorities, and to strengthen commitment to achieve the agenda's goals.

2.3 Kyoto Protocol

Carbon dioxide emissions, and climate changes caused by it, are seen as a major threat to the environment. In order to prevent dangerous effects on the climate, the temperature change should not exceed 0.1 degrees per decade. According to the most optimistic data, however, the surface air temperature will increase by 2 degrees in 2100 unless corrective action is taken. What is more, the latest research findings indicate that the surface air temperature will rise by 3-6 degrees. To ensure a safe level, worldwide CO_2 emissions must be reduced by 50% by the year 2050. Industrialised countries have a duty to take more responsibility and increase conservation even further, achieving reductions of 70 to 80% over this period. In 1997, *The Kyoto Commitment*, which defines targets and time-scales for the industrialised countries to reduce the CO_2 emissions and control climate change, was adopted on the basis of the United Nations Framework Convention on Climate Change. All countries included in this study have signed the Kyoto commitment, in which industrialised countries 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, Finland and France 0%, the Netherlands -6%, the UK –12,5% and Germany –21%. The comparison years cited are 1990 and 2010 (UNFCCC, 1992).

The problem is that the Kyoto Protocol will only enter into force after it has been ratified by at least 55 parties. So far, only 30 countries, all of which belong to the developing world, have ratified the Protocol. The climate change conference, which was organised in The Hague in November 2000, failed to result in the establishment of an agreement between different parties, and the negotiations to ratify the commitment were pushed forward. The United States, which is responsible for 40% of all CO_2 emissions from industrialised countries, announced in March 2000 that it does not intend to ratify the Kyoto Protocol, at least not in the coming four years. Nevertheless, negotiations will continue in Bonn in July 2001, and the European Union has taken an active role in negotiating with other countries to join the Protocol.

2.4 European Union Policy

In principle, the European Union is very committed to sustainable development. 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 also required the incorporation of the protection of the environment into all relevant legislation (EU Amsterdam Treaty, 1997). 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 launches Environmental Action Programmes approximately once every five years in order to guide the environmental process. The *Fifth Environmental Action Programme* was implemented between 1993 and 1998. The *Sixth Environmental Action Programme* entitled *Environment 2010: Our Future, Our Choice*, was recently introduced. It seeks new and innovative instruments for meeting environmental challenges, and more effective use of legislation together with more participatory approach to policy making (EU, 2001).

The European Union imports about half of its energy requirements; the UK and the Netherlands are the only net exporters. Energy policies vary between member states. France relies on nuclear power, whereas Germany, France and the 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. The plan to set the CO_2 tax has not yet gained enough support from all parties, but the discussion on it is ongoing.

Several directives aim at energy saving and efficiency in buildings. In addition to these, the SAVE and ALTENER programmes emphasise energy saving in construction. Development of environmentally friendly technology is supported with the JOULE-THERMIE program. The *Electricity Market Directive* (96/92/EU) aims to open 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 European Union is preparing to implement the Kyoto commitment as a community. The objective of the Commission is to double the amount of renewable energy resources in the EU energy balance from 6% in 1995, to 12% in 2010.

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 are now being 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. 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 that should be in operation in the EU in 2005. This Directorate also introduced the *European Climate Change Programme*, ECCP, which seeks to unite the different parties involved in an effort to reduce CO_2 emissions for mutual benefit.

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. This 'EU flower' is currently being renewed. 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 reuse 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 the 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).

Between 1970 and 1990, the total loss of biodiversity on earth was estimated at 30%. This issue is one of the main concerns in European Union environmental policy. The most important EU directive concerning nature protection is the *Habitat Directive* (92/43/ETY). By protecting biodiversity and ensuring living environment for different species, the directive has a direct impact on planning and construction activities. Under this directive, all projects with a significant environmental impact, such as power plants, highways or harbours, must undergo an environmental impact assessment before project plans are implemented. In some countries, the environmental impact of large housing developments also has to undergo assessment.

In 1985, the EU adopted the Directive about Environmental Impact Assessment, which has had a considerable impact on revising national planning legislation.

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.

2.5 Conclusions

Since most serious environmental problems are global, developments in sustainable building must be considered from an international perspective. As EU member states, the Netherlands, Germany, France, the United Kingdom and Finland are committed to the same policy of sustainable development, a policy established by agreement Agenda 21. Under Agenda 21, sustainable development is recognised to have social, economical and institutional dimensions. Although the implementation of this document is voluntary, it has been a major influence in the development of national strategies.
Currently, the most important international initiative is the Kyoto Protocol, which had a direct impact on national energy strategies and legislation even before its ratification. Despite the United States' disappointing decision not to ratify the commitment, the Protocol – as a legally valid measure – is an

interesting example of a pushing factor for the future when environmental problems will require radical action. It will require the industrialised countries to reduce the level of their CO_2 emissions in 1990 by 5.2% between the years 2008 and 2012. The construction sector, which accounts for over 30% of the CO_2 emissions in the EU, will play an important role in achieving this target.

The EU's mandatory policy is presented in directives, which member states are required to incorporate into their national legislation. The Union has also defined environmental policies as regarding voluntary factors and actively funds research programmes. However, given the opportunities that the Union offers for environmental co-operation, the concrete results have been relatively modest thus far.

3 The Netherlands

3.1 Introduction

This chapter offers an overview on sustainable building policy and regulations in the Netherlands. The structure of this chapter, and subsequent country chapters, is described in section 1.3. Section 3.2 begins with some background information about environmental policy. National policy on sustainable building in the Netherlands is stated in three action plans, which are described in section 3.3 along with other key measures. Section 3.4 presents examples of policy implementation through building regulations, and four Dutch tools developed to support sustainability in decision-making. To offer a better understanding of the possible impact of the policy on the social housing sector, section 3.5 examines the environmental efforts of Aedes, the umbrella organisation for Dutch housing associations. This chapter concludes with a summary and discussion in section 3.6.

3.2 Environmental policy

In 1988, the Netherlands responded to the Brundtland report with a report entitled *Zorgen voor Morgen* (Concern for Tomorrow), which describes environmental problems in the Netherlands. According to the report, reductions of 70 to 90% in emissions were necessary to achieve sustainable development (RIVM, 1998). The First National Environmental Policy Plan, *Kiezen of verliezen*, (Choose or Lose), was defined in 1989 on the basis of the report. This plan stated that the concept of sustainable development involves more than conserving a pristine environment. It also involves striking an optimal balance between socio-economic developments and nature and the environment, a balance that takes account of future generations. The message of the First National Environmental Policy Plan, NEPP, was that it is possible to solve many environmental problems within one generation, i.e. before 2010, (MVROM, 1989).
The *Second National Environmental Policy Plan* was introduced in 1993; it underscored the importance of separating the issues of pollution and economic growth (MVROM, 1993). In 1998, the European Union also adopted this principle of absolute decoupling. The *Third National Environmental Policy Plan,* which focused on promoting prosperity and welfare, was established in 1998 (MVROM, 1998). These National Environmental Policy Plans have been monitored and the findings show that the targets for emission reductions are attainable. However, the CO_2 targets were not attainable within set time limits using the methods applied. Nevertheless, the government has no intention of abandoning the programme objectives, but will extend the time frame instead. The Dutch government has allotted an extra 2.6 billion NLG for solving environmental problems between 1998 and 2010. This provision was

made in its policy program for 2000-2004, which was announced recently.
In 2001, the government presented the *Fourth National Environmental Policy Plan*. This plan extends to the year 2030, and focuses on the relationship between the quality of life and the environment. The plan emphasizes the international context in the environmental policy, and looks beyond the Dutch borders. Its objectives will have an impact on housing, in terms of resource consumption and land use. The quality of the built environment is one target, as is biodiversity, which is now implemented in the national ecological network.
Because of its high population density and ever-decreasing space, efficient land use is a crucial concern in the Netherlands. In 1999, the population density in the Netherlands was 384 inhabitants per km^2, which makes it one of the most densely populated countries in the world. Most of the Dutch population lives in the central and western provinces, a region called the *Randstad*. The population density there is approximately 1200 inhabitants per km^2. The Randstad includes the four largest cities in the Netherlands: Amsterdam, The Hague, Utrecht and Rotterdam, which is also the world's largest port. It covers an area comparable in size to Los Angeles. The cities and villages have grown so close that it is often difficult to tell where one ends and the next begins. It is one of the most important economic regions in Europe. The Netherlands is a small country that covers a surface of 42,000 km^2. Approximately 9% consists of water, and over 70% is used for agriculture. Infrastructure, housing and places of employment account for another 12% of the surface area.
Strong economic growth continues to put more pressure on new construction, and threatens the country's green, open areas. An unsustainable trend set in during the seventies: a continuous demand for space, space used for residential purposes and open, public areas surrounding residential facilities. The volume growth of the Gross Domestic Product (GDP) in 2000 was 3.9%, while the average economic growth rate for the European Union was 3.3%. The building industry also profited from the growing prosperity. In 2000, the construction sector increased its turnover by 10% as compared to 1999. This was the fourth consecutive year in which the growth rate was near the 4% range (CBS, 2001). Unemployment in the Netherlands has dropped by more than 50% in the last four years and is now remarkably low. In 1998, the unemployment rate was 4.4% of the work force (Haffner & Dol, 2000). The strong economy has made the task of achieving environmental objectives very challenging.

In 1998, the total primary energy supply in the Netherlands consisted of: oil (40.6%), coal (24.3%), gas (21.1%), nuclear energy (12.2%), renewable sources (1.2%), hydro energy (0.4%) and other sources, such as geothermal, solar and wind (0.1%) (IEA, 1998). Although the Netherlands has two nuclear power stations, the Dutch government plans to phase out nuclear power; both stations will be closed in 2004.

The energy from renewable sources is strongly supported by the government. The aims laid down in the *Third Policy Document on Energy* include promoting renewable energy sources and reducing the consumption of fossil fuels by 10% in 2020. The national government aims to cover 10% of energy consumption with sustainably produced energy. Wind power is one option in this regard. By 2020, it should be possible to produce about 2,750 MW, which is sufficient for an estimated 750,000 households (Ministry of Economic Affairs, 1997). Obstacles to more efficient use of wind energy include a lack of space, a need for spare capacity and aesthetic damage to the landscape.

3.3 National strategy for sustainable building: Action Plans and National Packages

In the Netherlands, sustainable building is referred to as *Duurzaam Bouwen*, commonly abbreviated as *Dubo*. The development of sustainable building started in the seventies with a number of experiments involving energy saving in buildings. These experiments, however, were prompted more by the economic interests arising from the oil crisis than by sustainability principles. *Dubo* accelerated in the eighties, at which time building materials become a special focus of attention. A series of demonstration projects, such as Ecolonia, were also conducted. And a growing interest in sustainability resulted in large-scale projects all over the Netherlands. During the nineties, sustainable measures that required no advanced technology were broadly applied in large housing projects. More innovative measures were restricted to experimental projects. This cautious approach resulted in a very slow increase in the scope of sustainability in the building sector (Joosten, 1995).
Since 1989, the construction industry has a major target group in environmental policy. The appendix to the *National Environmental Policy Plan Extra*, elaborates on the policy directions outlined above for the building sector. The following goals were established as a result:

- To pay explicit attention to the environmental consequences of building methods and building products in all stages of the building process.
- To reduce the use of finite natural resources and to contribute to the sustainable use of tropical forests.
- To double the re-use of waste from construction and demolition sites from 3 million tonnes in 1986 to 6 million tonnes in 2000, and to increase the re-use values of materials.
- To replace materials that have a significant impact on the environment consequences with respect to the extraction, the use or the waste stage.
- To increase by 25% the conversation of the energy used to heat buildings in 2000.
- To achieve good indoor environment quality (MVROM, 1990).

The national policy for sustainable construction has been defined in the *Action Plan for Sustainable Building*, Investing in the Future, which was published in 1995 (MVROM, 1995), as well as in the *Second Action Plan for Sustainable Building* in 1997 (MVROM, 1997a). The goals established concern the following four areas: harmonisation (creating clear and unified information), implementation (application of the information in practice), consolidation (embedding sustainable building in daily practice) and preparation (preparation of new visions and innovations). So far, the most successful actions have taken place in the first area.

The *National Packages for Sustainable Building* have been available for residential building since 1995 and are now well known in the construction sector. In 1998, 61% of all building permits adopted some measures from the Packages. At that point in time, the prognostications for 2000 put that figure at 80% (MVROM, 1999a). The National Packages are a collection of common measures and recommendations aimed at achieving sustainable building. In 1999, various sets of measures were published for new and existing housing, non-domestic buildings, urban planning and civil infrastructure. The sustainability measures for housing involve the following phases: initiative, design and development, preparation of production, application and use. The subjects examined include materials, energy, water and the indoor climate. The introduction of the packages brought about consensus about the definition of sustainable measures in the construction industry and among product manufacturers, developers and government authorities. However, the average reduction in the environmental burden achieved by means of measures in the National Packages is still relatively modest (Blaauw & Klunder, 1999). Another important step in disseminating information was the establishment of the *Nationaal Dubo Centrum*, the Centre for Sustainable Building, in 1996. This centre was set up to offer the construction sector objective information on sustainable building.

The Dutch Government also uses incentives to encourage sustainable building. The *Green Investment* initiative, for instance, helps to promote sustainable construction. An environmental point system is used in housing projects. This system allows borrowers with a qualifying score to take out lower-interest loans, which, in turn, makes sustainable construction more attractive. Since 1996, Green Investment provisions have applied to new construction as well as renovation projects. In other words, housing improvement loans are available at an interest rate lower than the common standard. Today, these provisions are used by housing associations among others. To qualify for a lower-interest loan, the residence in question must meet high requirements with respect to material use, energy consumption, water consumption and the quality of the indoor environment. Applications are judged on a scale based on the *National Package for Sustainable Housing Management*. Different points are allocated to the measures in this package. A renovation or refur-

bishment project must score a minimum of 125 points (Novem, 2000). Since early 2001, a new subsidy, the *Energy Premium Regulation*, EPR, has been available for all homeowners, including housing associations, and can also be used for renovation purposes. For example, thermal insulation, low energy glazing and photovoltaic systems are part of the EPR. Housing is rated with an energy performance assessment (EPA) and an extra 25% subsidy is granted for all recommended measures.
Novem, the Knowledge Centre for Energy and the Environment, carries out energy research and works an intermediary between the government and industry. Novem also grants subsidies for research projects and energy conservation projects using experimental techniques. Other institutions that play a significant role in the building sector include the SEV, the Netherlands Steering Committee for Experiments in Housing, which focuses on experimental housing, and the SBR, the Foundation for Construction Research, whose building research is funded by industry.
Several environmental agreements have been established between the government and market parties. In 1993, the Environmental Council for the Construction Industry, the MBB, the Government and the construction industry, adopted the *Policy Declaration on Environmental Targets*. The agreement on Tropical Wood limits the use of tropical hardwood to that originating from regions that practice sustainable forest management. The environmental negotiation group for the construction industry is a discussion forum in which different parties can establish common goals. Traditionally, decision-making in the Netherlands is based on a consensus approach. The government prefers discussions and information dissemination to methods of coercion. The construction sector itself prefers decisions to be formulated in terms of performance requirements. This gives them the freedom to choose solutions themselves. However, the model where objectives are lowered until everyone agrees can also slow down advancements in sustainable building.

The construction sector consumes about half of the energy used annually in the Netherlands. The Dutch government has undertaken to reduce the energy consumed to heat buildings, using 1989 as its comparison year. The target reduction for 2000 was 23%; the minimum corresponding figure for the period between 1995 and 2020 is 35% (Ministry of Economic Affairs, 1997). The goal for the residential sector is a 25-million ton reduction in CO_2 emissions between the years 2000 and 2012. According to the RIVM, the National Institute of Public Health and the Environment, the average residence in 2020 will consume 25% less energy as compared to 1995. However, overall energy conservation will diminish due to the volume effect, i.e. the increase in the number of residences.
The Netherlands produces some 15 million tonnes of construction and demolition waste each year. Approximately 90% of that, 13.5 million tonnes is re-

used as secondary materials. Roughly 11.5 million tonnes of waste from other industries is used in the building industry. Thus, the total amount of waste used in the construction industry comes to some 25 million tonnes each year. That figure accounts for approximately 18% of the raw materials needed in the industry. In other words, the construction industry uses more waste than it dumps. Re-using secondary materials can involve negative effects. Occasionally, for instance, additional materials are needed, as is additional energy to break stony fragments, etc. (Van Dijk & al., 2000).

The current policy aims to reuse the waste in its own cycle and at the highest possible level. In 1980, the government introduced an order for waste treatment procedures, which was called the *Ladder of Lansink*. That was later developed into the more flexible *Delft Ladder*. The order proceeds as follows: prevention, construction re-use, element re-use, material re-use, useful application, immobilisation with useful application, immobilisation, incineration with energy recovery, incineration and landfill (Boone, 1999). Prevention aims to prevent the production of waste, and must to be taken into account before demolition. This so-called *Design For Recycling* (DFR) can be conducted by using dismountable building systems or easy-to-separate recyclable/renewable materials that can be used in their own material cycle.

In its housing policy, the Dutch government stresses the importance of tenant participation. This was also presented in a recently released draft document from the secretary of state on housing, *Nota Wonen* (MVROM, 2000d). Stimulation of tenant participation is seen as essential to achieving a successful refurbishment process. The Open Building approach, which aims to enlarge consumer involvement in mass housing, has been developed in the Netherlands since the seventies. Over the years, various building products and tools have been developed. The *Industrial Flexible and Demountable Building Programme* (IFD), which falls in line with Open Building, was initiated in 1997. The government encourages IFD building; the underlying idea is promoted primarily by means of demonstration projects. However, despite interesting initiatives in practice, Dutch sustainable building policy allows little room for adaptability.

The current policy for sustainable building in the Netherlands focuses on urban development, consumers and energy. A new trend has emerged, in which attention in sustainable construction has shifted to the urban level, where further developments are taking place and many more aspects of sustainable development can be taken into account. Because of the high population density, efficient land use is an important aspect in sustainable building. This is strongly reflected in the set of indicators that the Netherlands has developed for urban planning and the construction industry. One category in this set is efficient use of space: use of space, building density, changes in compactness per type of living area and compactness. The Dutch government will discontinue its programmatic approach after 2004, by which time sus-

tainable building is expected to be part of the common policy. However, despite a well-defined series of policy plans, much effort is still needed to accomplish a broad application and firm establishment of sustainable building in daily construction practice.
Despite extensive subsidies, the energy efficiency of the existing stock is still fairly poor. Although the potential for energy saving in the existing stock far exceeds what is feasible with even the most effective new construction techniques, government strategies and regulations still focus on new construction. Recently, changes have been devised with a view to introducing a more updated, stock-focused policy. However, these changes have yet to be implemented.

3.4 Implementation of the national strategy

This section focuses on the implementation of the national strategy. Section 3.4.1 begins with a description of environmental requirements in building regulations. The measures for energy saving, materials and waste management and water conservation are studied in light of the research themes here. Section 3.4.2 then discusses four Dutch tools, which present different aspects of environmental assessment for the built environment and can support sustainable housing management. Public strategy has an impact on building regulations and tools, which also influence the social housing sector. These relations are discussed in section 3.4.3.

3.4.1 Environmental building regulations

Building regulations in general
The *Housing Act* in the Netherlands dates to 1901. The revised Housing Act, which regulates all housing in the Netherlands, entered into force in 1992. For technical requirements, the Act refers to the *Building Decree*. The Building Decree, which lays down the minimal nationwide requirements for building, was issued by the central government and entered into force in 1993. Technical demands are expressed as performance requirements; this allows some freedom in design and construction to meet requirements. A clause is included for exceptional solutions that do not meet certain requirements. However, the solution must be demonstrated to the relevant municipality be equivalent to the standards set by the performance requirements (Visscher & Meijer, 2001).
The building codes in the Building Decree fall into four categories: health, safety, functionality and energy-efficiency. In 1995, the energy efficiency category was expanded to include a general measure: *Energie Prestatie Coëfficiënt* (EPC), which is described below under energy saving. There are future plans to

integrate sustainable building standards, which are based on the National Packages for Sustainable Building, into building regulations. Although sustainability has been discussed as a fifth possible category since 1998, efforts towards that end have yet to take shape. The sustainability codes are still under review. In 2002, an amended version of the Building Decree will be published.
The sectoral approach that once characterized Dutch environmental legislation was replaced in 1993 by the integrated *Environmental Management Policy*. This policy document includes chapters concerning environmental planning, environmental impact assessment and waste management.
The *Environmental Planning Act* aims to ensure the best possible balance between the need for space in a particular area, and demands set by the society. The environmental impact of the implementation of certain building projects must be evaluated. This does not apply to individual housing projects, but concerns development areas containing over two thousand buildings, or four thousand buildings in a city district. The objective is to use assessment results as a major factor of consideration in decision-making.

Energy saving
The overall consumption of energy in buildings forms the main focus of thermal regulations. In 1995, the *Energie Prestatie Coëfficiënt* (EPC), or energy performance coefficient, was introduced. The EPC measures energy efficiency in buildings. Architects or engineers submitting building plans to local authorities are required to include an EPC calculation. Although this includes target values, it does not limit measures for achieving those values. This type of performance-based approach allows designers to select the optimum design solution from among many options. The EPC presents the energy efficiency of a building, and takes into consideration space heating, tap water heating, lighting, ventilation, humidification and cooling. It is one of the few energy measures that take into account the energy resource used. The EPC value is calculated by dividing the characteristic use of energy of a building by characteristic energy performance, which depends on loss area, heated floor area and building type. The lower the value, the more energy-efficient the building is. The EPC may not exceed a certain fixed value. The performance standard for residences was tightened from 1.4 to 1.2, and even further later to 1.0 in the year 2000. The future goal is to sharpen it every two years. Whether or not this will actually be done, however, is still the focus of much discussion.
In the near future, municipalities will need to develop energy visions in which Energy Performance per Location is important. The EPL describes location-based CO_2 reduction and energy saving. The *Energy Performance Advice* (EPA) was developed for existing buildings and may be established as a mandatory standard for future building permits.

Materials and waste management

In the Netherlands, most of material-oriented building regulations focus on substances, not on materials or components. Mandatory substance regulations concern ozone-depleting substances, cadmium and asbestos, which are banned, and formaldehyde, the use of which in materials, such as chipboards, is limited. Material and life cycle-related building regulations concern the ban on dumping building and demolition waste, 'dangerous materials' and the ban on manufacturing asbestos and CFC- and Cadmium production and application. In the future, attention will shift towards more performance-based regulations concerning building. A prototype has been developed of a method to determine a building's environmental performance. This method is expected to be incorporated into the Building Decree in 2002.

Buyers and sellers of building products in the Dutch construction industry want information about the environmental performance of building products. As a result, several manuals and black and white lists have been developed. These relatively quick and easy sources have been widely used despite the contradictory information they offer. This has been due to discrepancies in criteria. Moreover, the checklists have been criticised for being too subjective and narrow. The Dutch zinc industry, to name an example, responded furiously when zinc was placed on the list of substances to avoid in the Manual for Sustainable Housing (Anink & Mak, 1993). The building industry, in its turn, has undertaken to provide environmental information about products and materials themselves. This initiative resulted in the *Environmentally Relevant Product Information*, MRPI. Manufacturers have to go through the MRPI procedure in a certified research institute in order to obtain an MRPI for their product.

Reduction of waste and encouragement of recycling are important issues in Dutch national policy. The *Building Materials Decree*, which entered into force in 1996, sets mandatory regulations regarding hazardous building and demolition waste, the use of the building and demolition waste for civil works and recyclable demolition waste. The Building Materials Decree was introduced to ensure optimal re-use and protection of soil and water in areas with room for a potential conflict of interests. The decree also links material emissions to soil contamination. The application of secondary materials should always be accompanied with an assessment of the long-term environmental impact of materials on the soil. Strict regulations in the Building Materials Decree that ban on dumping recyclable waste ensure that 80% of the materials are re-used in other constructions. The 1993 Policy Declaration on Environmental Targets includes reduction, separation and secondary use targets for demolition waste.

The *Demolition and Construction Wastes Landfill Ban* was introduced in 1997. It prohibits landfilling with re-usable or burnable demolition and construction waste and the use of unprocessed waste. One objective is to promote the separation of construction waste into component streams that are transported to

processing plants rather than taken outside the construction industry cycle. The Landfill Ban also applies to the residues from construction and demolition waste processing methods, such as sorting and crushing. Landfill operators are permitted to accept residues only from certified companies and demolition contractors that separate waste at source and are required to take non-reusable materials to a sorting plant before they can transport it to a landfill site. This costs them more and can make at-source separation less attractive. However, together with the quality requirements of the Building Materials Decree, the Landfill Ban has improved the acceptance and processing of demolition and construction waste (Van Dijk & al., 2000).
Waste disposal in the Netherlands is organised mainly at the provincial level. Provincial authorities can include regulations in their *Provincial Environmental Ordinances* in order to implement their own *Provincial Environmental Policy Plans*. Provinces may adopt more stringent environmental policies than the general policy. However, their policies must remain within the constraints imposed by the general quality requirement laid down in Orders in Council and other regulations. The provinces regulate the disposal of commercial wastes through their Environmental Ordinances. Commercial wastes may not be transferred between provinces unless an exemption is obtained. This because the provinces want to prevent unnecessary waste transport and to ensure that the processing plants and landfill sites in their province are used.

Water conservation
Dutch building legislation lays down no mandatory regulations for quality improvement in the discharge of waste and rainwater. However, the 1993 Policy Declaration on Environmental Targets for the construction sector does include agreements regarding water conservation devices in buildings. Incentives are used to promote water conservation equipment, such as in showers and toilets. However, their use is not required in the building regulations.

3.4.2 Tools to support sustainability in decision-making

Duwon
Duwon is a method useful to housing associations in establishing sustainability as an element in their housing policies (SEV, 1997). Duwon is intended to create a link between the housing association's strategic policy and practical implementation of the environmental measures in the National Packages for Sustainable Housing, New Construction and Management. The housing provider obtains support for decision-making at all levels. Five tools have been developed to facilitate decision-making:

- A step-by-step plan, which gives sustainable management form and content. Consisting of four phases, this is the most important of these tools, and the others support it.

- Draft plans that specify strategies and measures.
- Theme pages that provide supplementary information on specific topics.
- Interior Environment Measures, which provides a method for determining the environmental quality of the interior of a complex.
- The EE method, which clarifies the advantages and disadvantages to energy-saving measures.

Duwon recognises sustainability ambitions, strategies and drafts. Sustainability ambitions are objectives that give direction but are not task-descriptive, as there are always specific situations that apply. The three ambition levels vary from high sustainability objectives in complexes with a long-life span, to relatively low ambitions in the case of a short remaining life span and a limited budget.
Sustainability strategies are geared towards the environmental objectives, which must be achieved through sustainable housing management. These strategies seek to ensure careful use of primary materials, ecosystems and space, to prevent harmful emissions to the air, water or soil, and to limit health risks. Sustainability strategies consist of basic guidelines, which do not refer to specific measures, but give general directions. These strategies fall into three main categories: sustainable maintenance, raising environmental quality and extending life span. Each of these categories is subdivided into more strategies.
To simplify the choice of measures for a certain problem or strategy, drafts were developed. Drafts serve as directions in seeking solutions. They indicate whether further investments should be made in a complex, and if so, to what extent. They are also useful in determining how long a complex should continue to operate. A draft can be adapted according to specific requirements in a complex. In total, six drafts have been distinguished: maintenance, consolidation, revalidation, conservation, restructuring and a mixed approach. Strategies and drafts have been linked and a package of measures has been defined for complexes.
The step-by-step plan is the most important measure. The other tools cited above support it. This plan consists of four phases:

- Phase 1. Policy at the housing stock level. This phase takes place in the beginning of a strategic housing stock policy. Sustainability ambitions are established for the entire housing stock. This can be done, for example, with energy saving targets, or an average score of the measure for the interior environment. Objectives can be set more specifically later when all phases have been completed.
- Phase 2. Policy on the complex level. In this phase, sustainability policy and ambition level is developed per complex. In addition to the market and financial data from the housing stock policy, technical information, such as insulation, is necessary in order to determine the current environmental

quality and potential of the housing stock. Each complex is given a 'rentability label' in form of stable, critical and unstable. The Duwon tool makes fourteen strategies available for different complexes on the basis of their construction year and other data collected per complex. Based on this data and the budget, ambitions can be fine-tuned and drafts selected.

- Phase 3. Policy and implementation on the complex level. The policies from the first phase are now further developed into a specific and verifiable level, for example energy saving expressed in m^3/kWh per year. The drafts per complex are developed into a general improvement plan. The previous phases must be repeated regularly to ensure that the measures are up-to-date.
- Phase 4. Developing the maintenance improvement plan at the complex level. In this phase, the general improvement plan is developed into a working plan: a management or renovation plan. The budget is established. The sustainability measures are described based on the ambitions and strategies established in previous phases. The environmental impact is formulated in concrete terms for each measure: water, interior environment, energy and material choices. The Duwon measures or those included in the National Packages for Sustainable Housing can be used. Current conditions and progress are indicated.

According to its developers, Duwon is an intervention that takes place between policy formation and policy implementation at the operational level. Duwon can be applied at that level, but requires a large amount of data about the housing stock. It is more practical to use it in the beginning of the strategic housing stock policy. Duwon is currently being revised.

Environmental Classification

The Environmental Classification method categorises building materials. During the period in which the Dutch government was encouraging environmental assessment, Dutch environmental policy was strongly product oriented. For that reason, the environmental assessments began focusing on building materials. Classifications and checklists were developed with a view to making environmentally sound choices; the Environmental Classification is an example. Materials are evaluated on the basis of eight criteria: energy use, exhaustion, deterioration, emissions, health, durability, reuse and processing. Seven performance levels are described, based on which building materials are assigned anywhere from one to seven points. The total number of points determines the categorisation into one of five classes. Class 1 means 'preferably apply' and class 5 means 'dissuaded'. The final score is determined by weighing factors (Haas, 1995).

The use of Environmental Classification is not limited to certain parties, building sectors, or process phases like renovation. It can be used in housing management for design management, or environmental benchmarking purposes.

Eco-Quantum

The EcoQuantum tool was developed to measure the environmental performance of building on the basis of life cycle assessment. It is a computer-aided tool, which calculates environmental effects during the whole life cycle of a building. Eco-Quantum takes into account extraction of raw materials, production, construction, operation and demolition, or re-use, phases. It expresses the evaluation results through thirteen environmental effects: depletion of raw materials, fuels and the ozone layer, the greenhouse effect, depletion, acidity, nutrification, human toxicity, ecotoxicity, photochemical oxidant formation, energy, harmless, harmful and radioactive waste. The flows of energy, materials and water are taken into account. The objective is to determine, to analyse and to improve the environmental performance of a building (Mak & al., 1996).

Eco-Quantum is targeted for the design phase and architects form the main target group. In housing management it can be used to evaluate the environmental impact of new buildings, In the near future, it will also be adapted for renovation.

GreenCalc

The GreenCalc method calculates what it would cost to prevent damage in the construction and use of a building. It also makes use of the life cycle assessment methodology, but is not limited to this. LCAs often are incomplete due to missing data. GreenCalc has introduced the TWIN concept, which combines available quantitative data with estimated qualitative data. Moreover, it is not limited to energy, materials and water, but also takes mobility aspects into account. Finally, it does not express the results in environmental effects, but in environmental costs (Stichting Sureac, 1997).

GreenCalc is used mostly for office buildings and is limited to new construction. However, with some adaptations, it can also serve housing managers as a useful, thorough approach.

3.4.3 Discussion

Public policy for sustainable building in the Netherlands considers building regulations important in terms of strategy implementation. The requirements concerning building and demolition waste are especially stringent. However, current environmental requirements apply only to new construction, where the volume of the total stock is very small. Therefore, the results attainable with building regulations are very limited, and the large volume of the social sector has not been achieved. The government's objective in the near future is to integrate measures from National Packages in legislation.

Table 3.1 describes characteristics of four Dutch tools in terms of their areas of application, i.e. development activities and the issues and scale covered.

Table 3.1 Characteristics of four Dutch tools

Characteristic	Duwon	Classification	Eco-Quantum	GreenCalc
Development activity				
New construction		x	x	x
Renovation				x
Management	x	x		
Issues				
Environmental	x	x	x	x
Economic	x			
Social				
Spatial level				
Material level		x	x	x
Building level	x		x	x
Urban level	x			x

Environmental Classification is limited to the material level, whereas EcoQuantum assesses the building level based on a life cycle analysis. GreenCalc also takes account of qualitative data and describes the environmental burden in terms of costs. The table shows that the tools studied focus mainly on building-related issues, new construction and environmental qualities of buildings. They do not cover social or economic aspects. Methods are available in the Netherlands to support sustainable management processes, such as Duwon, which focuses primarily on the existing stock and aims to integrate environmental aspects in traditional housing management. In the future, new tools must be created for sustainable urban development and for building renovation projects.

3.5 Environmental efforts in the social housing sector

This section examines the social housing sector in the Netherlands in terms of how the umbrella organisation has responded to the Action Plans for Sustainable Building. Section 3.5.1 offers background information about social housing in the Netherlands, and section 3.5.2 describes environmental agreements and other initiatives launched by the umbrella organisation.

3.5.1 Social housing in the Netherlands

Public housing in the Netherlands includes what is called social housing: non-subsidised, but affordable, rental accommodations. These residential units are built and managed by housing associations and municipalities. The large, though slightly decreasing, volume of social housing in the total stock, and its positive image, are typical of the Netherlands, and is interesting in terms of research and development activities. In 1999, 75% of the total rental stock (some 2.3 million residences) consisted of social housing; 17% of the newly completed dwellings were built for the social housing sector (Haffner & Dol, 2000). Government influence in this sector is on the decline. *Aedes* is the Dutch national umbrella organisation for social housing providers.

3.5.2 Umbrella organisation and sustainability

Given the definitions of their social tasks, the housing associations have felt responsible for the environment for some time. They themselves have been searching for ways to promote sustainability (Quist & Van den Broeke, 1994). However, what has actually been achieved in practice has not been much more than what the government prescribes. The main barriers that have prevented sustainability from really becoming established in common practice in housing management have been a lack of knowledge, appropriate instruments and good, clear-cut information (Luten & Van Bakel, 1997). These barriers should have been overcome with the introduction of the National Centre for Sustainable Building and various instruments, such as the National Packages (see 3.3.1). However, financial considerations have also played an important role. A gap has remained between environmental measures; this requires extra investments and housing provisions for low-income groups.
A few years ago, Aedes established the Sustainable Management project group. The group's aims included developing a strategy for implementing sustainability in management processes, and establishing a policy-level action plan to apply the strategy throughout the entire organisation. According to the group, strategic housing stock policy, which requires a more dynamic approach from the housing associations, offers a solid basis for the implementation of sustainable management, and long-term maintenance plans are opportunities for housing associations. The project proposed various strategies for housing associations. These are listed below.

- Incorporating sustainable management in strategic housing stock policy. This strategy was further developed; Duwon was created for this purpose.
- Promoting environmental improvements in housing.
- Developing a consultation structure to intensify residents' participation at the project and district levels.
- Developing a stimulating government policy.

In 1997, Aedes drew up an agreement on behalf of its members; in it, they committed themselves to sustainable construction. Eight parties adopted the agreement, including: the Ministry of the Economic Affairs, the Ministry of the Environment, Woonbond, EnergieNed, the Association of Water Boards, and Novem, the Knowledge Centre for Energy and the Environment. Below is a summary of points included in the agreement with respect to renovation and management:

- The housing associations shall apply the National Packages for Sustainable Building, both for housing and management.
- For the period 1998-2001 the management shall invest in sustainable construction measures in the approximate amount of 1.6 billion NLG, an annual average expenditure of 166 NLG per residential unit.

- In the total housing stock, including new construction, water saving measures must be taken with respect to 1995 and 15% energy saving achieved.
- When renovation takes place, the ground floor must be brought in line with the Building Decree requirements.
- Lead water pipes must be replaced in at least 24,000 dwellings.
- In addition to these points, housing associations must go beyond these objectives wherever the opportunity presents itself.

In 1999, Aedes published the *Manual for Sustainable Construction and Management* in co-operation with Novem. This manual aims to provide housing associations with a method to incorporate the objectives in the agreement into the environment policy plan at the housing association level. The manual consists of two parts: a step-by-step plan with sustainability as one element in quality assurance policy, and a model environmental policy plan. Aedes emphasises the involvement of both the employees and the tenants. The step-by-step plan is based on a classification of environmental themes and phases in the life span of a dwelling. The plan begins by drawing up an inventory of the organisation, knowledge and interests, the housing stock and environmental policy regulations. This generates a priority list of environmental issues. The environmental policy can then be formulated based on the list. Next, procedures are established at the housing association level. The last step is a strategic consideration per complex, a task in which Duwon comes in handy.

Implementation of the 1997 agreement in housing associations was monitored in 1998, and a second evaluation was carried out in 2001. According to the findings in 1998, the housing associations spent an average of 4,000 NLG for sustainable building measures in new construction, mainly for energy savings and materials, and 177 NLG in the existing residential units, including for energy efficiency. In addition to these costs, housing associations spent an extra 122 million NLG for asbestos removals. In 1998, over 2 million units were adapted with water conservation measures, bringing annual water conservation to 3 million cubic metres. Lead water pipes were replaced in 6,332 dwellings, and 14,000 ground floor dwellings underwent renovation because of radon. Only the energy targets in the agreement were not achieved. The objective was to save annual 46 m^3 gas per dwelling; the actual figure in 1998 was 23 m^3. Aedes is very concerned about achieving this target, and is working with the energy sector to find affordable solutions for the existing stock. According to the monitoring results, housing associations are positive about implementing sustainability measures in both new and existing buildings. However, they do not see sustainability as an objective as such, but one aspect of quality management, strategic stock policy and urban renewal. The problem is that environmental investment costs can be unreasonable, and housing associations cannot, or will not, pass them on to the

Considering the importance of efficient land use in the most densely populated country in Europe, the environmental impact of buildings has not been linked clearly enough to urban renewal.

tenants. Subsidies would be needed, therefore, in order to maintain the moderate rental rates (Weismann, 2000).

3.6 Conclusions

The construction sector has been a target group for environmental policy in the Netherlands since 1989, and three Action Plans have been published for it. Financial incentives support information dissemination by the National Centre for Sustainable Building and the National Packages. All in all, Dutch government policy is beginning to develop into fairly sophisticated strategy.
However, the current policy is focused on new construction, and devotes far

too little attention to the environmental problems of the existing stock. Moreover, considering the importance of efficient land use in the most densely populated country in Europe, the environmental impact of buildings has not been linked clearly enough to urban renewal. The Dutch government will discontinue its programmatic approach after 2004, by which time sustainable building is expected to be part of the common policy. However, as sustainability is not yet, as such, a market value, it is unlikely that market actors will have enough resources to take the lead in promoting sustainable building.

When it comes to implementing public policy, the Dutch government does not rely solely on voluntary measures, such as information provision and subsidies. Moreover, its objective is to integrate sustainable building standards, based on the National Packages, into future building regulations. So far, the issue of sustainability has been presented in terms of the EPC, which measures energy efficiency of a building, and strict regulations for building and demolition waste, ensuring that 80% of all materials are re-used in other construction.

Several tools for environmental assessment have been developed in the Netherlands. However, more support is needed for sustainable renovation and management. Moreover, social aspects have not received sufficient attention. Linking basic cost properties with environmental planning could help to motivate the construction to use environmental assessment tools. Duwon is an interesting method. It seeks to create a step between strategic policy development and practical implementation of environmental measures. This makes it easier for housing associations to establish sustainability as an element in their housing policy.

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. Nonetheless, the governmental Action Plans for Sustainable Building do not set specific targets for the social housing sector in particular.

In 1997, the umbrella organisation, Aedes, entered into an environmental agreement with the government on behalf of its members. Aedes has also developed strategies that can help housing associations to translate the objectives of that agreement into environmental policy at the housing association level. Implementation of that agreement was monitored. According to the findings, the environmental objectives were reached, except for those concerning energy consumption. However, various research findings suggest that environmental investment in the social housing sector will require subsidies. Housing associations have also cited a lack of proper information as a barrier to sustainable management. Given the availability of the instruments described in this chapter, this indicates a gap between government policy and its implementation in the social housing sector.

4 Germany

4.1 Introduction

This chapter offers an overview of sustainable building policy and regulations in Germany. Section 4.2 begins by presenting information about long-term environmental policy. Section 4.3 describes the national strategy for sustainable building in terms of political measures and concrete objectives. Section 4.4 presents the implementation of the policy through environmental requirements in building regulations, on which the German policy heavily relies; this section also discusses four tools developed to support sustainability in decision-making. Finally, section 4.5 examines the response of the social housing sector: environmental efforts of VdW Bayern, the umbrella organisation for social housing providers in the state of Bavaria. Conclusions on the situation in Germany are formulated in section 4.6.

4.2 Environmental policy

In Germany, the first *Environmental Programme* dates to 1971, and environmental protection has been an important component of local policy over the past 20 years. According to the national government, the integration of ecological, economic and social concerns, protecting life's natural foundations, and ensuring the survival of present and future generations, are the fundamental dimensions of sustainable development. The umbrella concept offers the option of combating different problems with a combined approach to their social, economic and environmental aspects. In 1994, the principle of sustainable development was defined in Germany's constitutional law. This principle was expressed in terms of 'bearing responsibility for future generations'. In the same year, the German environmental policy was described in the *Environmental Policy* report.

In Germany, the environment is not the exclusive responsibility of the Ministry of the Environment. It is integrated in different departments. The Ministry of Foreign Affairs, for instance, has its own green program. Political awareness for the environment is great and increasing. The German Green Party, *die Grünen*, was established in 1985. The environment is high on the party's list of priorities. Germany has a strong, steadily growing economy, but is plagued by a continuous unemployment problem. In 1998, 9.8% of the workforce was unemployed (European Housing Statistics, 2000). At times, unemployment has taken political priority over ecological issues. Attempts have been made to tackle these two problems together in a way that ensures mutual benefit. *Plus for Employment and Environment*, a programme by the *IG Bauen-Agrar-Umwelt* and Greenpeace, has proven that environmental protection efforts can serve to create and maintain new jobs. Sustainable renovation has the potential to create some 400,000 new jobs in the building indus-

try and to decrease the CO_2 emissions by 6% (Wallbaum & al., 1999).
Germany is marked by very different geographical, economical and social areas. Some of the differences can be attributed to the reunification of the former DDR and BRD in 1990. West Germany is densely populated and has prosperous cities. In East Germany, by contrast, the *New Länder* face unemployment and an ever-diminishing population. In 1999, 472,800 residential units were permitted in Germany. Compared to 1998, this is a decrease of 5.6% (Federal Statistical Office, 2000). The number of residences has actually increased in West Germany, but decreased in East Germany. The structure of the existing housing stock is also different: there are more housing complexes in East Germany, and in West Germany, the inhabitants have more living space per person.
National Germany, the *Bund*, is divided into Federal Republics, *Länder*, and municipalities, *Kommunen*. Different Länder have their own political agendas. The population and economic growth are also concentrated in certain centres in Germany. For example, the Rhine-Main region around Frankfurt has 5.2 million inhabitants and a density of 1.238 people per km^2; 7.5% of Germany's gross domestic product is generated in the Rhine-Main region.
The total area of the Federal Republic of Germany measures 357,028 km^2. Agricultural land accounts for 54.1% of the total area; 29.4% of the country is covered with forests, and 11.8% is used for settlement and traffic purposes. Germany has the largest population in the European Union. According to forecasts for the year 2050, the population will decline by over 10 million people from the current figure of 82 million.

Germany is one of the world's largest energy consumers and has the largest electricity market in Europe. Because of limited domestic energy resources, it imports most of its energy. In 1998, 35.9% of the total primary energy in Germany came from oil, 34.2% from gas, 17.5% from coal, 11.3% from nuclear sources, 0.8% from renewable sources and 0.2% from hydro energy (IEA, 1998). Currently Germany ranks fourth worldwide in its installed nuclear capacity. Approximately 30% of the country's electricity comes from nuclear sources, an issue that has become controversial. In 2000, the national government agreed to gradually phase out nuclear power; all the 19 nuclear power plants in Germany will be closed around 2018. However, the contract does not prevent the import of electricity produced with nuclear power from other countries, such as France.
The direct consumption of energy in Germany has remained almost unchanged since the early nineties. The national energy policy has relied on energy taxes to cut CO_2 emissions, reducing the use of nuclear power and supporting renewable energy sources. The *Ecological Tax Reform* was introduced in 1999 to encourage energy saving and to promote renewable energy sources. The reform increased the price of energy and will continue until at

least 2003. The energy tax revenue is used to fund renewable energy projects (IEA, 2000). As a result of a different energy policy, West Germany has what is mainly a privately owned system of energy supply, with high standards of energy efficiency and a strong commitment to environmental protection. East Germany, by contrast, had a centralised and primarily state-owned energy sector, which depended on dirtier energy sources, such as primary fuel. Lately, progress has been made in bringing the eastern energy sector up to the standards of the west.

Thanks to its long-term environmental policy, Germany has managed to stabilise the consumption of energy and the regeneration of waste despite the 11.5% growth in the growth of its gross domestic product between 1991 and 1999. According to the statistics for 1999, economic activities placed less pressure on the environment than was the case at the beginning of the decade. The consumption of raw materials decreased by 3.2% after 1991 and energy consumption dropped by 1.8% during the same period. The discharge of CO_2 fell by 15% as compared to 1990, and the emission of acidification gases decreased by 56% between 1991 and 1998 (Federal Statistical Office, 2000). This means that Germany has succeeded in increasing the productivity of natural input factors, and thus, in cutting the link between economic growth and the consumption of natural resources. This absolute decoupling is also the objective of the European Union. Updating the industry in East Germany, and closing down factories has been an important factor in this progress. One reason is that the sustainability process has already been in progress for some time in Germany: much information is available, environmental measures have established in legislation and attitudes towards ecological values and green consumption are positive.
In citing these results, we should note that the progress is still not sufficient for really sustainable development. The *Sustainable Germany* report, which was published in 1997 by the Federal Environment Agency, presents three different scenarios with four themes: energy use, mobility, food production and textiles. The Agency recognises, that the technical progress and resource efficiency are not sufficient to achieve the kind of lasting environmental development agreed upon in the 1992 UN Rio Conference. This would only become possible if technological efficiency were to improve, and changes were effected in consumer behaviour and legal and economic structures. The study shows that sustainable development in Germany is not possible without structural transformation and a growth in awareness. 'Business as usual', a scenario that follows from the current policy, would not bring about sufficient progress. The pollutant reductions achieved in one area through technologies or recycling are balanced out in another by shortcomings in sustainable management of materials and energy flows. Effective management of material flows, a crucial requirement in meeting sustainability criteria, is still in its

infancy (Federal Environmental Agency, 1997).
Moreover, Germany is not the only country where environmental policy is very cost conscious. In its 1998 report, the German Environmental Council expresses concern that economic issues will be given priority to ecological issues, perpetuating the tendency to receive environmental policy well only when it costs little (German Environmental Council, 1998).

4.3 National strategy for sustainable building: regulations and norms as policy

The *Environmental Policy* report, which was published in 1997, covers various areas of construction, but the German government has not defined separate action plans for sustainable building, such as was the case in the Netherlands. The policy is largely based on building regulations and norms.
Germany sees solar energy as a promising for the future, and the advantages to this power source are being actively developed. Positive results have been obtained from experimental construction. The emphasis there has shifted from small-scale to larger projects that use high-tech environmental solutions. An important event for sustainable building was the *Solar Energy in Architecture and Urban Planning Conference* in Berlin in 1996, where the Ministry of the Environment stated that society's concept of energy needed thorough renewal. The solar meeting emphasised Berlin as a model Solar City, which points the way for other cities. The City of Berlin has its own environmental program and local building regulations fully support use of solar energy. Financial benefits are given for the use of environmentally friendly construction methods and materials, such as renewable resources and sound insulation windows.
As outlined above, sustainable building in Germany is energy-focused. The field of building biology, by contrast, is a material-focused sub-field of sustainable construction. It views user as key actors, and promotes the use of natural materials and a healthy indoor climate. Occasionally, building biologists have engaged in conflicts involving energy development. They have, for instance, criticised passive energy houses for using environmentally unfriendly materials and large amounts of insulation, which keeps buildings from breathing (van Hal, 1999).
The German government sees biological diversity, as well as its protection, maintenance and use, as a focal issue in the 21st century. Land use and environmental protection in a more traditional, ecological sense, are also important issues in planning, land use and construction. In German public policy, the re-use of built-up land and the preservation of natural areas will take priority in the future over new applications. All new land designated for construction projects must undergo an environmental analysis. If rare plant or

animal species are found on the site, the project cannot usually proceed. Sustainable building in Germany also places great emphasis on environmental planning in the construction process, waste management and logistics at the construction site. The issue of transport must be taken into account, and all phases must follow ecological principles.
Environmental taxes are used as an essential tool in enforcing sustainable building and implementing the principle of making polluters pay for policy in practice. The increasing use of financial measures will 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 15 billion DM per year, or roughly 5 DM per square metre of total housing stock per year. Absolute damage values came to approximately 41 billion DM or 14 DM per square metre of total housing stock per year (Lintz, 2000). German environmental policy aims to internalise external costs of environmental protection. 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.

In 1995, about 29% of the primary energy in Germany was consumed directly by households. The aim of the government is now a 25% reduction of the CO_2 emissions until 2005 as compared to emissions in 1990. This rate means a physical reduction of approximately 32 million tonnes in the residential sector.
New technology is developed to reduce primary energy consumption in buildings, such as solar thermal systems and photovoltaic, PV panels. Other energy related issues include day light systems, natural ventilation and thermotopic windows. Passive energy houses, whose development is now managed by the separate Institute of Passive Housing, have become well known and are considered a national innovation. However, a new trend aims to change buildings from passive energy consumers to energy producers. In the future, the objective is to produce totally emission-free buildings. With the current energy concepts and techniques available, it is possible to produce buildings that are 50-70% self-sufficient.
In 1992, the national government described a statutory ordinance for its objectives for construction and demolition waste. In 1996, a new draft was introduced, setting the reduction target for the disposal of recyclable construction and demolition waste in 2005 at 50% of the level produced in 1995. High waste costs have made the construction industry pay attention to the amount of materials, re-use and recycling. Germany has a considerable capacity for the treatment of demolition waste, though the availability of processing facilities depends on the regions. There are about 650 companies operating around 1,000 crushes.
In Germany, green consumption is a well-known and stabilised issue. There is

a growing market demand for environmental products and ethical ecological investments. Several eco investment funds, alternative banks or pension funds have attracted private investors. Moreover, ecology is recognised as a good value throughout society. Much emphasis has been placed on information in efforts to promote environmental values. The government aims to continue making changes in basic attitudes and consumption habits. The life-long learning -process begins in the nursery, and is based on responsibility shared by different parties. Attitude changes also concern the governmental sector itself. Germany wants to renew all sectors in the Federation, steering them towards a more environmentally conscious direction over the next 10 to 20 years.

4.4 Implementation: building regulations and tools

This section describes the environmental requirements in building regulations and four tools. Section 4.4.1 begins by describing the implementation of environmental strategy through building legislation. Section 4.4.2 presents four German tools, which were recently developed for environmental impact assessment, including extensive information and cost properties. The relations between the government strategy, the building regulations and the tools are discussed in section 4.4.3.

4.4.1 Environmental building regulations

Regulations in general

Any new legislation introduced by the German Federal Government must be approved by the states. The building regulations are uniform and laid down in the Building Code for the states, which serves as a model for individual building codes. This model lies at the foundations of building legislation is referred to as the *Musterbauordnung* (MBO), or model building regulations. The most important legislation, which is valid for all States, is described in the *Baugesetzbuch* (BauGB). The BauBG includes references to the *DIN standards*. It also defines the confines within which the States must act in introducing specific regulations in their own area, and the options possibilities for establishing site-specific requirements in Master Plans. For example, Master Plans in cities may require environmentally friendly roofs in certain areas, or replacement of biomass in a more indirect way.

Under the MBO, the states have the freedom to develop their own legislation and present their demands in the *Landerbauordnung*. The level of ambition in that legislation may only exceed the regulations required in the MBO and BauGB. The building regulations may differ from state to state despite efforts

to achieve Federal uniformity. Altogether, German laws and regulations for monitoring the quality of building form an extensive and a well co-ordinated system (Meijer & Visscher, 2001).
The *German Industrial Standards* are obligatory in building projects and in the production of building products, building elements and construction systems. An additional protection for consumers, and also for tenants in subsidised housing, is the right of individuals to demand housing quality based on a private law that refers to national standards, the so-called DIN standards. If housing is unsatisfactory, tenants may refer to DIN standards, even if they are not mandatory in the building regulations, and require reparation.
The *Environmental Statute Book*, which contains key environmental regulations, was published in 2000. Despite their freedom in other fields, the states are required to implement environmental protection laws. The *Renewable Energy Sources Act* and the Ecological Tax Reform encourages the use of renewable energy sources.

Energy saving
More stringent building regulations were adopted in 1999 in an effort to achieve the CO_2 reduction targets set by the German government. In 2000, the energy conservation regulation was replaced with yet another regulation, the *Energiesparverordnung*. A building's energy consumption is calculated as the highest permissible energy consumption per floor surface, or per total cubic meters. The U-values for walls, floors, roofs and openings are taken into account in calculating the need for heating. Other factors included in the calculation are ventilation, internal heat production and passive solar energy. Cold bridges between structures must be carefully analysed. Heat recovery energy can be taken into account in design, depending on the tightness of the exterior envelope and the possible use of mechanical cooling. The efficiency of heating equipment has an impact on the design of the outside envelope. Less substantial insulation is permitted where the efficient heating systems described in the regulations are used. In the future, the energy from the heat recovery may be taken into account in the design, but only if machine cooling is not used. In principle, ventilation should be controlled on room-specific basis.
Germany's new thermal regulations will enter into effect in 2002. The standards on heat losses will be very demanding. What makes these regulations special and controversial is that they also apply to the existing housing stock. The renovation of the existing stock to meet new standards involves considerable extra costs, including in the social housing sector.

Materials and waste management
Germany adheres to the European Union directive on hazardous substances. Federal legislation for specific substances is laid down in the *Chemicalien Ver-*

botsverordnung. Examples of such substances include formaldehyde, radon and asbestos. As the states have a right to set their own targets, the regulations vary. The state of Berlin, for example, has set up guidelines for building materials, such as asbestos and tropical wood. The general building legislation does not contain specific requirements about the environmental performance of building materials, except for substances in paints and boards. However, health and environmental protection are among the approval requirements and aspects reviewed in the technical sustainability assessments of products.

Several instructions and regulations have been elaborated to determine quality standards for recycled materials that have to compete with new materials. As a volunteer measure the German eco-label, the *Blue Angel,* is applied to building products, including materials and building components.

Waste disposal standards in Germany are among the strictest in the world. The German *Waste Avoidance and Management Act* was introduced in 1986 and revised in 1993. *Kreislaufwirtschafts- und Abfallgesetz –KrW-/AbfG*, the Recycling and Waste Management Act, came into force in 1996. It implements the EU directives on waste into national legislation, and contains the basic principles of waste management and closed-loop recycling strategies. The Act assigns priority on waste prevention. The waste that cannot be prevented should be recovered, and waste that has been designed for recovery should be kept and treated separately. When neither prevention nor recovery is feasible or economically reasonable, waste must be disposed.

The states may adopt their own, more specific, regulations on waste. Some have already introduced requirements for demolition involving organised dismantling and separation of waste on site or at treatment facilities. Some municipal authorities already require all demolition permit applicants to submit a deconstruction plan, presenting the preparatory phases, the method of deconstruction or demolition, and detailed information regarding recycling for various materials (Schultmann & Rentz, 2000).

Recycling of construction materials has a long tradition in Germany. However, the use of recycled materials focuses mainly on low-grade applications. One of the main obstacles to using high-grade applications is the heterogeneity of the composition and contamination of construction waste. During demolition projects, materials are often mixed and non-hazardous components contaminated. Deconstruction or selective dismantling would make it easier to re-use materials. The latest developments in German building regulations on waste management encourage deconstruction (Schultmann & Rentz, 2000). The *TA Siedlingsabfall*, the Technical Instruction for Municipal Waste, is one of the important administrative directives concerning construction and demolition waste. Under it, waste must be collected and prepared for recovery separately at the place where it was produced. No mineral and unsorted construction and demolition waste may be disposed of in landfills. The *TA Siedlingsabfall*

will be implemented in stages, in 2001 for construction and demolition waste, and in 2005 for municipal waste.
In Germany, the full cost of waste management must be included in the production price. The *Materials Recirculation Law* makes the manufacturer responsible for the product until the end of its life cycle. Waste must be managed in the same state where it was produced. The *Packaging Waste Ordinance*, which was introduced in 1991, aims to reduce the amount of packaging and increase recycling.

Water conservation
In Germany construction must take into account water protection areas. Authorities may lay down requirements, prohibiting construction activities from having any impact on ground water during or after the construction process. The *Federal Water Management Act* entered into force in 1986. In addition, the use of water conservation equipment and the collection of rainwater – though not required under building regulations - is very strongly established in Germany. It is estimated that rainwater could replace about half of the water consumption of an average family.

4.4.2 Tools to support sustainability in decision-making

Legoe
Legoe is a new tool, which aims to combine ecological, economical, energy and comfort data with the CAAD system. CAAD is a design program widely used by architects and engineers around the world. Legoe uses a building model that serves as an input module. It is able to store, manage and interpret geometrical and semantic building information. The building is described by the elements, which consist of the building components, and which are described by the materials. Legoe uses a catalogue of building elements whose attributes contain all necessary life cycle information. The data concerning the life cycle impact is collected from literature and recorded from real process chains. A user can link elements from the catalogue to the elements of the CAAD system. This gives designers additional environmental (resource consumption and environmental impact), economic (investment and running costs), energy (observance of national laws) and health (comfort) data during the design process. It also offers designers feedback from the environmental, economic and energy information included with design choices. (Hermann & al., 2000).
Legoe includes costs for operation and maintenance. It was developed primarily as a design tool. However, it is also useful in stock management, renovations and maintenance, where it can be updated regularly as a project database. Legoe is still under development, and will be available in 2001, though only with restricted CAAD properties.

Ecopro

Ecopro is also a CAAD system-based computer tool, which is used in the preliminary design phase. It is geared towards architects and engineers as a decision support tool. Ecopro aims at optimising material, mass and energy flows, and costs during the early planning process. The Ecopro tool is based on life cycle analysis and covers the entire life cycle of a building up to demolition and disposal. It also takes into account external costs (monetarization). The basic data used in the program is taken from research findings, information obtained from the construction industry, the 'oekoinventare' database, the element catalogue and German and Swiss building standards, which are also used as a basis for economic data. A building is composed of element groups for structure, fabric, interior divisions, coatings, HVAC and electronic equipment and exterior surface treatment. In conducting evaluations, Ecopro uses a reference value for the purpose of comparing the building performance assessed (IEA Annex 31, 2000).

Although not primarily a management tool, Ecopro can be used in housing management, including in renovations, for example to support sustainability in design guidance and in environmental benchmarking.

ECOPT

ECOPT is based on the same principles as Ecopro, a more widely known tool than ECOPT. It is used in the design brief level and is geared towards planners and owners. This tool evaluates the environmental impact for various options in new construction, refurbishment, and solutions that aim to re-use existing buildings. Assessments are made on the basis of the building program, costs and energy needs. ECOPT aims to help users determine whether they need a new building or can adapt an existing building. It is based on functional surfaces, with which different values, such as energy needs or costs are associated. The impact of transportation needs is also taken into account. The tool allows simulation of the alternative solutions to support early decision-making, and helps to set target values for the design phase. As an output of the evaluation, ECOPT presents the assessment results in a profile. It is drawn on the basis of the eight main criteria, considering the time scale (IEA Annex 31, 2000).

ECOPT can be very useful in housing management and in determining whether a new building is needed or whether an existing building can be adapted. It also helps to simulate different options and to set environmental target values for subsequent design stages.

GaBi

GaBi is a computer-aided environmental impact assessment model, which is geared towards experienced LCA practitioners. The GaBi system started as a Life Cycle Engineering project for automotive parts. The database obtained

from research and industry includes 800 different energy and material flows. The ten process types include industrial processes, transportation, mining, power plants, transformation processes, servicing, cleaning, repairing, wear and reduced consumption processes. The flows are contained within these process types. Users can define the criteria for valuation. Monetary, technical and ecological assessments are possible. GaBi can carry out detailed cost evaluations (Life Cycle Costing) of any system assessed. The ecological fields can be classified according to database indexes, such as resource consumption, ozone depletion, release of toxic effective substances, or acidification (IKP, 2001).
GaBi was intended primarily for manufacturing companies and as a management tool for decision-making. It can assist users in analysing weak points optimising products and processes. Theoretically, it can also be used in housing management. In practice, however, it may be too complex a tool for that purpose.

4.4.3 Discussion

Germany's stringent environmental policy is supported with legislation and environmental taxes. Together, the building regulations and norms form a sophisticated system, which ensures a certain minimum level of environmental quality in all buildings. The government will soon introduce new thermal requirements, which will also apply to existing housing. Considering the volume of the total stock, this policy can help to achieve impressive results in terms of reducing energy consumption and CO_2 emissions. The renovation costs, however, will be considerable.
Table 4.1 presents characteristics of four German tools. Ecopro, ECOPT and Legoe are all built on the same principle. These tools are based primarily on material flows and the life cycle analysis related to standard cost and energy calculations. GaBi is a more complicated tool for users that are already familiar with

Table 4.1 Characteristics of four German tools

Characteristic	Legoe	Ecopro	ECOPT	GaBi
Development activity				
New construction	x	x	x	x
Renovation	x		x	
Management	x	x	x	x
Issues				
Environmental	x	x	x	x
Economic	x	x	x	x
Social				
Spatial level				
Material level				x
Building level	x	x	x	x
Urban level			x	

the life cycle analysis. Germany's long-standing experience with environmental issues is reflected in its development of tools, which take account of economic *and* environmental aspects. These tools can also be useful in renovation and management phases. The rational objective in the technology underlying the tools is to integrate environmental and energy information of design choices in commonly used design programs. Nonetheless, the tools are limited in certain technical areas, such as energy and waste. Moreover, the relationship between social and environmental issues has yet to be studied.

4.5 Environmental efforts in the social housing sector

This section examines Germany's social housing sector against the backdrop of environmental policy. Section 4.5.1 presents an overview about social rental housing in general. Section 4.5.2 goes on to discuss environmental efforts in VdW Bayern, the umbrella organisation for the State of Bavaria.

4.5.1 Social housing in Germany

In Germany, the term social housing is used to describe a method of financing housing with a set of regulations, which concern allocation of tenancies, rent levels and standards. It does not refer to a physically identifiable stock of residences. Social housing flats can later become private rented housing, once the subsidised loans with which the units were built are paid off. Usually, this takes about 15 years. However, there are also large social estates, which were built on the peripheries of major cities during the sixties and early seventies (Kleinman, 1996). In 1999, only 15% of the total rental stock in Germany consisted of social rental housing (Haffner & Dol, 2000).

It is the states' and municipal authorities' responsibility to grant housing subsidies. The states are able to determine much of their own housing policies. For this reason, the quality of social housing, the methods of financing construction and subsidy regulations can vary considerably between states (Boelhouwer & van der Heijden, 1992).

Germany's housing sector is also characterized by a certain mentality, which differs from those of other countries. Germans tend to view homeownership as a life-long commitment and are prepared to invest a great deal in their homes. Rental accommodations are popular before this phase. A few years ago, the average age of first-time homeowners was 36; on average, this group was expected to live in their homes for 28 years (van Hal, 1999). This ownership-orientated atmosphere can mean that sustainable building has markets in the private sector, but tenants are reluctant to invest in their living accommodations.

Integration of foreign immigrants into the German population is an important objective in housing policy, and also a challenge to the social housing sector. In 1998, approximately 7% of the 37.5 million private households in Germany included foreign nationals; in cities with over 500,000 inhabitants, that figure clearly rose to approximately 12% (Federal Statistical Office, 2000).
The GdW, *Bundesverband deutscher Wohnungs-unternehmen*, is the umbrella organisation for social housing providers in Germany. Due to its large size, the GdW is more an administrative organisation than an active developer in the field of sustainability. For this reason, we have focused in here on another organization as our concrete example: VdW Bayern, *Bayern Verband der bayerischer Wognungswirtschaft*, which is the umbrella organisation for social housing providers in the State of Bavaria.

4.5.2 Umbrella organisation and sustainability

Like all social housing providers in Germany, VdW Bayern must observe certain ecological standards in order to meet housing subsidy criteria, including those for renovations. The environmental ambition level for the subsidy criteria is higher than it is for building regulations. Examples of requirements include mandatory use of energy-efficient facades, very well insulated windows and modern heating equipment. The State of Bavaria has also defined a special environmental programme that sets higher ecological standards than those required under ordinary building regulations. A specific programme, *Kfw Kreditanstalt für Wiederaufbau*, has been developed exclusively for energy conservation and carbon dioxide reduction in buildings.
VdW Bayern itself does not conduct any research into the environmental impact of its housing stock. Ecology is not one of its research and development themes; sustainability, however, is linked to the other topics.
During the 1999 Seminar on Environment and Energy in the Housing Sector of CECODHAS, (European Liaison Committee of Social Housing), the GdW stated that social housing organisations in Germany have managed to reduce their carbon dioxide emissions. All the same, the government has continued to urge the social housing sector to conserve energy. The new thermal regulations, which aim at reducing CO_2 emissions by 30% as compared to the current level, will also apply to the existing stock. Social housing organisations are concerned about the extra costs anticipated. VdW Bayern estimates that renovation expenses for its member associations alone will amount to some 40 billion DM, though the need for renovations is not exclusively attributable to the new regulations. GdW emphasises energy efficiency as a positive measure, but considers the new requirements, which are based on a concept level of DIN norms rather than current practice, too academic and ambitious. GdW is now advocating simpler regulations and voluntary implementation of the new requirements in the meantime.

The financial impact of German public policy will be reflected on the social housing sector soon with the introduction of new thermal regulations and the renovation expenses anticipated as a result.

In its renovation planning, VdW Bayern also considers the option of demolishing the building in question. But in practice, demolition is rare. In weighing the option of demolition versus renovation, attention focuses more on costs rather than environmental ramifications. However, we should note that this umbrella organisation is situated in West Germany, where conditions can be very different to those in the mass housing complexes in the east.
Another important issue in Germany's social housing sector is the indoor climate, problems with which have created a need for renovation. Due to efficient thermal insulation, new housing has become increasingly denser. This has created a need to devote extra attention to ventilation and air quality. According to VdW Bayern, certain groups, especially tenants in housing built according to certain EPS standards, are vulnerable to allergy symptoms. In order to prevent tenant complaints, the GdW strives to pay special attention to the indoor climate in carrying out renovations.

4.6 Conclusions

Germany has not defined a series of specific action plans for sustainable building. However, its Environmental Policy covers several areas of it. The government relies on the mandatory approach, which is based on regulations and norms and supported by education.
Many governments are afraid to resort to environmental taxation and other

stringent measures in their environmental policy. The general population in Germany, however, seems to accept such measures. As a result of the government's long-term policy, careful approach and promotion of environmentally friendly consumption patterns, some progress has been made in stabilising energy consumption and waste generation. However, the approach is not very holistic and poses a risk: the progress made as regarding energy may be counterbalanced by other problems, such as those relating to materials, if those problems are not taken into account.

As a system, German building legislation is well organised, and its stringent waste and energy standards can serve as an example for other countries.

When it comes to pulling factors, most German tools seem to be based on material flows and life cycle analysis, as well as linked to standard cost and energy calculations. Their structure is adaptable to countries where cost information, for instance, is still lacking. When finished, the CAAD-integrated tool, Legoe, which gives users environmental, economic and energy feedback regarding design solutions, will be very useful and can be used as a database for housing managers. However, the cultural and social aspects of sustainability have been largely ignored in tool development.

Regulations and norms in Germany ensure that social housing providers observe certain environmental measures, including in renovations. In other words, 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 will be reflected on the social housing sector soon with the introduction of new thermal regulations and the renovation expenses anticipated as a result.

5 France

5.1 Introduction

This chapter offers an overview of sustainable building policy in France. Section 5.2 presents a general introduction of environmental policy in France. Section 5.3 goes on to describe the national strategy for sustainable building. To offer a better understanding of strategy implementation, section 5.4 presents the environmental requirements in French building regulations, and characteristics of four French tools. Section 5.5 examines environmental response in the social housing sector, focusing on the umbrella organisation for French social housing providers, L'Union National d'HLM. Section 5.6 concludes this chapter with a summary and discussion.

5.2 Environmental policy

French environmental policy is a responsibility of the Ministry of the Environment, the Ministry of Housing and the National Agency for the Environment and Energy Management, ADEME, which was established in 1992. In its 1996 *Strategy for Sustainable Development*, the Ministry of the Environment stated that sustainable development must allow all people on this planet satisfactory access to social, economic, humanistic and cultural development, in an environment where resources are used more rationally, and species and environments are preserved.

The national sustainability strategy concerns the following areas of construction: improving quality of both new and the existing buildings, a right to housing for all and proper urban integration of buildings. In France, the concept of sustainable development is quite new compared to countries such as Germany. In 1999, for instance, Germany implemented nearly 1500 Agenda 21s, and France about 20. Factors that have slowed down the promotion of sustainable housing in France include the general pattern of consumers and attitudes towards recycling or environmentally friendly consumption, which are still not very ecological. Moreover, potential innovations in the eco-industry have yet to have any impact on consumption patterns (Bourdeau & al., 1998).

France is the third most populated country in the European Union. Of its expansive 544,000 km^2 surface area, 54.8% is used for agriculture, 5.4% is unused agricultural land, 27.5% is woodlands, and 12.3% is non-agricultural land. The Ile-de-France region, which includes Paris, has a population of 10.6 million people and a density of 912 people per km^2. This region is very important in France in terms of government, population and economy. Traditionally, the role of the central government has been stronger in France than in many other European countries. France also has a long history of state ownership. Today, the European Union requires less government involvement in

different industries. France has a stable economy, but struggles with unemployment. In 1998, 12.1% of the workforce was unemployed (Haffner & Dol, 2000). After difficult times, in 1999, the French construction industry witnessed an increase of 5.3% in volume as compared to 1998. This recovery is largely due to new construction. The year 2000 was a good one for building, mainly because of the decrease in VAT on maintenance work in residential buildings, which has also a positive environmental impact (INSEE, 2000). The number of residential accommodations rose faster than the population between 1990 and 1999. While residential units grew increasingly larger, households diminished in size. Space has become an element of comfort (INSEE, 2001).

Energy efficiency has remained one of the French government's main objectives. Because of its very limited domestic energy resources, France is vulnerable to world oil prices and depends on imported energy. France has sought independence in nuclear energy, and it is one of the world's largest nuclear power producers. In 1998, almost 80% of the electricity consumed came from 57 nuclear power plants. Previously, the government planned to have 100% of the country's electricity generated by nuclear power, but environmental objections to this have increased in recent years. Since 1997, the national government has included members of the Green Party, *Les Verts*. The Greens have threatened to pull out of the coalition unless a nuclear power phase-out is launched. France must decide whether to replace obsolete nuclear plants with more modern nuclear plants, or to begin phasing out nuclear power like Germany. According to an announcement by the French Finance Minister in 2000, France's nuclear operations are to be reorganised (IEA, 2000). In 1998, the total energy supply in France came from the following sources: nuclear power (39.8%), oil (35.5%), gas (12.8%), coal (6.4%), renewable sources (4.3%), hydro sources (2.0%) and other energy sources, such solar or wind power (0.1%) (IEA, 1998).
Positive energy-related trends have also emerged in France. The rate of energy consumption is steady, and energy and carbon intensity is on the decline. In 2000, France announced an extensive 10-year plan to cut down carbon emissions in order to meet the Kyoto commitments. The 10-year plan requires reductions of greenhouse gases from transport, industry, agriculture and construction. France has reiterated its need - in connection with the plan - to develop renewable energy sources to maintain energy self-sufficiency. The enforcement of thermal regulations is among the priorities set in efforts to achieve the targets in the construction sector. France has estimated that it is possible to fulfil international agreements only if the construction sector stabilises its CO_2 emissions, and transport and energy industry cut theirs by one third (Habitat et Société, 2000).

5.3 National strategy for sustainable building: HQE initiative

The French government recognises that habitat and building construction is at the centre of social, economic and environmental concerns. According to the Ministry of Housing, sustainable construction responds to the needs of comfort, health and quality of life, and preserves natural resources. These aspects do not concern sustainable construction only, but are essential in every building (Association HQE, 2000). However, it has not yet defined a special action program for sustainable construction. One exception to this is an initiative called *Haute Qualité Environnementale* (HQE), which stands for High Environmental Quality. It was not until the late eighties that the problem of links between the environment and buildings were really raised, when the National Building Research Centre, CSTB, clearly identified that topic in its research program. CSTB and its future studies, Bâtiville Club, has elaborated on the discussion of sustainable building with a set of 24 criteria. These criteria concern the entire life cycle buildings from beginning to demolition. The criteria are divided according to design phase, mastering the operation and management/retrofit/demolition.

In France sustainable building is referred to in terms of HQE, high environmental quality. The government established the HQE Association in 1996. One of the association's objectives is to create a reference for an otherwise vague HQE concept. It has established a set of 14 targets, which feature agreed characteristics for sustainable construction. The main categories include: eco-construction, eco-management, comfort and health. The HQE concept includes the entire life cycle of a building: from program, conception, construction and use, to adaptation, rehabilitation and demolition. The environmental aspects must be integrated in every stage. The French approach to sustainable building is voluntary. There are no special HQE legislation or labels, though some building regulations cover environmental issues. Public buildings, which include those in the social housing sector, are current HQE priorities; they are also used as examples to promote sustainable building. Generally, the HQE is estimated to cause a 5-15% increase in the investment costs because of extra time reserved for studies, new materials and non-standard working methods. However, these investment costs are expected to pay for themselves in the long run (Association HQE, 2000). In its housing policy, the French government points out that public attention is usually aimed at optimising investment costs in housing while it is often the operating costs and the secondary external costs, such as transportation and access to services, that are crucial to people with modest incomes. Experimental building projects can be granted financial support from the government, provided that they are approved as environmental quality realisations, also termed *REX-HQE*. Each REX-HQE site must emphasise at least one HQE aspect.

Currently, the construction industry uses 45% of the energy in France and is responsible for 30% of the country's CO_2 emissions. Recently, awareness about energy conservation has increased dramatically. The government has introduced various incentives for improving energy efficiency in existing housing. Some countries aim to reduce electric heating. France, by contrast, does not support or restrict the use of any energy sources.

Important issues in France currently include health concerns relating to materials, and the quality of the indoor climate. The latter issues involves concerns about pollution risks associated with construction products, equipment, maintenance or improvements, radon pollution risks and air pollution, ventilation for air quality, CFC substitutes in building products, lead and asbestos. Use of local and recycled materials is encouraged because it eliminates transport needs and can facilitate more natural integration of a new building into its surroundings (Habitat et Société, 2000).

According to ADEME, the French construction sector generates over 24 tonnes of waste every year, 80% of which is demolition waste. It is estimated that 1% of the working costs in new buildings come from waste dumping costs; the corresponding figure for demolition is 50%. Re-use of construction waste is still inefficient as compared to Germany or the Netherlands. Minimisation of waste is one of the priorities in sustainable building and the green construction sites program, *Chantiers Verts*. This government programme aims to achieve the following without incurring excessive costs: to minimise disturbance from construction sites to the surrounding environment, to support environmental waste management and to integrate waste management procedures in environmental management.

France has taken a very holistic approach to sustainable construction not restricted to a few specific technical issues. It is also one of the few countries that discuss the spatial quality of buildings as one part of sustainable construction and places emphasis on location. At the building level, this means that new construction should take account of local conditions, such as climate, and the area surrounding the construction site. The next objective is to adapt the HQE concept in existing buildings. This is a more difficult plan and one that must take account of real inhabitants. In 2000, the French government launched a large urban renovation program. One of its two themes, *Moderniser pour l'habitat*, focuses on improving social housing. The objective is to enhance the use value of social dwellings, taking account of the economic capacity of its inhabitants. Environmental housing management is one of its topics.

The existing housing stock in France is relatively old and thus energy inefficient. Most of the residences were built before 1975, the year when the first thermal building regulations came into force. It is estimated that investments in energy savings in housing built before that year carried out pursuant to these measures have permitted energy savings of around 10% of the total

consumption of heat. In France, the state provides subsidies for improvements in existing social housing. This is done through a program called *Prime d'Amélioration au Logement à Usage Locatif social* (PALULOS). Subsidies are based on 20% of the total costs with a maximum ceiling of 85,000 Francs. A reduced VAT rate of 5.5% also applies to renovation, transformation and rehabilitation work for social rental housing. The reduced VAT rate, in combination with a PALULOS grant of 10%, adds up to a total support package equivalent to 22% of the total cost for renovation projects.

5.4 Implementation of the national strategy

This section describes the implementation of the national strategy for sustainable building, both in terms of mandatory and voluntary measures. Section 5.4.1 describes environmental requirements in building regulations. Measures concerning energy conservation, materials and waste management and water conservation are examined here in light of the research themes. Section 5.4.2 presents four current tools, whose holistic criteria clearly reflect the French approach to sustainable building. Section 5.4.3 discusses the impact of the government's strategy on building regulations and tools, as well as on the social housing sector.

5.4.1 Environmental building regulations

Building regulations in general
In France, the central government is responsible for legislation concerning planning, building regulations and housing subsidies. The French system of building regulations is complex. The principal documents are the laws (*Lois*), regulations (*Ordonnances*), decrees (*Décrets*) and implementing orders (*Arrêtés*). In addition, several ministerial rulings can function as regulations. The rulings and regulations for any given topic are included in Codes, such as the *Code de la Construction et de l'Habitation* for building and housing, and the *Code de l'Urbanisme* for urban planning (Meijer & Visscher, 2001).

Energy saving
In 1974, the French government introduced mandatory heat insulation requirements for new constructions. Since then these regulations have been tightened regularly. Their scope has been widened to take account of heating performance in buildings (including solar gains), heating equipment and the hot water system. This has been done in order to develop a holistic approach to energy consumption in buildings. The current thermal regulations have been in force since 1989, and were revised in 1994 and 1997. New, more stringent regulations were passed in late 2000 and became applicable to new

buildings in mid 2001. The energy requirements are set on a basis of a reference building, which is described in the building regulations. A building must not exceed the energy consumption of a reference building. Because insulation makes the enveloppe denser, the new regulations require designers to demonstrate, using calculations, that interior temperatures fall below a maximum permissible value in the summer. Machine cooling is allowed only if alternative options are explored first; examples include structural solutions, such as sunshades. France is one of the few countries to have included measures regarding the solar orientation of residential units in its building regulations.

Requirements regarding CO_2 emissions are more stringent in the new thermal regulations. The new regulations have also been simplified, which makes observance easier to monitor. The new measures proposed seek to increase by 60% savings in the energy consumed in new housing in France as compared to housing built before 1974, without mandatory insulation requirements. The requirements are based on two methods: a calculation method that allows project-specific optimisation, and a method where regulations are defined for insulation and installations. The proposal pays special attention to the use of energy-efficient windows and the prevention of cold bridges, which account for 20 to 30% of the current loss of thermal energy. France is divided into three climate zones, H1 (north), H2 and H3 (south), each of which has its own different requirements.

In the new proposal, less substantial isolation can be compensated by better installations. As in other countries that use similar methods, this is not without problems. After all, an installations' life span is much shorter than life span of insulation (Beerepoot, 2000). The installation of control systems is also required. The costs of implementing the new requirements must be kept within reasonable limits. The extra costs for new buildings are anticipated to fall under 1% of the total costs; the additional investment is also expected to pay for itself in energy savings (Herve Barrier, 2000).

Materials and waste management

French building regulations lay down requirements regarding hazardous substances and radiation, and follow EU legislation concerning dangerous substances. Few other requirements are made in regard to materials. The initiative is left to the construction industry. Dissatisfied with the environmental information available, French building product manufacturers established a working group. The group's task is to establish a common framework for all parties in the industry to provide complete and objective environmental assessments of their products based on verifiable data. The evaluation includes a life cycle analysis, but also examines more specific building issues, such as the health of occupants or the project's contribution to water or energy management.

A law on *Waste Disposal and Recycling for General Waste* entered into force in 1992. France has also established requirements regarding the reduction of household packaging waste. However, as compared to Germany or the Netherlands, French waste legislation is still relatively lenient towards the construction industry. In 2002, waste separation will become mandatory for household waste. The task of enforcing this in practice will require changes in architecture and equipment and education of the general public.

Water conservation
Sustainable water use in buildings is not required under French law, although water conservation is well covered in the HQE concept.

5.4.2 Tools to support sustainability in decision-making

ESCALE
ESCALE is a computer-aided design tool. It aims at diversity, and assesses environmental quality of building projects, using 11 criteria through all design phases. These criteria consist of pure environmental aspects, such as resources consumption, emissions and comfort, and semi-environmental issues like maintenance, adaptability and sustainable management. ESCALE does not include economic dimensions. What makes this tool interesting is its capacity to adapt the evaluation to the data available. That, in turn, makes it suitable for use throughout all stages of the design process. Depending on how much data is available and how accurate the assessment needs to be, the user can choose between two assessment modules for each criterion: a) a simplified module, which is meant for the early design phases; or b) a detailed module adopted for the detailed design phases. ESCALE places emphasis on the operation phase. It also makes conjectures and draws up scenarios for a building's use. It does not, however, take account of material disposal or demolition (Nibel, 2000). The output data can be presented in a final profile, which is based on performance scores, or in more detailed sub-profiles. ESCALE presents project performance in relation to a scale: the limit values, which are the current building regulation level, and the target values, which is the best practice, the optimisation level.
ESCALE is a design, rather than a management, tool. The owner can use it for design management purposes, in target setting in single projects, and in benchmarking. Although this tool can be useful in renovation projects, it was designed for new buildings. ESCALE is still under development. The paper version has been completed, but the software is not yet finished.

TEAM LCA
TEAM LCA for the building sector is a computer-aided tool that conducts LCA-based assessments of buildings. This tool allows users to select the level of

detail in the building's description, the life cycle stages examined, and the environmental impact indicators for the evaluation. TEAM LCA includes maintenance in its assessment. The data input for this tool consists of information on the lifetime of building components and material assumptions. TEAM LCA also takes into account the impact on biodiversity, flora and fauna (Nibel & Rialhe, 1999).
One aspect interesting to owners is that the study of operation and end-of-life stages may help the tool user to select the most environmentally friendly end-of-life scenario for the building.

EQUER
EQUER is an LCA-orientated and a CAD-system based tool that uses Swiss and German data. EQUER is a life-cycle simulation tool that can be used in all phases of a building project. It employs 12 environmental indicators. The main environmental issues considered include resource depletion, material and energy flows and environmental burdening. All of these are examined from the global, local and regional perspective. EQUER assessments are limited in their focus to the building's influence on the outside environment. Other tools would be needed to assess, say, interior comfort. The tool has links to the Energy Analysis software, COMFIE. EQUER calculates the overall input and output of a building throughout its entire life cycle and draws up an eco-profile from the results. It compares the project assessed to a standard reference building (Nibel & Rialhe, 1999).
EQUER can be adapted to some extent in order to facilitate housing management. As it takes account of a building's location, it can be used to select locations based on environmental considerations. It is mainly used for new buildings, but also adaptable for refurbishment projects.

EPIQR
EPIQR is a planning tool for the renovation of existing housing. This tool also takes account of technical and economic aspects. It was developed in the European Joule II program. It is, therefore, a European - and not a strictly French - tool. EPIQR helps the owner to evaluate the condition of a building systematically, thus offering a standardised starting point for a renovation project. In addition to evaluating condition, EPIQR draws up a diagnosis, taking account of energy performance, emissions, construction waste and the indoor climate. Based on that information, EPIQR then estimates the costs of renovation. If the owner decides not to proceed with renovation plans, EPIQR will draw up an assessment of the future condition of building components without maintenance and of future evolution costs (Flourenzos & al., 1999).
EPIQR can be very useful in housing management in terms of planning sustainable renovations. For this reason, it shows great potential as a tool for housing associations.

5.4.3 Discussion

Table 5.1 Characteristics of four French tools

Characteristic	ESCALE	TEAM LCA	EQUER	EPIQR (EU)
Development activity				
New construction	x	x	x	
Renovation	x			x
Management				x
Issues				
Environmental	x	x	x	x
Economic				x
Social				
Spatial level				
Material level				
Building level	x	x	x	x
Urban level			x	

The French government has taken a fairly voluntary, and extensive, approach to sustainable building. In the building regulations, a number of requirements contribute to sustainability, especially energy regulations, but it be exaggerated to claim that France has environmental building legislation.

Table 5.1 presents four French tools in relation to their application areas. It shows that the tools studied in this section focus on new construction, and on the building level. They are based on life cycle analyses, and are more useful in the design phase rather than in housing management. EPIQR, which was developed as a part of the European Joule II program, and is therefore not really a French tool, is one of the few currently available methods with the capacity to support sustainable renovation. Following the HQE concept, these French methods also take account of 'softer' and semi-environmental issues, such as adaptability. However, economic and social aspects, which would be of great importance to the social housing sector, cannot be assessed using these methods.

5.5 Environmental efforts in the social housing sector

This section examines how the social housing sector in France has responded to the HQE initiative. Section 5.5.1 describes social housing system in general. Section 5.5.2 presents its commitment to sustainability and practical actions in the umbrella organisation.

5.5.1 Social housing in France

Social housing in France is subsidised and known as *Habitations à Loyer Mo-*

déré, HLMs. There are two major groups of organisations that manage rented housing: public institutions (public HLM offices), and public development and construction offices (HLM companies). In 1999, 46% of the total rental stock in France consisted of social rental housing; 13% of the newly completed residential units were built for the social rental sector (Haffner & Dol, 2000).
Social housing in France is provided mainly for low-income families. As HLM institutions are not permitted to manage their housing stock at a loss, they can refuse to accept tenants incapable of meeting their financial obligations. As a result, households whose income falls under a certain minimum amount have problems renting from the HLM sector (Boelhouwer & van der Heijden 1992). Due to French allocation policy, low-income groups in the country struggle with a housing shortage. There are homeless people, especially in big cities. In 1999, 4.3 million immigrants were living in France, accounting for 7.4% of the total population (INSEE, 2000). They comprise a higher proportion of tenants in public housing, and nearly a half of the tenant immigrant population lives in HLM housing, particularly in the oldest facilities.
HLM institutions are united at the national level under the *Union Nationale des Fédérations d'Organismes d'HLM*, UNFOHLM. This umbrella organisation is well organised and has an impact on the government housing policy. The influence of the French Communist Party, PCF, on a number of HLM institutions is significant. In France, the government can influence the level of new social housing by granting subsidies to keep that level consistent with the government's broader social and economic objectives (Boelhouwer & van der Heijden 1992). Environmental objectives have not yet included in the criteria.

5.5.2 Umbrella organisation and sustainability

UNFOHLM adopted sustainable development in its future policy during the 2000 the Bordeaux conference. HLM organisations are, therefore, committed to preserve the environment and to respond to the needs of the tenants. In addition to ensuring the quality and durability of materials, architecture and location, the HLM organisations will participate in the struggle against the greenhouse effect, facilitate selective collection of waste and contribute to reductions in energy and water consumption. UNFOHLM recognises that environmental objectives may involve extra costs for its member institutions, but recognises that it is impossible to ignore it given the current European framework of norms. An environmental approach with healthy materials and cost benefits can also improve living conditions for tenants. In 2001, UNFOHLM will be participating in the international development of Habitat II. The objective in this regard is to give more precise and concrete form to the concept of sustainable development.

The main environmental objectives for HLM institutions are:

- To build HQE housing and to ensure environmental quality in the implementation and operation of housing.
- To support tenants in managing water and energy consumption by means of residence-specific consumption monitoring.
- To renew and restructure social housing neighbourhoods to ensure diversity and adaptability, and to keep estates attractive, with special attention to common spaces, security and public participation.
- To renovate existing housing for energy and water conservation purposes (Habitat et société, 2000).

UNFOHLM has concluded a number of environmental agreements with ADEME, the National Agency for the Environment and Energy Management. These agreements aim at sustainable housing management. An energy agreement offers the HLM sector financial incentives to introduce energy auditing, renew heating equipment, modernise housing management using information technology, employ eco-management principles and introduce an action plan for preventing unpaid energy bills. It also financially supports efforts to use renewable energy sources and improve ventilation efficiency and deconstruction experiments, such as sorting of demolition waste. Another agreement with Gaz de France, a state-held company that practically runs the French gas industry, has enabled renovations of collective heating systems, especially in terms of transferring fuel systems to gas and increasing safety in 270,000 HLM residences (Habitat et société, 2001).

In 2000, UNFOHLM entered into an agreement with ADEME and Eco-emballage, Eco-packaging to support government waste policy. This agreement aims at optimising waste separation in social housing; under it, HLM organisations can receive financial support for investments. Waste separation is tested in pilot projects, supported by good practice guides for occupants and personnel. Experience so far has already shown the difficulties in getting occupants to adopt waste separation permanently (Habitat et société, 2001). UNFOHLM also participates in the government programme for environmentally friendly construction sites.

During the 1999 CECODHAS (European Liaison Committee of Social Housing) Seminar on Environment and Energy in the Housing Sector, UNFOHLM pointed out that meeting EU requirements regarding water quality would make it necessary to clean the water supply in the social housing sector. Lead, nickel and arsenic levels have been reduced. Moreover, the target of halving lead levels to 25 mg in 2004 is possible. However, the next stage of reducing levels to 10 mg in 2014 would be difficult, as it would require replacing lead pipes and plumbing, which have been used in France until recently.

In France, where the existing stock was built primarily before 1975 and the introduction of mandatory thermal regulations, renovation has great poten-

France is only beginning to deal with the HQE concept. The policy targets are ambitious, but of descriptive nature and without measurable objectives, monitoring will be difficult.

tial in terms of achieving energy benefits. Currently, VAT can be reduced for renovation projects. According to UNFOHLM, this provision has enabled important investments in energy efficiency. In 1999, approximately 100,000 HLM residences were renovated, which was 12,900 more than the previous year. A visible trend has emerged: small adaptations requested by tenants and minor renovations are preferred to major projects. The average renovation costs in 1999 amounted to 58,000 Francs per residence, which was lower than the corresponding figure for 1998 (HLM, 1999). French environmental policy emphasises sustainable urban renewal. Previously, social housing was built in on the periphery, in inexpensive locations. According to UNFOHLM, however, social housing should be located in centres, helping to impede urban sprawl (Habitat et société, 2001).

UNFOHLM recognises that demolitions, especially in problem neighbourhoods, enable modern and energy efficient dwellings. All the same, environmental ramifications are not a focus in weighing renovation versus demolition in the decision-making process. In 1999, 1,600 HLM residences were demolished, and 800 residences were demolished and replaced by new housing. In 1999, the number of vacant HLM residences over a three-month period rose by 0.2%. This is a problem in low-demand areas, where 60% of the long-term vacant residences are located (HLM, 1999).

5.6 Conclusions

In its sustainable development strategy, the French government recognises that habitat and building construction lie at the centre of social, economic and environmental concerns. However, it has not has not yet developed an action program for sustainable building, despite the HQE initiative. The French approach to sustainable building is vague and extensive. However, it

does take account of a few issues that many other countries ignore, such as location and the spatial quality of buildings. All the same, sustainability is still a relatively new issue, and general consumer patterns and attitudes are still not very ecological.

The HQE concept is based on a voluntary approach. However, a few environmentally friendly requirements have been included in building regulations. New thermal requirements are supposed to increase by 60% savings in energy consumption as compared to the figure for the majority of residences, which were built before 1975. Waste legislation is still lenient, and any claims of environmental building regulations would be exaggerated.

The four French tools studied in this chapter focus on new construction, whose evaluation is based on very extensive criteria. These tools are not geared towards housing management, but can be partially adapted to support design management and environmental benchmarking. EPIQR, which was developed in European co-operation as a part of the European Joule II program, is a promising tool for sustainable renovation.

In 2000, the 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. In France, VAT can be reduced for renovation projects, a provision that has enabled investments in energy efficiency. As social rental housing accounts for 46% of the total rental stock in France, it could be used efficiently to promote the national policy of sustainable building. In many cases, however, urban renewal can be a more sensible option for tackling problems than renovation of individual buildings.

6 The United Kingdom

6.1 Introduction

This chapter offers an overview of sustainable building policy and regulations in United Kingdom. Section 6.2 begins by presenting information about the UK's environmental policy. Section 6.3 describes government strategy for sustainable building, which is supported with a more market-led agenda, and concrete objectives. Section 6.4 presents the implementation of public policy through environmental requirements in building regulations and four commercial tools developed to support sustainability. Section 6.5 examines the social housing sector in terms of environmental efforts in England's Housing Corporation. Finally, conclusions regarding the UK's situation are discussed in section 6.6.

6.2 Environmental policy

The UK government strategy for sustainable development dates to the Brundtland report, which was published in 1987. The current strategy was published in 1999, and is called *A Better Quality of Life* (DETR, 1999). The four main objectives for sustainable development include: social progress that recognises the needs of everyone; effective environmental protection; prudent use of natural resources; and maintenance of high and stable levels of economic growth and employment. The decisions, which aim to support sustainable development, must be based on scientific information and risk analysis. The building-related objectives of the national strategy are to construct more homes on brown-field rather than green-field sites, making more use of recycled and waste materials, and eliminating non-confirming sewage discharges into rivers and seas. The government has set a concrete target for new housing: 60% is to be built on previously developed land. Altogether, the UK has a surface area of 244,820 km^2 and nearly 59 million people. Central London has a population of some 7 million people.

Different indicators play an important role in the UK's strategy for sustainable development. The core of the national progress reports is a set of 140 indicators and a sub-set of 14 headline indicators. Three of these indicators are relevant to construction: construction waste destined for a landfill, primary aggregates output per unit of construction value and amount of secondary and recycled aggregates used as compared to virgin aggregates. In addition, a large number of other indicators, including social and economical areas, are influenced by the construction industry.

Unlike many other European countries, where the state has been a key industrial actor, the UK has favoured a strong private sector. For this reason, it has met the EU privatisation and competition deadlines more quickly and easily than have other members. Unlike the other countries in this inventory, the

United Kingdom does not intend to adopt the European currency, the Euro. The UK's economy is stable, but 6.2% of its workforce was unemployed in 1998. In 1997, 191,000 new residences were completed in the United Kingdom (National Statistics, 2001). In examining all the current initiatives in the UK to improve housing quality and productivity in the construction industry, we should note that the atmosphere in the building industry is often aggressive. The construction industry has been criticised for being old-fashioned as compared to the other industries, unreliable in terms of quality and time scale, and inefficient. Contracts are often won solely on the basis of price. Contractors often file suits against each other, and lawyers are involved in the construction sector (van Hal, 1999).

In 1998, the total primary energy supply in the UK consisted of the following: gas (48.6%), oil (37.5%), coal (12.0%), nuclear energy (1.4%), renewable sources (1.4%) and other sources, such as solar and wind energy (0.1%) (IEA, 1998). The United Kingdom is a major European oil and natural gas producer. The new environmental directives in the European Union are expected to increase coal production costs, and some predict that the UK's coal industry will meet its end in the near future (IEA, 2000). The share of coal is replaced with natural gas. Environmental conditions in the United Kingdom have improved over the last few decades with a reduction of sulphur dioxide and carbon dioxide emissions.
Public policies to reduce emissions are presented together in the *Climate Change Program*. The objective is to use market mechanisms rather than regulation. The *Climate Change Levy,* which was introduced in 2001, focuses more attention on alternative energy sources. The government's aim is to increase electricity from renewable energy sources, from its current 2% to 10% in 2010 (IEA, 2000). The Department of Energy set its goal for CO_2 emissions in 2000 at the level for 1990. It has also undertaken to reduce that level by 20% in 2010 and by 25-30% in 2030 as compared to 1990. Energy consumption – both in industrial and domestic sectors – increased by 3.4% between 1991 and 1998, whereas CO_2 emissions dropped by some 7%. The decrease in CO_2 emissions is largely due to the use of natural gas and nuclear energy in electricity production (National Statistics, 2000).

6.3 National strategy for sustainable building: Building A Better Quality of Life

The current government strategy for sustainable construction is called *Building a Better Quality of Life 2000* and it contains 10 themes for practical action:
- Re-using existing building assets.
- Designing for minimum waste.

- Aiming for lean construction.
- Minimising energy in construction.
- Minimising energy in use, encouraging the use of renewable sources.
- Avoiding pollution.
- Preserving and enhancing bio-diversity.
- Conserving water resources.
- Respecting people and their local environment.
- Setting targets, comparing achievements with others and aiming at continuous improvement (DETR, 2000).

According to the government policy, the construction industry can contribute to government priorities by being more profitable and competitive. Sustainable building should also make good business sense and improve the image of the building industry.

Published in 1997, the market-driven *Rethinking Construction report* has since become the banner under which the government, industry and its clients have united to bring about radical change in construction. The report, which is often referred to as the Egan report, is the product of a working group that was formed by the construction industry. Its objective is to develop the building sector into an industry that focuses on the needs of its customers, improves profit margins, measures and compares its performance, learns from others and shares experience. It develops and respects people and understands its work in an ethical and sustainable manner (Egan, 1998). The Egan agenda is not focused on environmental issues, but overlaps with sustainability objectives in several areas. Examples of these objectives include waste minimisation, process interaction, a commitment to people and a quality-driven agenda. The report also places emphasis on improvements in the social housing sector. The housing associations are expected to achieve successful results in social, economic and environmental terms.

As a successor to the Egan report, the *Movement for Innovation* (M4I) group was created, and is managed by the industry. *Housing Forum* is the organisation that aims to implement the report findings in the housing sector. The UK government is tracking progress towards the Egan agenda, using an annually published set of *Key Performance Indicators* (KPIs). These indicators measure building performance at the project level. The KPI sustainability set concerns waste, energy, water, ecology, transport and recycling.

In the United Kingdom, public participation is seen as essential to sustainable development, and different groups are asked to respond to public policies. The *Opportunities for Change* report, which was published in 1998, was the construction industry's response to the public policy. According to the report, market actors want the government to take the lead in sustainable development (DETR, 1998). The UK's government wants to set an example as a leading client of the construction industry. All governmental departments have

made a commitment to introduce environmental management systems under ISO 14001 in their estates, to implement programmes for better quality in building design. All construction clients are also expected to endorse a programme for more sustainable construction procurement.
As in the other countries studied, the UK's government invests considerable sums of money in sustainable construction research and its dissemination in practical construction. The concept of sustainable construction is also becoming broader in the UK. Projects of *Construction Research and Innovation Program Prospectus 2000* think in terms of all three key facets of sustainability, not only economic and environmental, but also in social terms, which means respecting and treating stakeholders friendly, and a safe and healthy built environment (DETR, 1999). The Government has also launched an interesting *Foresight Program*, which presents future scenarios for different industries, including the construction sector, for 2030 (DTI, 2000).

In the UK, buildings account for 50% of the primary energy consumption as well as CO_2 emissions. Energy saving in buildings is promoted by means of various research activities and Best Practice Programmes. The government is now exploring options for improving energy performance in existing, often energy-inefficient buildings. It is also trying to determine whether building regulations can be applied to renovations. The existing housing stock in the UK is relatively old; only about 22% of the housing stock was built after the energy crisis. In 1991, 26% of housing had insulated outside walls, and 45% of dwellings had single glazed windows.
Reduction of waste at all stages is one of the main targets of the public policy. It is also high on the priority list in the Egan agenda. According to the government, waste minimisation can be achieved by avoiding over-specification of materials and services, introducing a co-ordinated approach to design and construction, and adopting standardised solutions. *Less Waste More Value* is a government program, which promotes the waste hierarchy. Its priorities have been set as follows (in order of importance): waste reduction, re-use of waste, recycling and finally waste disposal. In addition, the Environment Agency is working in partnership with industry to develop a UK-wide system, the *Waste Classification Scheme*, which contains information about the polluting potential of waste.
Most construction and demolition waste in the United Kingdom goes to landfills. This practice is due to the way construction sites operate. The total land consumed for waste disposal and recycling facilities in the UK is estimated at 800 hectares. This area is dominated mainly by landfill operations. If it were possible to achieve a 10-20% reduction in waste, then six million tonnes of material might be diverted from landfills, saving approximately 60 million pounds in disposal costs. The government's objective is to reduce the proportion of waste destined for landfills from 70% to 60% in 2005.

The *Landfill Tax* was introduced in 1996. It applies to waste, which is disposed of in licensed landfills and ensures that the price of landfill reflects the impact that it has on the environment. The Landfill Tax guides the construction sector to minimise, re-use and recycle waste. It has already contributed to an increase in crushing and recycling sites. Compared to approximately 100 sites in 1994, there are around 400 in 2000. Landfills are becoming gradually more expensive and most probably, the disposal of recyclable materials will be banned. The Landfill Tax met with a mixed response in the construction industry. Its implementation caused contracts to grind to a halt while the parties involved determined who was to pay for the new expenses. Sometimes, overall extra costs have been passed on to the client (McGrath & al., 2000).
The government's strategy encourages the construction industry to consider refurbishment or renovation as an alternative to new buildings. Two interesting guides are available to support sustainable housing renovation in the UK, *BRE ECO Homes Guide* and *Green Guide Specification for Houses* (BRE, 2001). These guides are easy to use, but are voluntary and do not include any mandatory regulations. Demolition is seen as one option for refurbishment. Normally, however, it is viewed as a less beneficial option.

6.4 Implementation of the national strategy

This section focuses on the implementation of the national policy. Section 6.4.1 describes the environmental requirements in British building regulations. Section 6.4.2 presents four tools developed in the Building Research Establishment, BRE. These tools were selected to represent British methods in this study, because as commercialised products, they represent well the national market-driven approach. The relationships between government strategy, regulations and tools are discussed in section 6.4.3.

6.4.1 Environmental building regulations

Building regulations in general
The current *Building Regulations*, and the supporting *Approved Documents*, in the United Kingdom were published in 1991. Since then they have been revised several times. The main building regulation relating to energy savings is *Part L*, the approved document L, on the conversion of fuel and power. The revised Part L of the Building Regulations will enter into effect later this year. Part M is soon introduced.
Other legislation regarding housing development includes the *Environmental Protection Act*, which entered into force in 1990. The EPA 90 was a product of extensive discussion of amendments to environmental law and covers a wide

range of sustainability topics. Part I of the Act describes *Integrated Pollution Control*, IPC, which is applicable to the release of pollutants to air, water and land from certain processes. It establishes the criteria for *Best Available Techniques Not Entailing Excessive Cost*, BATNEEC. Part II specifically concerns the deposit of waste on land. The EPA 90 requires local authorities to locate contaminated land areas and evaluate their impact on construction activities. The objective is to clean these areas and use them again.
The *Environment Act* entered into force in 1995. It established the Environment Agency and the Scottish Environment Protection Agency. This act makes amendments to the EPA 90 and to the other major environmental statutes.

Energy saving
Minimum mandatory requirements for energy performance have been in force in British building regulations since 1965. Although they have been revised every few years, thermal regulations have been lenient so far. The energy regulations were tightened in 2000; the revised regulations will enter into force during the course of 2001. The government has also been exploring options for regulating existing buildings.
The required U-values depend on the calculation methods used. In the elemental method, U-values of separate structures must fall under a certain level. In the target U-value method, a building's average U-value must fall under the target level. Since 1995, the energy rating method has been based on SAP calculations. All new residences and conversions in England and Wales must have the *Standard Assessment Procedure for Energy Rating of Dwellings*, the SAP rating. The SAP factor is evaluated according to examples in the building regulations. It is calculated with insulation values of construction parts, heating and ventilation systems, and profit of passive solar energy. Minimum values depend on the floor surface of a dwelling. In SAP calculations, values can range from 1 to 100. The closer the SAP factor is to the maximum value of 100, the better the energy condition in a building. According to the latest English Housing Condition Survey, the SAP for new housing in the United Kingdom normally ranges between 60 and 80.
The UK's government has introduced a stimulation order called the SAP 80+. Residences with SAP scores of over 80 are granted incentives from the program in the form of energy saving promotion material that can be given to prospective buyers. The authorities have set out, in this way, to motivate housing associations and developers to strive voluntarily towards higher SAPs. The SAP rating takes account of energy costs, which has official estimations for design purposes. The SAP value is based on energy consumption costs, whereas the EPC focuses on primary energy consumption directly linked to CO_2 emissions. In the UK, residences that feature electrical heating can have high SAP scores, even if the electricity comes from nuclear sources.
The 1995 *Home Energy Conservation Act*, HECA requires local authorities to

evaluate the energy efficiency of the housing stock and to draw up plans to achieve a 30% reduction in CO_2 emissions from domestic premises by the year 2011. Taxation was increased by 8% to support the law. The Energy Saving Trust offers a grant support to local authorities in meeting this target.

Materials and waste management

The requirements on building materials are described in the Building Regulations. The health and safety regulations include some requirements about avoiding harmful materials and practices. These were established primarily to protect workers, but also serve to protect the environment. Restrictions on the use of hazardous substances are applied with a view to protecting health. For example, white lead in paints and some sorts of asbestos are banned. The use of formaldehyde and radon substances is also restricted. The contents of these regulations are based on the EU directive on hazardous substances. The UK's government relies on market actors for the reduction of raw materials and building products.

Consciousness about environmental performance in building materials is left primarily up to market actors. Black and white lists for materials are used, but are not official. A voluntary standard has been introduced for the durability of buildings and building elements, products and components, (*BS 7543: 1992*). This standard sets guidelines for durability, and definitions for required and expected life spans of buildings and building products. Another system is the *Housing Association Property Mutuals*, HAPM, which integrates life spans of buildings and building products into the HAPM insurance system. This method was developed in the nineties. Since then, over 50,000 residences have taken out HAPM insurance and over one hundred real estate organisations belong to the system.

Most of the mandatory requirements concerning waste management in the construction industry are described in Part II of the Environmental Protection Act, the EPA 90, and the Environmental Act, 1995. The *Special Waste Regulations* entered into force in 1996. Building regulations on waste are still relatively lenient. The 1996 Landfill Tax was an important step towards increasing the re-use and the recycling of construction waste (see 6.3.2).

Water conservation

The *Water Resource Law,* which entered into force in the UK in 1991, protects surface and the ground water from pollution, for instance when construction work is implemented in a contaminated land area. There are no mandatory requirements in UK building regulations that regulate water conservation in buildings.

6.4.2 Tools to support sustainability in decision-making

BREEAM

In 1990, the Building Research Establishment developed BREEAM, the first commercial building environmental assessment method. Since then, nearly 500 new office buildings in the UK, about a quarter of all new offices, have been evaluated with BREEAM. EcoHomes, a new version for rating residences, was launched in 2000. The assessment is given of a certificate evaluator and is voluntary. The environmental impact of buildings is studied taking account of energy, transport, pollution, materials, water, land use and ecology, and health and well-being. All of these aspects are examined from the global, local and regional perspective. For each of these groups, certain criteria have been established for buildings; each measure is evaluated with points. All groups are required to achieve a certain minimum number of points. The points are not calculated together at the end of the evaluation, because there is no clear consensus about their relationship to each other. However, there is a simple classification to determine a building's performance: fair, good, very good or excellent. The BREEAM criteria and point scale are quite limited because the method has to remain simple and all measures have to be essential, practical and clearly measurable. The assessment can be done for all phases of a building's life cycle (Grace, 2000).

BREEAM is a useful environmental benchmarking tool for the owner because it presents assessment results in a simple form and is a well-recognised method. It has even become a commercial brand. In housing management, BREEAM can also be used when objective information is needed for environmental policy.

BRE Environmental Profiles

The BRE Environmental Profiles for construction materials is a computer-based tool, which provides LCA-based information for building materials, components and complete buildings. The data for the method are provided by product manufacturers in the UK. The BRE Environmental Profiles database features various levels of data, ranging from per tonne inventory for individual materials to data for over 200 building elements. The Environmental Profiles present environmental ramifications in terms of climate change, ozone depletion, fossil fuel depletion, human toxity, eco toxity, water pollution, water extraction, low-level ozone creation potential, acid deposition, mineral extraction, waste disposal and transport pollution and congestion. The data can also be described by means of comparisons with the relative environmental impact of one UK resident (Edwards & al., 2000).

In order to make results simpler for the construction industry, the BRE has developed Ecopoints, which presents the environmental impact in a single score. This score is based on the Environmental Profiles database and is calcu-

lating using a weighting factor.
The Environmental Profiles tool allows users to compare the environmental performance of different materials and components. In housing management, the owner can use it for environmental benchmarking and for comparisons between different materials or components with the same functions.

ENVEST
ENVEST is a computer-aided tool recently developed in BRE. It is geared primarily towards designers. The tool allows owners, users and designers to review and improve to environmental performance throughout the life cycle of a building. With the help of ENVEST in the early design phases, users can study the relationships between the life cycle impact embodied in the design and the operational impact of the building during its use. The environmental ramifications of different design options are compared in Ecopoints. The tool makes assumptions concerning the environmental impact of various strategies for heating, cooling and operating buildings. The main stages include selecting the shape of a building, changing building details, modifying the fabric and services and producing graphics. The designer can graphically illustrate the environmental characteristics of different design options for the client (Edwards & al., 2000).
Unlike BREEAM, which provides a formal certification, ENVEST is a 'self-help' computer tool for initial design stages. In housing management, it can be used to compare environmental qualities of different design options.

BRE Environmental Management Toolkits
BRE Environmental Management Toolkits include the Office Toolkit, the School Toolkit and the Local Authority Toolkit. These computer-aided toolkits provide a simple environmental management system for smaller organisations that focus on potential financial and environmental benefits. They also present environmental ramifications in Ecopoints. The Toolkits focus on building operation, maintenance and services. (BRE, 2001).
The Environmental Management Toolkits can be considered as guidelines and checklists, and their use requires only simple, easily accessible data. They can be used as an intermediate phase before an environmental management standard such as the ISO 14001. However, the BRE Management Toolkits do not cover housing yet.

6.4.3 Discussion

The UK's government has invested tremendous effort in promoting sustainable building. Implementation of sustainable building measures, however, is mainly voluntary. In this sense, the government relies heavily on market actors. The building regulations are used as one way to encourage sustain-

Table 6.1 Characteristics of four British tools

Characteristic	BREEAM	BRE Environmental Profiles	ENVEST	BRE Management Toolkits
Development activity				
New construction	x	x	x	x
Renovation		x		
Management	x			x
Issues				
Environmental	x	x	x	x
Economic				x
Social				
Spatial level				
Material level		x		
Building level	x	x	x	x
Urban level	x			

ability, but the current ambition level is not very high and the requirements apply only to new construction. Thus, the effect of the regulations on the social housing sector, which accounts for a significant portion of the housing stock in the United Kingdom, is very limited.

Since indicators are an important part of sustainability strategy in the UK, much effort has been invested in developing environmental assessment methods, including in the construction sector. Table 6.1 describes characteristics of four British tools studied. As the table shows, these tools cover quite thoroughly different aspects at the building level. However, despite a few characteristics of the BRE Management Toolkits, they do not take account of economic measures and cannot support renovation and management. Although research has been conducted in the UK concerning the relationship between environmental and social issues, these tools do not cover the social aspects of sustainability.

6.5 Environmental efforts in the social housing sector

This section examines England's social housing sector in the light of the national strategy for sustainable building. Section 6.5.1 describes the nature of social housing in the United Kingdom in general. Section 6.5.2 goes on to present environmental policy in the Housing Corporation, which is a co-operative organisation for social housing providers in England.

6.5.1 Social housing in United Kingdom

Housing associations in the UK are societies, bodies of trustees or companies established for the purpose of providing non-profit housing. In the UK, approximately 18% of social housing is owned and managed by local authorities, and another 5% is owned by housing associations (Haffner & Dol, 2000). In 1999, 66% of the total rental stock consisted of social rental dwellings, down from 71% in 1980. This decrease is partly due to the sale of housing

from housing associations to private owners. The influence of local authorities and the government on social housing has declined in recent years.
The *Housing Corporation* is a non-departmental public body, which is sponsored by the Department of the Environment, Transport and the Regions, DETR. Its role is to fund and regulate the Registered Social Landlords in England, who are the main providers of social housing and manage almost 1.5 million homes in England. The Corporation standards are important, as the social housing projects must meet them in order to receive partial funding. Scottish Homes, Scotland's equivalent to the Housing Corporation, has also recently published its Environmental Policy and a Sustainable Design Guide.

6.5.2 Umbrella organisation and sustainability

The Housing Corporation published its *Environmental Policy* in 2000. It supports government strategy by working in partnership with others with regard to the social, environmental, resource and economic aspects of proposed scheme development. In addition to making its own operations more environmentally friendly, the policy commits the Corporation to changing its investment and regulation policies and procedures in order to maximise the impact of the environmental policy in housing associations. An annual report about progress has been prepared and a formal review will be held in three years (Housing Corporation, 2000a). At the building level, the Housing Corporation is particularly interested in energy and water efficiency and measures to reduce CO_2 emissions. It also intends to construct accessible homes for the disabled and the elderly.
In addition to the government strategy, the Housing Corporation considers the implementation of the Egan agenda important. It is developing criteria for defining whether its housing schemes comply with the principles outlined in the report. It also works with housing associations to ensure that they develop their procurement processes. UK government's *Green Paper on Housing*, which was published in 2000, has had a major impact on the social housing sector and makes a commitment to implementing the Egan report.
Sustainability is one of the four main themes of the Housing Corporation's *Innovation and Good Practice Programme*. The aim of this IGP programme is to support innovative projects that develop and test new ideas in order to improve services to residents. In 1999, some 1,000 projects received funding. Through this programme, the Corporation has supported the *Sustainable Homes* project, which promotes awareness of sustainable development and encourages housing associations to improve their environmental performance and adopt environmental policies. Recently, Sustainable Homes has developed an *EcoDatabase* that offers practical sustainability guidelines and examples of good practice projects for social landlords and housing associations. This includes an EcoDatabase for environmental housing schemes and

a *Good Practice Guide* on development in the UK.

As indicators play an important role in the UK's strategy for sustainable development, the Housing Corporation has also developed indicators. *Housing Quality Indicators*, HQIs, which were formulated together with the DETR, are a tool for measuring and assessing prospective and existing housing schemes, focusing on quality as well as cost. The Housing Quality Indicators examine housing projects, focusing on three main aspects: location, design and performance. In 2001, housing associations will be required to use HQIs. In its own environmental policy, the Corporation uses the *Total Cost Indicator*, TCI, which is a money measure value.

The Housing Corporation does not have an accredited Environmental Management System. The use of the environmental standard ISO 14001 is now being tested in one regional office, the Vale Housing Association. Depending on the results, it may be extended throughout the Corporation. The EMS in the Vale Housing Association consists of the public Environmental Policy, Environmental Performance Data and Environmental Statement. The contractors are required to apply environmental standards and adopt the environmental policy of the housing association. Focal concerns include the need to keep abreast of legislation and monitor environmental performance. EMS documentation is supported by other documents, such as the Tenants' Handbook and the Design Guide. The ISO 14001 standard is valid for three years, and surveillance visits a by nationally accredited company are conducted every six months (Vale Housing Association, 2000).

In the future, the Housing Corporation aims to shift from funding stand-alone housing schemes towards providing housing that helps to create viable communities. The Corporation sees sustainability issues more as a community issue than one of individual buildings. It has also carried out research on housing association policies in relation to the Agenda 21. It views the Local Agendas as an opportunity to deal with the population and household growth: 'lessons have surely been learned from past disastrous, and ultimately very costly, attempts to meet housing needs without reference to the wider context' (Sustainable Homes, 1999).

In its investment strategy, the Corporation states that the social landlords' first priority should be to repair and to modernise their stock in areas of continuing demand, ahead of subsidising new housing. Social housing providers in the UK can apply for the *Rent Surplus Fund*. A new issue in the social housing sector is the vacancy in low demand and problem areas. The issue of hard-to-let estates in the seventies and eighties was believed to be a passing problem. By the nineties, however, the excess supply of social housing in the housing markets of certain regions of the country was felt to be a serious problem. In 1997, 6,300 clearance residences were closed or demolished. According to the findings of research project by the Innovation and Good Practice Programme, which examined the demolition of low-demand hous-

A new issue in the social housing sector in the UK is the vacancy in low demand and problem areas. The resulting pressures to resort to demolition has important environmental ramifications, for example, in terms of demolition waste versus environmental friendly technology in a new building.

ing, demolition projects run the risk of overreacting to the issue of low demand, as it may be temporary phenomenon in some areas. On the other hand, selective demolition causes funding difficulties in allocations, transfers and community development. The study emphasised a need to take an 'outward-looking' approach to regeneration and a holistic view to housing markets. Sustainability must be viewed in terms of future community aspirations, rather than to assume that dwelling improvements will automatically produce sufficient demand and community support in a longer term (Cole & Shayer, 1998).

Another study resulted in the development of the *Sustainability Toolkit*, which is based on findings regarding people's reasons for wanting to live in certain areas. The main factors of influence include demand for housing, the reputation or image of the community, crime and anti-social behaviour, social exclusion and poverty, the accessibility of facilities, the quality of the environment, the design, layout and quality of housing, the extent of social cohesion, and a mix of the community. The Toolkit is used in the Corporation's sustainability policy.

6.6 Conclusions

Energy saving, reduction of waste and landfill are priorities in the UK's strategy for sustainable construction, which is entitled *Building A Better Quality of Life 2000*. However, it is the market-driven Rethinking Construction report, which overlaps several areas of sustainable construction, that has become a banner under which the government, the construction industry and real estate sector have united in efforts to improve competence in the construction industry.

The problem with this industry-orientated approach is that market actors alone are unlikely to promote sustainable construction when the market for it is still weak. According to the Opportunities for Change report, which was published in 1998 as the construction industry's response to public policy, the market actors themselves want the government to take the lead in sustainable development.

The UK's approach does not rely primarily on legislation. So far, the building regulations have been lenient from the environmental perspective. Efforts have been made to improve the situation, especially concerning energy saving, by means by tightening SAP requirements and the Home Energy Conservation Act. The Landfill Tax has increased waste recycling. However, a large portion of construction and demolition wastes is still disposed of in landfills. As housing in UK is relatively old, the real potential for energy savings lies in renovation, which is unaffected by current requirements, rather than in new construction, where the measures are targeted.

This overview examined four tools developed in the Building Research Establishment, BRE. These commercialised tools have been well marketed, and the evaluation results can be easily adapted for marketing purposes. This is not a negative aspect, as it gives owners an incentive to use them.

The social housing sector 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. 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. 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. These initiatives show great potential as social housing in the United Kingdom accounts for 60% of the total rental stock, and housing management is considered as important research and development theme. 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.

7 Finland

7.1 Introduction

This chapter offers an overview of sustainable building policy in Finland. Section 7.2 begins by presenting information about Finnish environmental and energy policy. Section 7.3 describes the national strategy for sustainable building, which is outlined in the government Programme for Ecologically Sustainable Construction. Section 7.4 presents policy implementation through environmental requirements in the building regulations and four tools developed to support sustainability in decision-making. As Finland does not have an umbrella organisation for social housing providers, section 7.5 examines the environmental policy of ATT, the housing production department of the City of Helsinki. Conclusions are discussed in section 7.6.

7.2 Environmental policy

Energy saving has been an issue of concern in Finland since the seventies. It was not until the late eighties, however, that public strategies for sustainable development began to develop. The current *Government Programme for Sustainable Development* is the third document outlining national measures to promote ecological sustainability, and to lay down the economic, social and cultural requirements for achieving this target. The programme's primary goals are to reduce the use of non-renewable resources, to improve ecological values, and to generally improve the state of the environment (Ympäristöministeriö, 1998a).

Construction-related Finnish Indicators for Sustainable Development include: changes in the energy consumption of the building stock, the use of renewable sources, changes in water consumption, the market share of eco-efficient products and solutions, and the use of tools, such as EMAS. The promotion of sustainable development is a focal aim of the government's housing strategy, which was approved in 2000. State-subsidised housing production and public-sector construction projects are required to set an example of good practice in sustainable building and emphasise life cycle thinking as an essential part of quality and cost control.

The Finnish strategy for sustainable development emphasises voluntary agreements between trade and industry and the government as a key measure. The market-orientated approach is seen as the most effective and positive means of promoting sustainable development, rather than mandatory enforcement through laws. Training and information play a key role in the implementation of the programme.

Finland's population density does not place much pressure on land use. It is a sparsely inhabited country with a surface area of 338,000 km^2 and 5.2 million inhabitants. Much of the country is covered by pristine natural reserves: 68%

of the surface is forest, 10% water, and 6% is cultivated. Finnish forests account for a large portion of the EU's forest conservation areas; nearly 10% of the area consists of (strictly) protected forests. As compared to other countries in this inventory, Finland's climate is very cold. In January 1999, the average temperature in Helsinki was –5.1 degrees. The corresponding figure for Lapland, which lies in the north of the country, was –18.5 degrees.

Finland's population density is only 17 inhabitants per km^2. However, 81% of the population lives in centres that account for only 2.5% of the surface area. In these areas, the population density is 200 inhabitants per km^2 (Ympäristöministeriö, 1999). The Helsinki metropolitan area, which consists of the cities of Helsinki, Espoo, Kauniainen and Vantaa, as well as eight other municipalities, witnessed its population increase to 891,000 inhabitants due to the new wave of internal migration in the nineties (Tilastokeskus, 2000). This represents almost a fifth of the Finnish population. Another area of population increase and economic growth is Oulu in northern Finland. According to the forecasts, this migration to growing centres will continue, whereas other areas of the country will see their populations diminish. This may cause problems in the future. As compared to other European countries, Finland has few foreign immigrants. In 1999, only 85,000 foreign nationals were living in Finland, almost half of which had settled in the Helsinki area.

Generally, population density and efficient land use are not problems. However, the government has taken action to deal with problems caused by internal migration to the Helsinki metropolitan area and other growing centres. In 2000, a co-operative agreement was signed between the central government and the municipal authorities in the Helsinki region to promote housing production and related investments, such as in traffic. Recently, a working group set up by the Housing Minister, prepared an action programme to improve housing in areas of decreasing population. This programme aims to adapt the housing stock and supporting services for the ageing population and diminishing population.

Finland's economic situation has been plagued by a persistently high unemployment rate, which peaked in 1993 at 17.9% of the workforce. In 1998, the unemployment dropped to 13.2% (Haffner & Dol, 2000). The situation has improved slightly. In February 2000, 248,000 individuals were unemployed (9.8% of the workforce). The economic recession, which seriously affected the construction industry, has also made a slow, but steady, recovery. In 1999, 13,323 new apartment buildings were completed. The need for new housing is expected to continue at a level of 30,000 to 40,000 residential units per year (Tilastokeskus, 2000).

Reduction of energy consumption and emissions of greenhouse gases are a priority in the government's programme. The programme's target for intensified energy efficiency by the year 2010 is twofold: a) achieving a 10-15% reduction in overall energy consumption (as compared to the level of consumption if no

conservation measures were taken) and b) maintaining CO_2 emissions at their level in 1990. The CO_2 tax is levied on coal, oil and natural gas for heating.
In 1998, Finland's total primary energy came from the following sources: coal (16.8%), oil (32.9%), gas (10.2%), nuclear energy (17.4%), renewable sources (18%) and hydro sources (4%) (IEA, 1998). Unlike many other European countries, Finland has no plans to phase out nuclear power. However, the issue of building a third nuclear power plant has been the focus of a long-standing political debate. As compared to other European countries, the amount of energy from renewable sources is relatively high in Finland. Currently, most of this energy is produced with wood, as well as with hydropower, which is now being limited. All the same, the country stands to profit even more from renewable energy, and the government has undertaken to increase it.

7.3 National strategy for sustainable building: Programme for Ecologically Sustainable Construction

Sustainable building was introduced in Finland along with energy saving. Since its introduction, energy saving has become the most intensely developed measure in sustainable construction. The government sees the construction and real estate sector as a very important contributor to sustainable development. This sector is required to focus on energy efficiency, water economy and waste management, clean indoor air, and the durability and service age of buildings and their components.
In 1998, the Ministry of the Environment described, together with key actors in the building and real estate sector, the *Government Programme for Ecologically Sustainable Construction*, which is a decision-in-principle of the State Council on ecological building. It promotes ecological sustainability in construction, renovation and property maintenance, and considers economic, social and cultural aspects of sustainable development. The main strategic targets of the programme are:

- To reduce significantly environmental burdening caused by the construction and real estate sector.
- To ensure that environmental knowledge and technology improves the construction sector's competence.
- To increase the construction and real estate sector's resources for environmental and client-based decision-making.
- To reinforce ecological sustainability in community development (Ympäristöministeriö, 1998b).

Finland spends large sums of money on sustainability research and public information. During the 1990s, a great deal of research was conducted, especially in the field of materials and life cycle requirements. However, the

impact on practical construction has not been significant. In some cases, market factors and ineffectiveness have slowed down innovation (Working Group on eco-efficiency, 1998).

Experimental ecological areas currently under construction have drawn a great deal of attention and the advancement of sustainable building depends largely on their success. The most important project at the moment is Viikki, one of four new Scandinavian eco-cities. It is located near Helsinki, where construction began in 2000. Ambitious goals have been set for the architecture, experimental research projects and the consumption of thermal energy. (The latter will be reduced by a minimum of 30% under the normal level). Moreover, the Government Programme for Ecologically Sustainable Construction states that the experiences with Viikki will serve as a basis for decisions regarding the broader application of measures to other areas owned by the City of Helsinki. Difficult soil conditions have increased investment costs in the area. Viikki can efficiently promote sustainable construction, but could also give sustainable construction an expensive - and complicated - reputation (Hakaste, 2000).

In Finland, buildings consume 40% of the country's primary energy. In 1999, 22% of the primary energy was used for space heating. The construction and real estate sector produces one-third of Finland's annual CO_2 emissions. Buildings in Finland are so well insulated that the annual amount of energy used per cubic metre is similar to that of southern countries. During the seventies, triple glazing was introduced in windows. In addition, heat recovery equipment is being installed in more and more new buildings.

However, according to the energy audits of buildings and processes, which were supported by the Ministry of Trade and Industry, buildings have a conservation potential of up to 20.5% in heating, 7.6% in electricity and 13% in water consumption.

The Finnish government has set one main environmental challenge for the construction and real estate sector: it must obtain the resources to achieve the Kyoto targets in 2010. The government has prepared a strategy for saving energy in buildings. This strategy includes the following: tightening building regulations, supporting the construction of low energy houses, establishing more requirements regarding efficient energy in renovations and introducing renovation incentives. The new, more stringent, building regulations are scheduled to enter into force in 2003. However, the implementation of other measures is currently under consideration.

The National Technical Research Institute, VTT, has developed a low-energy house that reduces the need for heating by 60-90% without remarkably increasing investment costs. According to the calculations, if all new construction is based on low energy principles, it will be possible to achieve annual energy savings of 7 TWh as early as 2020 – a figure equivalent to the annual energy produced in one Finnish nuclear power plant. Energy saving

measures that can be combined with basic renovation and maintenance measures have the potential to save up to 10% in thermal energy. It would take approximately ten years for investments in these measures to pay for themselves.

Finnish national strategy aims, among other things, to conserve natural resources and promote by-products. The national government wants to promote the use of wood in construction, which is not as common in Finland as often believed to be the case in the other countries. The country's very stringent fire regulations, however, pose a major obstacle to the use of wood in public buildings and apartment complexes of over three stories.

It is estimated that in 1997 some 1.1 million tonnes of construction waste was generated on Finnish construction sites: 20% came from new building construction, approximately 50% from renovations, and the remaining 30% from demolitions of entire buildings. Approximately half of the new construction waste, when measured in weight, is used on-site as a landfill. One third is disposed of in dumps, and under a third is re-used. In 1997, the utilisation rate of demolition waste in the average rehabilitation project was around 20% (Perälä & Nippala, 1998). Altogether, the construction industry in Finland produces 8 million tonnes of waste every year, roughly 27% is recovered, and 73% disposed of (Finnish Environment Institute, 1999). Major future challenges to sustainable building in Finland include the need for waste reduction and more effective recycling of building materials. The *National Waste Plan* set a concrete target for the year 2000, requiring 50% of all building waste to be graded and recycled. The corresponding target for 2005 is 70%.

Construction and demolition waste in Finland is not commonly re-used as a product: it is demolished for use as a new material, or is burned, which is significant in energy consumption as most of the material waste is wood. Demolition of entire buildings is rare, because the existing stock is so new. More efficient profit and re-use of waste is limited by high costs of work and lack of knowledge in practice. With the exception of southern Finland, long distances to recycling stations are also a problem as the country is large and sparsely inhabited.

Accessibility is an important concern in Finland. It is often discussed in terms of 'life cycle living' within the concept of sustainable building. Preparations for housing for the ageing population is also a major issue in the national *Housing Policy Strategy 2000-2003* (Fredriksson, 2000).

So far, sustainable construction in Finland has focused on new construction. In the future, the concept must expand to include renovation of the existing stock and urban renewal. The existing housing stock in Finland is new: 65% of rental housing was built after the energy crisis in the seventies. Investments in renovation now correspond to those made in new building production. The state supports housing renovation with the repair grant scheme. Subsidies can be obtained for a variety of reasons, including for installing lifts, elimi-

nating health risks and covering the costs of condition assessment or renovation planning. The aim is to encourage maintenance and to improve the housing stock. During the recession, investments were also made for the purpose of maintaining employment in the construction sector. Nearly all new housing developments are a mixture of private sector, owner-occupied residences and social rental housing. This has been done in order to establish socially integrated neighbourhoods.
The Ministry of the Environment has financed, and the Finnish Real Estate Federation co-ordinated, projects that have developed instructions for ecological building management. The Ministry of the Environment emphasises that the task of improving energy efficiency in the building stock calls for more than just making an impact on new construction. Energy consumption in old buildings must be reduced by means of renovations and new heating systems. The Ministry of the Environment is also preparing, together with the construction industry, energy labelling for residential units and building components, such as windows. One way to promote renovation in the existing stock would be volunteer energy saving agreements between the residential sector and the government. However, renovation incentives, which would enable environmental improvements, cannot be taken further without increasing funding.

7.4 Implementation of the national strategy

This section examines the implementation of government strategy in daily construction practice. Section 7.4.1 describes implementation through environmental requirements in building regulations. Section 7.4.2 presents four Finnish tools, which evaluate building scale projects from different aspects and are used in daily construction practice. The government's strategy influences building regulations and tools, which in turn, influence the social housing sector. These relationships are examined in section 7.4.3.

7.4.1 Environmental building regulations

Building regulations in general
Finnish building regulations are laid down in the *National Building Code of Finland*, the *National Building Act* and in the *National Building Decree*. The National Building Code applies to all new building projects.
The *Land Use and Building Act*, which supports sustainable development, was introduced in 2000. The act aims at achieving a healthy, safe, socially functional and esthetical environment, and emphasises more systematic environmental impact assessment and public participation. Local decision-making is enhanced. The quality of buildings, the consideration of environmental

aspects, and the lifecycle approach, are key targets in the supervision and management of construction. Longevity, flexibility, and well-planned management of buildings are factors of consideration. The quality of buildings is promoted with the qualification categories for the parties involved in the construction process.

Energy saving

The ambition level of Finnish thermal requirements is among highest in the world. The current energy regulations date back to 1985. They focus on U-values, the thermal transmittance values for the exterior enveloppe, as the main design criteria. The building regulations set the maximum permissible U–values.

The national government wants to continue to tighten thermal isolation requirements. The objective is to improve them by 30% from the current level in 2003. In 2000, requirements regarding U-values were tightened. In the near future, energy regulations will be revised to focus primarily on total energy consumption per floor area. This will bring about a shift in the focus of building assessments: from examining details to viewing buildings as entities. In addition, there will more compensation possibilities to fulfil the energy requirements. The new model is expected to enter into force in 2008 at the earliest.

In Finland, heat recovery in the ventilation systems is widely used, but not obligatory. In the future, heat recovery may become mandatory in most buildings. It is likely that the use of mechanical ventilation will increase in future. However, contrary to the common European trend, the number of cooling systems in use is not likely to increase rapidly because of the climate.

In Finland, the extent of construction activity allowed on sites is calculated using the outside wall measures. A thicker structure decreases the usable floor area, which in turn, increases investment costs per usable floor area. According to current regulations, if the outside wall of a building is more than 250mm thick, the floor surface of the building can exceed the otherwise permissible maximum surface area with the area of the wall structure.

Materials and waste management

Material-related building regulations in Finland are based on the European Union directive on hazardous substances. Finland also has regulations on indoor climate quality, which concern radon and formaldehyde. Asbestos is completely banned. Generally, the building regulations do not take account of the environmental aspects of building materials. On a component level, Finland has few mandatory requirements regarding insulation components.

There are a few environmental classifications for building products in Finland. However, their use is not obligatory, and the entire issue is still relatively new in the market. Some products adhere to the *Environmental Description*; this contains information on LCA-based environmental burdens, recycling

guidelines, and recommendations for use, which aim at ensuring durability. In Finland, material preference lists do not exist as such. Generally, progress in environmental knowledge about building materials lags behind that achieved in energy efficiency. The *Classification System for Indoor Climate* was adopted to promote healthy building. This system is supplemented by emission categories for finishing materials. Over 200 finishing materials available on the market are classified in the first category of low emission materials. Indoor quality and mould are important issues in sustainable building.
In 2000, the requirements concerning the *Maintenance Manual* for buildings were introduced in building regulations. The maintenance manual is a document, which advises users on maintenance for the materials and equipment used in new buildings. It is a data management system equivalent to a car service book. Its aim is to ensure proper maintenance of property and to improve the performance of maintenance work. Compilation of maintenance manuals is mandatory for state-subsidised housing. In the future, these manuals will also be required for private sector housing. Manuals are not required for renovation projects, but are recommended.
Finland has mandatory legislation that concerns selective demolition, waste re-use and landfill in the building industry. Waste requirements are based mainly on the *Waste Decree* and the 1994 *Waste Act*, which was drawn up in keeping with EU directives. Under the Waste Act, environmental authorities are required to set up national and regional waste plans. The regional waste plans were drawn up in 1996. The National Waste Plan entered into force in 1998 and will be revised in 2001. The construction sector is one of the main target groups of the Waste Plan. In 1996, the government made a decision on construction and demolition waste. Under that decision, construction waste must be separated into four groups: wood, metal, stone materials, and mixed waste.

Water conservation
Due to Finland's ample water supply, little attention has focused on water conservation in sustainable building. There are no mandatory requirements regarding water conservation in buildings. However, the use of water conservation equipment has become common in construction, even though it is not required by law. The rainwater collection is not common, partly because of the cold climate.

7.4.2 Tools to support sustainability in decision-making

PIMWAG
PIMWAG ecological criteria were developed to evaluate housing projects in the experimental housing area, Viikki (see 7.3). Every project in this area is required to meet certain basic criteria in order to qualify for a building permit. PIMWAG assesses the environmental performance of housing projects,

taking account of five aspects: pollution, natural resources, health, natural biodiversity and nutrition (Aaltonen & al., 1998). The data output consists of a table, which presents the points scored by the project for each criteria. The scores range on a scale from 1 to 3. One disadvantage to this method is that it is not computer-aided. For this reason, calculations have to be made using separate programs. The scope of the method is quite limited, which makes it somewhat impractical. What makes PIMWAG interesting is that its use can become common practice. A surveillance group is currently collecting feedback from users. If that feedback is positive, PIMWAG may be used more extensively in governmental building projects. Energy efficiency and life cycle issues will improve in the next version.
PIMWAG can be used in sustainable housing management to define, rate and compare the environmental performance of a housing project. It could also be adjusted for use in renovation projects.

EcoProP
EcoProP is a computer-based tool, which helps real estate owners to set measurable environmental requirements for sustainable design and maintenance at the onset of a building project. Unlike the PIMWAG method, EcoProP does not aim so much to evaluate the environmental value of buildings, as it does to offer a systematic method for taking account of environmental properties in building projects and setting targets for them. The EcoProP classification of building properties consists of the following: building performance, cost properties, environmental properties and the implementation process (VTT, 2001). The measures are not limited to environmental characteristics only. The tool also takes account of such aspects as design, implementation and safety.
EcoProP requires a great deal of data. This is due to its extensive approach, which will also cover the costs associated with performance requirements, based on a few categories. Once it is completed, EcoProP will be a useful tool for sustainable housing management. It can be used as a database for setting sustainability targets, for environmental benchmarking and for verification of the targets established.

LCA-House
LCA-House is a material-oriented and a computer-aided tool. It presents the environmental impacts of standard structures based on a life cycle analysis. It also compares the results to alternative structure possibilities. LCA-House is geared primarily towards designers, researchers, builders, owners and material producers. The data for the program was drawn from the construction industry. The tool emphasises the environmental burden of overall energy consumption and emissions during the entire operation phase, more than the environmental burdens resulting from the material production (Vares, 2000).

Housing associations can use LCA-House as an environmental profiling tool for buildings, as well as for the marketing or benchmarking different buildings and individual building products.

Environmental Classification of Buildings
A research project, now being conducted in co-operation between several actors, including ATT, is preparing the Environmental Classification of Buildings. This tool is similar to the BREEAM, and is being testing in pilot projects. Use of the Environmental Classification in Finland will be voluntary. First, users needs to give background information about the building evaluated. This information should cover such aspects as energy consumption, waste, adaptability, information technology in building and location and transport. The classification evaluates the consumption of natural resources, waste and emissions, the biodiversity of the construction location, transport and service, environmental risks and health aspects. The outcome of the evaluation is based on indicators for measurable ramifications and on performance aspects. The aim is to enable use of the assessment documentation as an attachment to official procurement documents and contracts (RAKLI, 2001).
Housing providers can use the Environmental Classification for environmental labelling of their housing and for benchmarking purposes. Based on the findings of the pilot projects, the Environmental Classification of Buildings will be developed further in 2001; it will be published and marketed in 2002.

7.4.3 Discussion

Finnish strategy for sustainable building is based on a voluntary approach. However, the Finnish thermal regulations have traditionally been among the most stringent in the world, even before the concept of sustainable building was properly introduced. Finnish waste requirements do not reach the ambition level of the energy regulations, and water conservation in buildings is not supported in legislation. Finnish building regulations apply primarily to new construction. Although renovations are expected to bring older housing up to the standards of new construction, in practice, this is required in state subsidised housing only.
Environmental assessment is a relatively new issue in Finland. Recently, however, it has formed the focus of much research. Table 7.1 presents characteristics and application areas for the four Finnish tools presented in this section. Current methods and tools focus mainly on new buildings and take account of energy, materials and waste. LCA-House is based on a life cycle analysis. Material checklists are not used in Finland. The table shows that not many tools are available for evaluating the existing stock and specific tools for sustainable housing management have yet to be developed. EcoProP is a method for setting environmental requirements at the onset of a building project. But

Table 7.1 Characteristics of four Finnish tools

Characteristic	PIMWAG	EcoProP	LCA-House	Classification
Development activity				
New construction		x	x	x
Renovation				
Management		x		x
Issues				
Environmental	x	x	x	x
Economic				
Social				
Spatial level				
Material level			x	
Building level	x	x	x	x
Urban level				x

unlike PIMWAG, it is not really an assessment tool. Environmental Classification for Buildings is a new tool, which once completed, can also be useful for housing management purposes. An interesting method currently under development is the BSPro COM Server program, which is a link that enables data transfer between different program adaptations. With the current version, for example, data concerning building geometry can be transferred from the architect's CAD plans directly to calculation tools in energy simulation and other programs.

7.5 Environmental efforts in the social housing sector

This section examines Finland's social housing sector and how it has responded to the government's programme of sustainable building. Section 7.5.1 begins with background information about social housing in Finland. Section 7.5.2 then goes on to present examples of sustainability in practice.

7.5.1 Social housing in Finland

Finland's social rental housing is financed with a state-subsidised loan. Social housing providers are public communities and non-profit housing societies. In 1998, the number of social rental residences was 392,000, which accounts for 52% of the total rental stock. This figure also includes residential units for the elderly and students. In 1999, 42% of the residences completed were built for the social housing sector (Haffner & Dol, 2000). The volume of social housing has been increasing slightly, because during the recession in the nineties, the government strongly supported the construction of new dwellings.

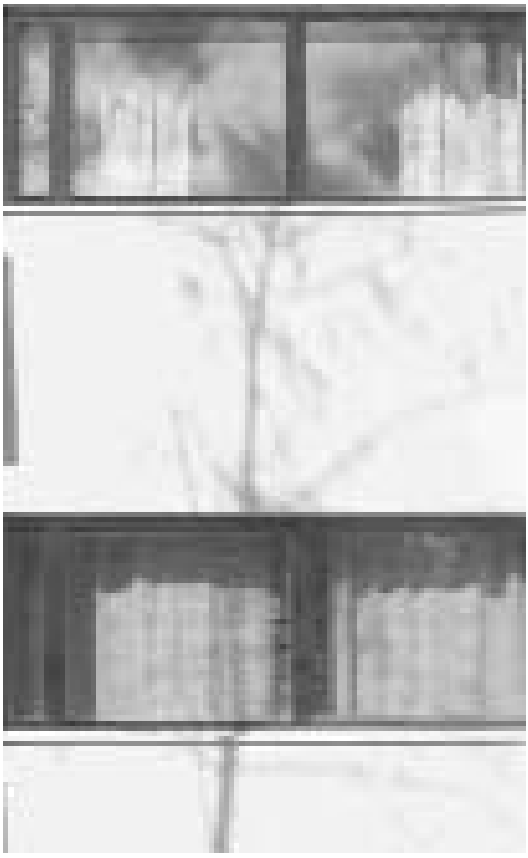
Housing allowances in Finland are is not restricted to social rental housing. They are also available for rental housing in the private sector. In 1999, 51% of housing allowance recipients lived in social rental housing. People living in owner-occupied homes have significantly higher incomes, but the new social housing projects are high in quality.

The Housing Fund of Finland, ARA, which works under the Ministry of the

Environment, is an important contributor to Finnish housing policy. The ARA´s principal functions include granting state loans, approving interest subsidies for social housing, controlling prices and the quality of construction and renovations in state-subsidised housing, and allocating repair and other grants for housing. Under the regulations for state-subsidised housing, which entered into force in 1998, new construction projects must be examined from the standpoint of life-cycle economy. The focus has shifted gradually shifted from minimising initial project costs, to examining the life-cycle costs of a building and its effects on the environment and health.
The Ministry of the Environment stated in the program for Ecologically Sustainable Construction that it will draw up sustainability targets for state-subsidised housing. The Ministry wants to integrate environmental objectives in housing subsidy criteria. So far, however, no action has been taken. When, and if, this plan is actually implemented, it will make social housing providers more conscious about sustainable building.
Social housing providers in Finland are not organised under one umbrella organisation. However, in order to present a general picture of practical measures, this paper steers away from the method used for other countries in this inventory and examines one Finnish housing association. *Helsingin Kaupungin Asuntotuotantotoimisto* (ATT) is the housing production department of the City of Helsinki. It is one of the largest housing developers and managers in Finland. ATT builds rental, right-of-occupancy, and ownership housing. The City of Helsinki owns about 45,000 rental apartments, which are managed by 21 independent housing companies. ATT is also responsible for the renovation of the housing stock owned by the City and the aim is to renovate about 2,000 apartments annually.

7.5.2 Housing provider and sustainability

The ATT, the housing production department of the City of Helsinki, is managed according to the principles adopted by the City and the requirements set by its financiers, such as the ARA. In addition to the *Government Housing Program*, which takes account of environmental issues, the most important policy documents are the *Environmental Program* and the Environmental Management System of the City of Helsinki. Generally, the ATT sees the national programme for Ecologically Sustainable Construction as a guiding document that offers principles, rather than as an action plan, which would require radical changes in current practice.
The City of Helsinki calculates an annual *Environmental Balance* in order to survey implementation of its environmental objectives. ATT is also required to do this, and the environmental balance calculation will be integrated into its Quality Management System. In the future, the ATT aims to develop environmental indicators, and to present financial calculations of the environmental impact of



If the Housing Fund of Finland will integrate environmental issues in the subsidy criteria, it will make social housing providers very conscious about sustainable building.

its actions. In 2000, the quality objectives relating to the environment were:

- In new construction: to define targets for energy and water use and waste separation in the design guide, and to take account of life cycle objectives in choosing building materials.
- In renovation projects: to improve energy efficiency in buildings, eliminate health risks caused by construction damage, and to establish regulations for demolition waste at demolition sites.
- In its own actions: to reduce unnecessary waste, separate paper waste and packaging materials, and avoid using throw-away products.

In the experimental ecological area in Viikki, ATT has built two pilots of sustainable housing. One of these includes three, and the other, seven buildings. If the solutions tested prove effective, they can be integrated into normal housing production and management. The energy supply for one pilot project in Viikki consists of a combination of solar panels and district heat. The ATT believes that emission-free solar energy will become more important when environmental costs increase. Energy savings have been achieved with extra insulation in the enveloppe, the use of super windows, which have a U-value of 1.0, heat recovery, the use of thermal buffer spaces and the use of communal areas, such like saunas and a laundry facilities. So far, energy targets have been used only in experimental construction. Water conservation has been achieved with the use of water conservation equipment, a residence-specific consumption measurement and the collection of rainwater. In the ATT, environmental improvements, such as the use of water conservation equipment, electricity saving lamps or heat recovery, are considered case-specific. The investment costs and the use costs are studied from a life cycle perspective. In Viikki, construction waste was minimised by means of ordering materials and components with exact measurements.

According to the ATT, the market situation and limited resources have slowed down the use of pilot innovations in normal production. The current market

situation is not beneficial to any experimental concepts. The ATT's future aims include the following: a) producing functional, healthy and comfortable spaces; b) improving sustainable housing so as to minimise the consumption of non-renewable resources in production, maintenance, use, adaptation and demolition; c) generating as few harmful emissions as possible; and d) supporting socially sustainable development.

7.6 Conclusions

Finland published its programme for Ecologically Sustainable Construction in 1998. The national strategy is based on voluntary agreements between the government and the industry. In promoting sustainable construction, this strategy relies heavily on the environmental consciousness of market forces. It is too early at this stage to evaluate the impact of this programme. However, the programme's potential for success is doubtful given its general and voluntary nature, as well as its lack of any actual time frame for its objectives and measures to achieve those objectives.

Due to the cold climate, energy saving is a priority in sustainable building in Finland. The thermal requirements in building regulations are very stringent, and the government's objective is to improve them by 30% in 2003. Progress in material and waste requirements lags behind that achieved in the field of energy. The reduction of waste and more efficient recycling are important challenges for the future.

Although environmental assessment is a relatively new issue in Finland, several methods and tools have been developed for the evaluation of the built environment. Most of these focus on technical issues, such as energy consumption or materials. However, there are also methods for rating buildings from a holistic point of view, such as PIMWAG and the Environmental Classification of Buildings. No special tools have been developed for the sustainable housing management process, although current methods can facilitate this task.

Unlike the other countries studied in this inventory, Finland does not have an umbrella organisation for social housing providers. Even if the volume of the social housing sector is small, an organised umbrella organisation could offer advantages. 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.

8 National strategies and their implementation

8.1 Introduction

This chapter presents a comparative analysis between the Netherlands, Germany, France, the United Kingdom and Finland. The structure and research approach used are explained in section 1.2 of the introductory chapter.
Section 8.2 begins by describing the environmental policies in general. Section 8.3 presents similarities and differences in national strategies regarding sustainable building. This study on public strategies aims to answer the following questions:

1a How is sustainable building related to the national environmental and energy policy?
1b What are the main approach and concrete objectives in the national strategy for sustainable building?
1c Does the strategy also apply to the existing stock?

Section 8.4 compares policy implementation through environmental requirements in the building regulations and tools that have been developed to support sustainability in decision-making. The study on regulations and tools aims to answer the following questions:

2a What principal requirements have been formulated in national building regulations in order to support the national strategy for energy saving, materials and waste management, and water conservation?
2b What are the characteristics of four national tools for environmental impact assessment, and how can they be used in housing management?

Finally section 8.5 describes the impact of the national strategy on the (social) housing sector. This section aims to answer the following questions:

3a What is the environmental policy of social housing providers in relation to the public strategy?
3b Has the (social) housing sector concluded environmental agreements with the government, or carried out development work in the field of sustainability?

Conclusions and recommendations are formulated in chapter 9.

8.2 Environmental policies

The Netherlands, Germany, France, the United Kingdom and Finland have all developed environmental policies since as far back as the seventies. However, environmental policy at that time was regarded more traditionally as nature protection. This continued to be the case until the 1987 Brundtland report and the 1992 United Nations Conference in Rio introduced an extensive concept of sustainable development with environmental, economic, social and cultural dimensions. One essential aspect of sustainable development in all

five countries is that it should allow economic growth, while reducing the burden on the environment. Since 1998, this 'absolute delinking' has been an objective of the European Union. Nevertheless, even if the social and cultural issues of the concept are recognised in theory, they have clearly received less attention than environmental or economic aspects in the national strategies.
The construction sector is one main target groups of environmental policy in every country. The governments see this sector as the focus of sustainable development. Construction-related objectives primarily concern the consumption of resources and land use. At a more concrete level, they focus on energy savings in order to support the Kyoto targets and reduce waste. Housing as a right for all is considered important in achieving sustainable development, but otherwise there is less interest in cultural and social issues than on environmental and economic aspects.
According to the United Nations' expectations, a set of national indicators for sustainable development has been developed in all five countries. A number of these indicators concern the construction sector, both directly and indirectly. So far, however, these indicators have remained fairly distant from daily construction practice, and have not been linked to the environmental assessment methods currently used.

Energy policies, and views on the environmental impacts of different energy sources, differ between countries. For example, Germany and the Netherlands have made plans to gradually phase out their nuclear power facilities in upcoming years. Nuclear power in France, however, has not been perceived to be a problem. Until recently, nuclear power in France was encouraged. In fact, in 1998, 80% of France's electricity came from nuclear sources. Finland has witnessed a long-standing political debate about building a third nuclear power plant, though it has no plans to reduce the amount of energy from nuclear sources in the future.
If the Kyoto Protocol is ratified, it will place real pressure on these countries to reduce their carbon dioxide emissions by 2010, varying from -21% for Germany to 0% for Finland as compared to the emission level in 1990. In addition to energy saving, the Kyoto objectives require more efficient use of renewable energy sources, which is already a major government objective in all five countries. Despite the problems and costs involved, this is one of the few options for separating economic growth from energy consumption, and for achieving energy self-sufficiency, especially if nuclear power is phased out. Currently, the amount of energy from renewable sources is very small in all countries. The European Union has undertaken to double the amount of renewable energy from 6% in 1995 to 12% in 2010. However, the definition of 'renewable' has remained fairly open between countries. Many 'green' energy sources are in fact 'greyish green', as they also place a burden on the environment and are, therefore, not clean.

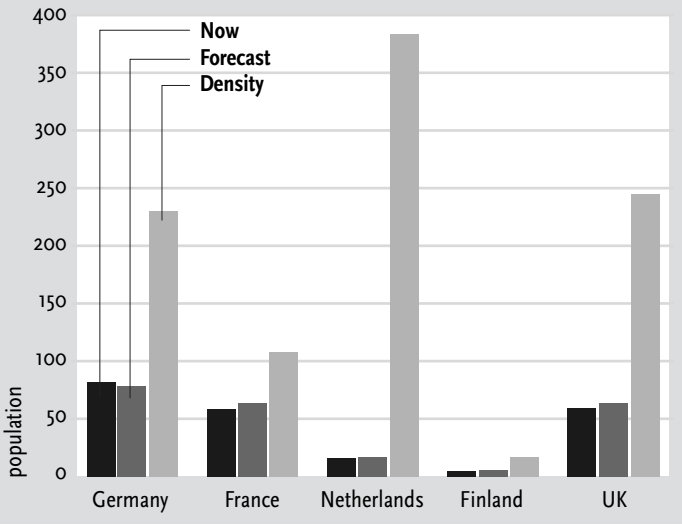
Table 8.1 Demographic and economic data that has impact on housing

	Population (million)	Population growth (%)	Population forecast (million)		Population density (population/km²)	GDP per capita at market prices (x 1000 ECU)	
	1999	1980-1999	2010	2020	1999	1991	1997
The Netherlands	15.8	11.1	16.4	16.9	384	15.6	20.5
France	58.5	8.9	61.7	63.5	108	17.0	20.9
Germany	82.0[1]	4.8	81.0	78.4	230	17.4	22.5
Finland	5.2[2]	7.9	5.3	5.3	17	19.6	20.6
UK	59.2[2]	5.2	61.6	63.5	245	14.1	19.3

1) Including population of the Ex-DDR 1980: 16.7 million.
2) SF, UK: 1998.

Source: Haffner & Dol, 2000

Figure 8.1 Population, population forecast and density



It should be stressed that when international objectives are transformed into national strategies, differences arise due to factors, such as density, national economy, geographical and climate conditions. Table 8.1 and figure 8.1 present basic information on variables, which may have an impact on national sustainable building strategies.

The population density, which places pressure on new construction and has an impact on land use, varies considerably between countries. As the most densely populated country in the Europe, the Netherlands is facing a shortage of land for construction and the importance of preserving green spaces already in the near future.

However, even the key figures in table 8.1 do not present the actual situation very well. Even though the population has not really grown in these countries, with the exception of a small increase in the Netherlands, an outstanding population trend has emerged: the centralisation of population and economic wealth in certain, very limited, areas. This kind of development is highly unsustainable both in terms of the ramifications of overpopulation and the diminishing populations of other parts of the country. In the Netherlands, for example, the four largest cities form an area called the Randstad, which is inhabited by some 9.7 million people, over half of the Dutch popula-

Figure 8.2 Gross Domestic Product per capita at market prices (x 1000 ECU)

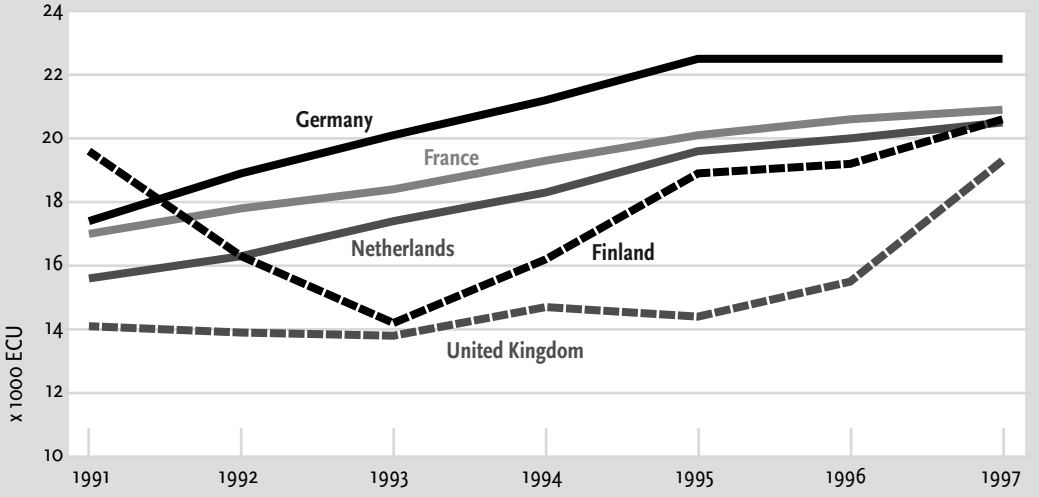
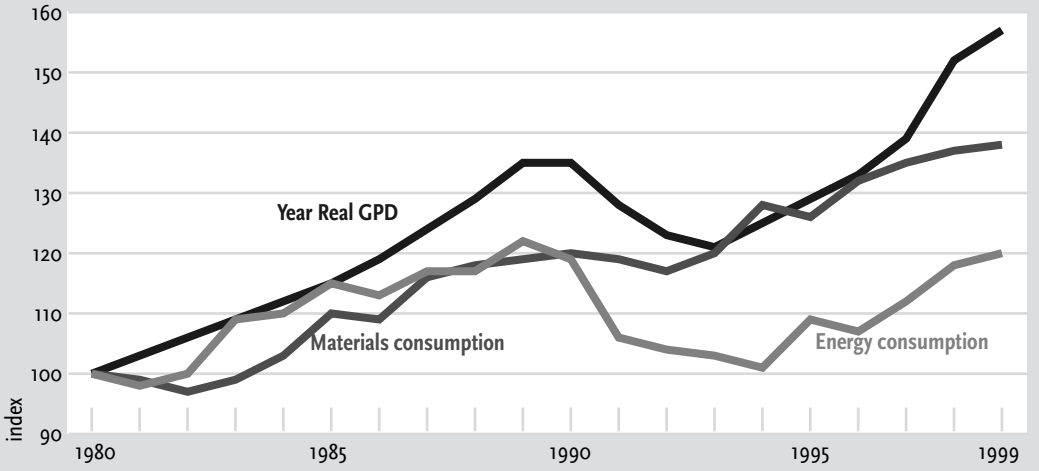


Figure 8.3 Trends in real GPD, energy and materials consumption (1980=100)



tion. The population density in this region is over 1,205 inhabitants per km^2. Although Finland is otherwise sparsely populated, the Helsinki Metropolitan Area has gained a population of 0.89 million people with a density of 1,199 inhabitants per km^2. The problems that follow are similar, including a lack of good construction land, pressure on environmental areas, mobility problems, a housing shortage and increasingly serious environmental problems, such as air pollution. This concentration of the spatial structure is a serious problem, which lacks adequate attention in environmental policies.

Figures 8.2 and 8.3 show that all five countries enjoy an economic growth associated with increased energy consumption and CO_2 emissions, which makes environmental objectives more difficult to achieve.

8.3 National strategies for sustainable building

According to the importance recognised in environmental plans, the governments have defined strategy plans for the construction sector. The Netherlands, Finland and the United Kingdom have described their objectives in programmes for sustainable building. The German government has not defined a separate, corresponding action plan for the construction sector, but has integrated environmental targets in an extensive system of building regulations and norms. In addition, Germany's environmental policy covers several areas of construction. Despite other initiatives, France has not yet established a separate action plan for sustainable buildings, but even the French programme for sustainable development covers several areas of construction.
In the national programmes, sustainable building is seen primarily in terms of ecological construction: management of biodiversity, tolerance of nature and conservation of natural resources. The public policies emphasise the importance of energy conservation, reductions in CO_2 emissions, prevention and re-use of waste, life cycle issues, healthy indoor environments and efficient land use. The strongest driving forces to make vague aims more concrete include the Kyoto Protocol and the European Union directives, which place pressure on energy saving and waste reduction. Recognition of the problem of climate change is guaranteed to keep energy conservation at the focus of attention in the future. Due to an ample water supply in all five countries, water conservation in buildings often seems to be overshadowed by other issues.
Corresponding to the general strategies for sustainable development, environmental and economic values are well represented in the national programs for sustainable building. Social and cultural dimensions, however, receive less attention. For example, spatial quality, adaptability for future use and accessibility, which are important factors in terms of ensuring a long life span in buildings, are not often discussed in sustainability policies. The risk in the technically-oriented approach is that the progress achieved regarding issues, such as energy, can be negatively counterbalanced in other areas, such as materials or indoor climate, if those areas are not taken into account. Currently, sustainable building tends largely to be limited in its focus to building interiors and their technical aspects. So far, France has not taken many steps towards sustainable development in practice. All the same, its approach is extensive and takes account of a few aspects ignored by many other countries, such as location and the spatial quality of buildings.
Building scales are not clearly linked in public policies to the urban development. If this continues as a trend, it can lead to an undesirable situation, where sustainable buildings emerge in an unsustainable environment. The Netherlands and the United Kingdom have already emphasised that scope of

So far, national strategies have not proposed measures for sustainable renovation and stock management. However, the annual volume of new construction is very small and the CO_2 targets cannot be achieved without renovating existing housing.

their programmes in the future will expand to include social aspects and urban renewal.
Sustainable building policies in all five countries focus on new buildings. However, the annual volume of new construction is very small compared to the capacity of the existing building stock. The governments recognise that the next challenge is to adopt the concept in improving the existing building stock. So far, however, national strategies have not proposed measures for sustainable renovation and stock management. The aim of the German government is a 25% reduction in CO_2 emissions in 2005 as compared to the level in 1990. This means a physical reduction of some 32 million tonnes in the residential sector. Dutch households face the challenge of reducing their CO_2 emissions by 25 million tonnes between 2000 and 2012. These targets cannot be achieved without renovating existing housing.

The government programmes focus on the near future, but seldom set time frames for their objectives, or describe measures to achieve them. The study on the national strategies suggests that it makes a difference whether the objectives are qualitative or quantitative, and whether the approach to sustainable building is voluntary or mandatory. Germany and the Netherlands already have long-term environmental policies, and both have adopted strict approaches. Both use specific quantitative targets, which can be measured and controlled. Consequently, partial results have been achieved. Germany has managed to stabilise its energy consumption and waste production despite of economic growth. Sustainable construction is a well-known issue

in the Dutch construction sector; in 2000, 80% of all new buildings were estimated to adopt sustainability measures from the National Packages for Sustainable Building. The strategy, which relies on legislation or environmental taxes, also poses disadvantages. For example, in Germany, the implementation of more stringent thermal regulations in the existing stock can significantly reduce energy consumption and CO_2 emissions in the residential sector. However, it places extra pressure and nearly unacceptable costs on housing owners and tenants.

Conversely, the governments in France, the United Kingdom and Finland have adopted a voluntary approach to sustainable building, which relies heavily on the environmental consciousness of market actors. In their sustainability strategies, they use qualitative and descriptive objectives, which take account of the complexity of sustainability issues. At the same time, however, these objectives are open to different interpretations and difficult to verify. These three countries recognised environmental problems somewhat later than did Germany and the Netherlands. Therefore, the concept of sustainable building needs to be better known in the construction sector before any measures are taken to make it more mandatory. In Finland and the UK, government authorities see sustainable building as a way to promote the competence of the construction industry, which is they measure its success in financial terms as well. However, it is doubtful whether market actors are sufficient to promote sustainable construction, especially when the market demand is still low. Sustainable building can fall prey to – or be supported by – economic trends. There is a risk, therefore, that it will become limited in its focus to areas of greatest financial profit.

8.4 Implementation of the strategy

This section compares the implementation of national strategies in terms of mandatory building regulations and voluntary tools. Section 8.4.1 focuses on environmental requirements in building regulations, which are studied according to the research themes: energy saving, materials and waste management and water conservation. Section 8.4.2 presents a general comparison of tools developed to support sustainability in decision-making. Section 8.4.3 concludes with a discussion about relationships between the policy, its implementation and its potential impact on the social housing sector.

8.4.1 Environmental building regulations

Building regulations in general

Building regulations are often seen as an efficient way to force current construction practice towards more sustainable practice. In the Netherlands, for

It is doubtful whether market actors are sufficient to promote sustainable construction. Sustainable building can fall prey to – or be supported by – economic trends. There is a risk, therefore, that it will become limited in its focus to areas of greatest financial profit.

example, the government's objective is to integrate sustainability standards, which are based on the National Packages, in the building regulations in the near future.

Traditionally, building regulations have been feature-based, as they still are in countries such as Finland. However, a trend has emerged towards more performance-based requirements, such as is the case in the Netherlands. This latter type of requirements allows designers more freedom in fulfilling regulation targets.

Corresponding to the priorities in the government programmes, environmental requirements that concern the building industry are focused primarily on energy, indoor air quality, waste and emissions of hazardous material substances. Due to the European Union directives and national Kyoto strategies, many measures are now being taken in environmental legislation. All five countries are now revising regulations, especially those on thermal energy.

Energy saving

In all five countries studied, the thermal requirements have been gradually tightened in order to reduce energy consumption, CO_2 emissions and the life cycle costs of buildings. Table 8.2 compares the U-values required in building regulations. Due to its cold climate, Finland has traditionally had one of the most stringent thermal requirements in the world; requirements regarding the U-values for the outside enveloppe are especially stringent. However, the government wants to continue tightening energy requirements, and its objective is to improve these requirements by 30% from the current level in 2003.

With its new proposal, Germany will achieve, and even surpass the Scandinavian standards. The new regulations aim at reducing CO_2 emissions by 30% as compared to the situation today, and they will also account for the existing housing stock.

Similarly, the Netherlands has improved its performance with stringent

Table 8.2 Comparison of the current allowance U-value (W/Km²) requirements

Component	The Netherlands EPC 1,0	Germany	France	UK SAP>60	UK SAP<60	Finland
Exterior wall	0.37	0.56-0.20[2]	0.46	0,45	0,45	0,28
Roof and ventilated floor	0.37	0.17	0.23/0.36[1]	0,20	0,25	0,22
Ground floor	0.37	0.28	1.40[3]	0,35	0,45	0,36
Door (closed)	3.40	1.40	- (ref. 1.50)	3,00	3,00	0,70
Window, glass	1.70	1.40	2.90	3,00	3,00	2,10

1) Roof / floor.
2) Highest value is for middle dwellings in detached houses and apartment buildings, and the smallest value is for the dwellings at the end of housing with normal heating system and whose density is not measured.
3) 0,5 metres from the outside wall the reference value is 0,30.

Source: Kalema & al., 2000

requirements regarding for window insulation. Requirements regarding the EPC value, which represents energy efficiency in residences, have been tightened since 1995. However, as table 8.2 shows, the Netherlands can still improve as compared to Finland and Germany.

In the United Kingdom and France, thermal insulation requirements have been lenient. In France, new energy regulations were introduced in late 2000, and will be implemented in new buildings in 2001. The new measures should bring about a 60% savings in energy consumption in new housing as compared to the majority of housing, which was built before 1975, when the first thermal requirements entered into force. In the UK, the Home Energy Conservation Act requires local authorities to plan a 30% reduction in CO_2 emissions from domestic premises in 2011.

The Netherlands and the United Kingdom employ fairly similar methods for calculating energy consumption in residences. These are the EPC (*Energie Prestatie Coëfficiënt*) and the SAP (*Standard Assessment Procedure for Energy Rating of Dwellings*). However, SAP scores in the UK are based on energy consumption costs. By contrast, the Dutch EPC is based on primary energy consumption, which is directly linked to CO_2 emissions. Moreover, the permissible U-values for the enveloppe depend on the energy source used. Thus, a residence in the UK can have a high SAP score, regardless of whether the energy came from elec-

With a few exceptions, building regulations in all countries apply only to new construction. The ambition level of the current standards should, nevertheless, be raised considerably.

EU waste disposal directives have prompted developments in waste sorting and building regulations regarding recycling. Germany and the Netherlands are pointing the way for other countries in waste management.

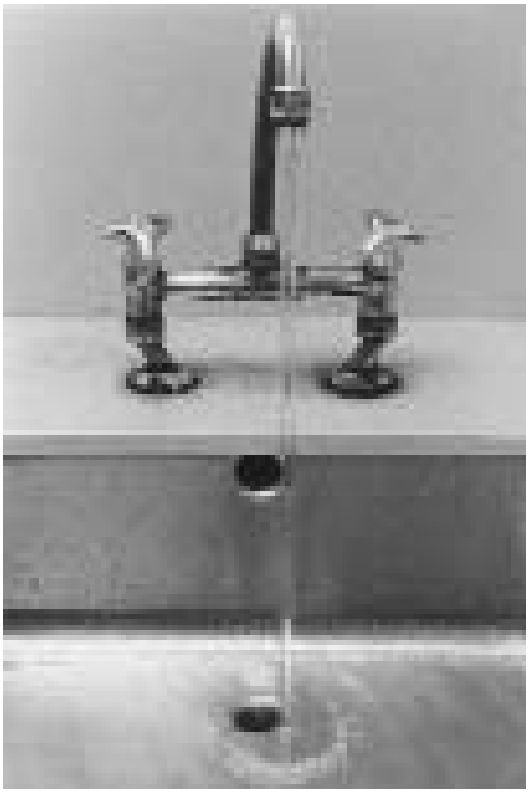
tricity or renewable sources.
More stringent thermal regulations have encouraged a tight and a dense enveloppe. This has also has side effects, which must be considered in efforts to preserve quality in indoor climates. For instance, when insulation in the enveloppe improves, interior temperatures should not rise too high in the summer. The common objective is to minimise cooling that uses electricity. The new proposals also discuss the possibility of compensation. For example, under the new French energy regulations, less substantial insulation can be compensated by better installations. However, this can cause problems, since an installations' life span is much shorter than that of insulation or other building components.

Materials and waste management
Most of the mandatory requirements in building regulations regarding building materials or products apply at the substance level. They usually concern materials or substances that influence indoor air quality, such as asbestos and formaldehyde. All five countries have taken action in regard to harmful substances as they recognise them as health hazards. A certain consensus exists about hazardous materials, a consensus based on the European Union Directive concerning hazardous substances.
Very few mandatory requirements have ever been established regarding building materials and products, except for a handful of products. The governments are reluctant to set mandatory regulations for materials, as they want to keep their role objective. Nevertheless, volunteer initiatives concerning construction materials cover a large area in building, both at the component and material levels. For instance, Ecolabels, such as the Nordic Swan in Scandinavian countries or the Blue Angel in Germany, and environmental information on construction products have been nationally developed in the Netherlands, Germany, France and Finland.
EU waste disposal directives have prompted developments in waste sorting and building regulations regarding recycling. The Landfill Directive, which requires each member state to draw up a strategy for a three-stage reduction in the quantity of biodegradable municipal solid waste disposed of in landfills, has significantly influenced national legislation. The Landfill Bans have improved the acceptance and processing of demolition and construction

Table 8.3 Comparison of material and waste measures in the building regulations

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.*

waste. The EU principles also require waste processing to take place near the production site, except in the case of re-usable materials. In addition, waste produced inside the European Union may not transported beyond EU borders. The idea that the material producer is responsible for a product until the end of its life cycle will serve a guiding principle in the future. Germany has already implemented this principle. All five countries are slowly adopting requirements concerning selective demolition, and the re-use of building



The ample supply of water in all five countries appears to have resulted in careless attitudes towards the use drinkable water. Building regulations include no requirements concerning the reduction of water consumption in buildings.

components and waste from buildings.
Country-specific initiatives for waste management are presented in table 8.3. German waste standards are among the most stringent in the world. High waste costs have made the national construction industry pay attention to the amount of materials used, re-use and recycling. Generally speaking, Germany and the Netherlands are pointing the way for other countries in waste management. Waste regulations in France and the UK are still relatively lenient. In Finland, the progress made in developing requirements for materials and waste lags behind that achieved in the field of energy.

Water conservation
Building regulations in Germany and the Netherlands can prohibit construction activities from having any impact on ground water during or after the implementation phase. In the United Kingdom, the Water Resource Law protects surface and ground water from pollution.
Despite activities to protect the ground water areas, which is an important issue in all countries, building regulations include no requirements concerning the reduction of water consumption in buildings. Dutch regulations lay down no mandatory regulations for quality improvement in the discharge of waste and rainwater.

8.4.2 Tools to support sustainability in decision-making

The governments in all countries examined in this inventory, have invested considerable sums of money in research. As a result, they have actively developed national methods and tools for environmental impact assessments of the built environment. Four methods from each country were presented in the previous country chapters and examined in light of their application areas.
The methods and tools studied focus mainly on new construction, especially on housing. Life cycle assessment is widely used as an approach. Energy consumption, indoor quality and reduction in the use of natural resources, all of which are underscored in the government strategies, can be well assessed with the current methods. Water flows, and less measurable issues, such as adaptability, receive less attention and are often entirely excluded from evaluations.
Only a few of these tools, such as EPIQR, take account of the renovation and

In the current methods, there are tools to evaluate material and building scales, mainly on the basis of life cycle analysis. Not many tools, however, take account of cost impacts. This reduces interest among market actors in using the methods.

management process. The lack of appropriate tools for the existing stock is a serious disadvantage, as building regulations do not cover these areas. Duwon, which was developed in the Netherlands, is an exception in that it focuses on the sustainable management process. This method has no equivalent in the other countries and could prove useful, with some adaptation and development, for the other countries as well. BREEAM in the UK and Environmental Classification of Buildings in Finland are similar managerial tools. Both are examples of simple sustainability labels that can express the environmental performance of a building in one value and offer a consensus for a common rating in the construction sector.
All the tools studied focus on environmental aspects. Economic and social aspects are recognised in the government policies as important dimensions of sustainable development. Not many tools, however, take account of cost impacts. The social aspects have been entirely neglected by these assessment methods. A lack of economic data poses a serious disadvantage, except in tools such as the German Legoe or Ecopro. Undoubtedly, this lack of data reduces interest among market actors in using the methods. However, hard cost data will still be easier to integrate in existing methods than equally essential social aspects, whose descriptive nature makes them very difficult to incorporate into tools.

In the current methods, there are tools to evaluate material and building scales, mainly on the basis of life cycle analysis. The life cycle approach no longer works as smoothly in the urban scale. Most of the tools, apart from a few exceptions like GreenCalc or EQUER, do not consistently consider environmental impacts in relation to the urban level, and limit themselves to a building's interior. However, in order to obtain reliable and relative assessment results and to link a building level to the urban development, aspects such as transport and biodiversity must be considered in the evaluation.
Most of the tools examined in this inventory are computer-aided, and those

that were not, such as PIMWAG, should be. There are already CAAD-based design programs, which are linked to product libraries or catalogues, where they can collect information about environmental and economic impacts of the design choices. The German CAAD integrated Legoe, which contains environmental, economic and energy data on the design choices, can serve as a design tool as well as a database for housing associations. The design process in all of the countries studied is very computerised. However, the tools could be more integrated into existing software, such as AutoCad or ArchiCad, in order to offer easy access to environmental impact data during the entire design process. The software currently used in environmental impact assessment programs is not particularly innovative.

8.4.3 Discussion

All five countries implement their public policy for sustainable building through mandatory regulations, but only partially. Germany, which implements a stringent public policy, relies mostly on regulations. As a system of regulations and norms, German building legislation is well organised. Due to the Kyoto targets, most provisions in legislation for environmental improvements have been introduced in the course of revising energy regulations. However, as the regulations apply only to new construction, except in Germany, they do not have any impact on the existing stock. Moreover, they are unlikely, as measures only, to achieve dramatic energy savings in the housing sector. Generally, initiatives to revise national legislation are prompted primarily by EU directives, rather than by national policy, which, as already explained, is mostly of a voluntary nature.

The development of tools is important especially in areas that building regulations cannot cover, such as the social and cultural aspects of sustainable development.

Assessment methods offer the construction sector information about the environmental impact of their products and services. For this reason, their development is encouraged in all five countries. The tools correlate to a certain extent to the development of national policies and focus on the priorities of the programmes. However, the governments do not support the use of these methods in any way, which could, for instance, involve requiring environmental assessments as a condition

for obtain subsidies or building permits. The use of tools is voluntary, and consequently they are not used much in daily practice, not even in housing management. Social housing providers have developed tools for their own use, though these tend more to be checklists and guidelines focused on technical and financial data than evaluation methods with a more extensive view of sustainability.

8.5 Environmental response in the social housing sector

This section discusses environmental initiatives in the social housing sector against the backdrop of government policies. Section 8.5.1 presents a general comparison of the system of social housing in different countries. Section 8.5.2 contains a discussion of environmental policies and other initiatives in the social sector, focusing on the umbrella organisations.

8.5.1 Social housing in general

Developments in public policy and legislation may more or less follow the same principles in the Netherlands, Germany, France, the United Kingdom and Finland. However, nature of social housing and national umbrella organisations, and therefore also environmental response, is very different in each country.

Aedes in the Netherlands, UNFOHLM in France and VdW Bayern in the State of Bavaria in Germany are all umbrella organisations under which housing associations are organised. The Housing Corporation in England also grants subsidies for social housing providers and supervises their standards. Finland has no umbrella organisation for social housing providers. Even though the volume of social housing is small in Finland, an organised umbrella organisation for the social housing sector could offer advantages.

Table 8.4 compares the volume of the social housing sector in each country. It shows that social housing in the Netherlands accounts for 75% of the total rental stock. The corresponding figure for Germany is a mere 15%. This is why Aedes in the Netherlands has more resources to promote sustainable building than does Germany's umbrella organisation, which despite its progress in other environmental issues, is not that advanced in sustainable housing management. 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 rent index in table 8.4, which indicates the affordability of social housing, has risen high in Finland and the UK. Since there is a limit to how high it can climb, it is relevant to environmental investments.

Table 8.4 Volume of the social housing sector

	Social rental dwellings of the total dwelling stock (%)		Social rental dwellings of the total rental dwelling stock (%)		Social dwellings of newly completed dwellings (%)		Rent index of social rental dwellings (1985=100)	
	1980	1999	1980	1999	1980	1999	1990	1999
The Netherlands	34	36	58	75	34	173	119	175 [4]
France	15	18	33	46	15	13	124	164
Germany	nav	nav	26 [1,2]	15 [1]	11 [1]/ ex-DDR 87	71 [3]/ ex-DDR 13	113 [1]	154 [1,4]
Finland	nav	nav	39	48	24	44 [3]	126	202
UK	nav	nav	71	66	45	20	156	245 [4]

1) Excluding ex-DDR.
2) D: 1985.
3) SF, D, NL: 1998.
4) D, NL: 1998; UK: 1995.

Source: Haffner & Dol, 2000

Table 8.5 Housing facts that has impact on energy efficiency and renovation needs

	Age of the dwelling stock[1] (%) (x 1000)			Dwellings newly completed area per dwelling (m²)		Average useful floor	
	1946-1970	1971-1980	>1980	1980	1999	Total dwelling stock[4]	Newly built dwellings[5]
The Netherlands	31.7	19.5	27.6	113.8	90.5 [2]	98.0	112.0
France	33.0	--32.0	—	400.0 [3]	317.5 [3]	88.0	102.5
Germany	48.0	11.0	11,0	500.8 [3]	472.8 [3]	86.7	101.9
Finland	32.5	24.7	31.0	49.6	302.0	76.0	81.8
UK	35.7	8.5	13.3	242.0	169.3	76.0	76.0

1) Latest year available NL, G, SF: 1998; F, UK: 1996.
2) NL, SF: 1998.
3) F: Dwellings started; G: Including extended dwellings and reconstructed, renovated dwellings.
4) NL, SF: 1995; F: 1996; D: 1998; UK: 1980-1996.
5) SF: 1995; UK: 1996, NL, F: 1998; D: 1999.

Source: Haffner & Dol, 2000

Table 8.5 shows how the age structure of the existing housing stock varies considerably between countries. This has a direct impact on renovation needs. As table 8.5 and figure 8.4 show, the existing stock in Finland and in the Netherlands is relatively new. Since it was built primarily after the energy crises in the seventies, it is also relatively energy efficient. The existing hous-

ing in Germany, France and the United Kingdom is older and was built according to lenient standards. France, for example, had no mandatory thermal legislation until 1975. Figure 8.5 shows how the volume of the newly constructed dwellings in 1999 has decreased in all countries as compared to 1980. Nonetheless, government policies for sustainable building, and the regulations and tools that support its implementation, are clearly focused on new construction.

Figure 8.4 Age of dwelling stock

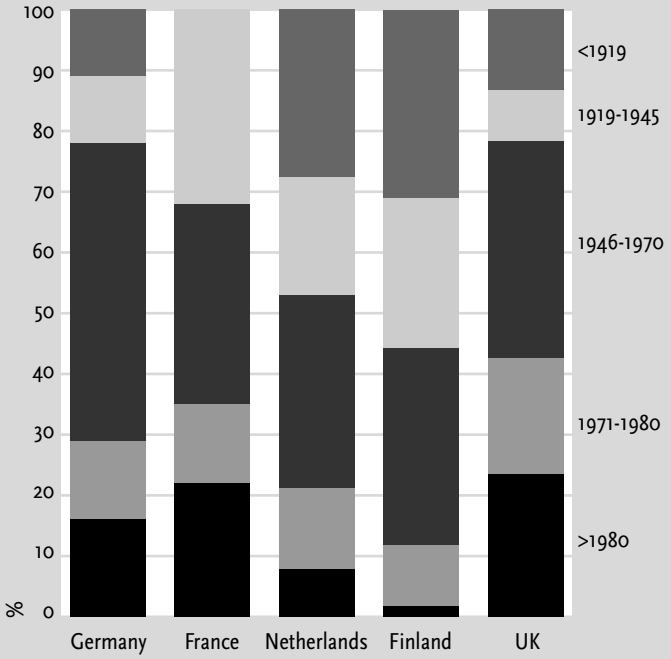


Table 8.5 also shows that the useful floor area per dwelling has continued to grow due to increasing prosperity and the resulting space consumption. Figure 8.6 shows that, in the Netherlands, the average useful area per residence in the total residential stock was 112.0 m^2 in 1998, which is clearly highest in this inventory. Increased floor area means a need for more energy and land. In a country that is running out of good construction sites, this type of space

Figure 8.5 Dwellings newly completed (x 1000)

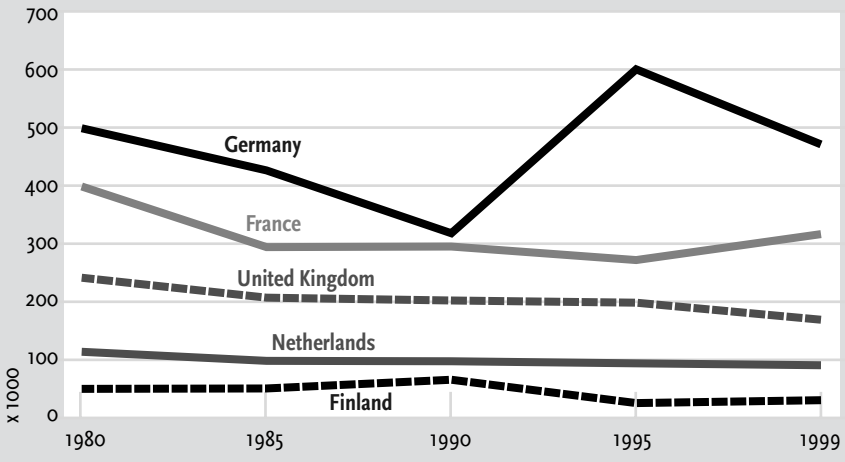


Figure 8.6 Average useful floor area per dwelling (m²)

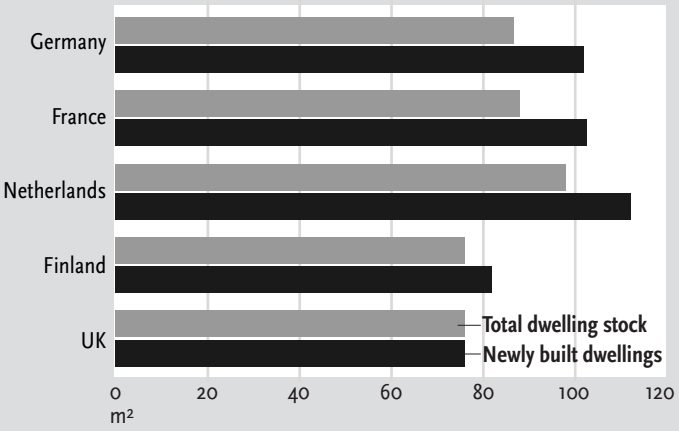
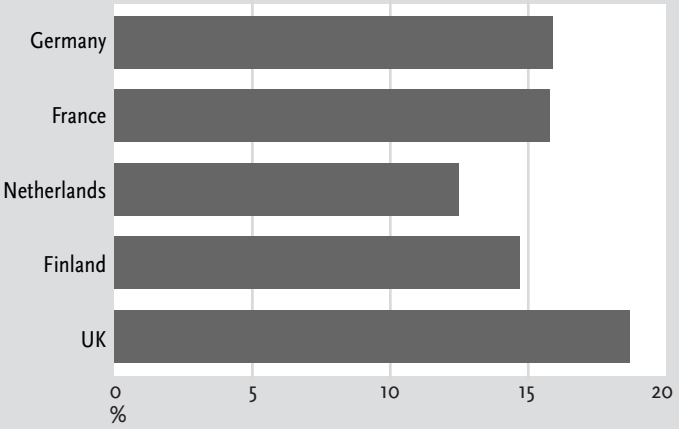


Figure 8.7 Population over 65 years of age (%), 1-1-1999



consumption is definitely not sustainable. High density may need to be compensated with private space. In the sparsely populated Finland, the average useful floor area per dwelling was only 76 m² in 1998, and 25.4% of the population lived in small accommodations, i.e. where each room is occupied by more than one person (National Statistics, 2000).

Strong trends in household development are recognisable in all five countries. 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 & 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. Figure 8.7 shows the portion of population over 65 years of age in 1999. 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 & Dol, 2000). Due to changing family structures and a more individual style of living, many of the elderly will be living alone. This will soon create a need for requirements regarding accessibility in social housing.

The increasingly ageing population will change the future composition of social housing tenants.

8.5.2 Umbrella organisations and sustainability

The umbrella organisations in all countries seem very conscious about their role in the promoting sustainable building. However, 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. Implementation of environmental policies or agreements at the housing association level is only in the beginning stages. At present, efforts towards sustainability are concentrated more in separate experiments in individual and demonstration projects than in systematic sustainable housing management. Generally, social housing providers are most interested in energy and water conservation and lucrative methods of waste management.

However, even if sustainable management has not yet become common in practice, the umbrella organisations do have defined environmental policies for their actions. For example, the Housing Corporation in England, which published its Environmental Policy in 2000, emphasises the integration of sustainability in all Corporation actions. Its policy document considers, at least in theory, not only environmental, but also social and economic aspects. In France, the HLM institutions committed themselves to the principles of sustainable development in 2000. The environmental policies of the umbrella organisations focus largely on the community level. This is logical given that umbrella organisations do not manage housing stock directly themselves.

Current environmental policies 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.

Moreover, the majority of problems affecting the social housing sector, such as social segregation, must be solved at neighbourhood level and in terms of urban renewal, and not at an individual building level. Nevertheless, current policies 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. What is more, objectives that are not measurable are difficult to monitor. Environmental policies are important as future statements. But unless concrete action is taken, they will remain theoretical and ineffective at the housing association level.

Environmental agreements between the government and the construction sector are used as one measure to promote sustainable building. Aedes concluded an agreement with the Dutch government in 1997, which includes concrete objectives, presented in clear figures, for housing associations. Implementation of the covenant was monitored in 1998; a second evaluation will be carried out in 2001. According to the findings in 1998, all targets, apart from energy, will be achieved. Housing associations are positive about sustainability measures, both in new and existing buildings. However, subsidies are needed due to high investment costs. 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. On a smaller scale, UNFOHLM in France has entered into environmental agreements that offer incentives for introducing improving relating to energy and waste in HLM housing. Considering the entire process of introducing the objectives of agreements at the housing association level, the Aedes agreement is very interesting compared to those of other countries.

Unlike sustainability strategies in the other four countries, Germany's strategy relies mainly on regulations and norms. This policy can also be seen in the social housing sector. 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

In France, VAT can be reduced for renovation projects and this provision has enabled important investments in energy efficiency.

for pushing social housing towards more sustainability. It has been considered in other countries, such as Finland. At present, however, Germany is one of the few countries where it is implemented in practice.

The umbrella organisations also prescribe research for their members. Aedes in the Netherlands and the Housing Corporation in England have conducted a great deal of research and development work in the field of sustainability. This is attributable to the fact that the social housing sector is large and important in both countries. Aedes has developed tools for housing associations, and the Housing Corporation has established sustainability as one of the four main themes of its Innovation and Good Practice programme. By contrast, UNFOHLM in France is only beginning to deal with the HQE concept and Germany's umbrella organisations do not conduct research. In Finland, where there is no umbrella organisation for social housing, development of sustainable housing management depends on the individual fields of interest in governmental research programs.

It has already been concluded, that current government policies focus on new construction. Therefore, they do not set many requirements for the existing housing stock that housing associations manage. However, all of these five countries have a large volume of social housing, which was built fairly inexpensively and quickly either after the Second World War, or during the sixties and seventies. Renovation strategies differ between countries. For example, in Finland, the renovations of state-subsidised housing aims to bring housing up to new standards. This is an expensive approach. However, if renovated housing were comparable in quality to new housing, it could attract and keep higher-income families in the social housing sector. In other countries, such as France, the trend has shifted towards small renovations and improvements requested by tenants.

Inevitably, the question will arise in the near future of whether it is better to renovate or demolish problematic housing estates. At present, cost is the

The social housing sector has already struggled with the problem of vacant dwellings, low demand areas, and the resulting pressures to resort to demolition as a solution. Inevitably, the question will arise in the near future of whether it is better to renovate or demolish problematic housing estates.

main criteria in weighing the option of renovation versus demolition. Yet this decision has important environmental ramifications, for example, in terms of demolition waste versus environmental friendly technology in a new building. The social housing sector in the United Kingdom and France has already struggled with the problem of vacant dwellings, low demand areas, and the resulting pressures to resort to demolition as a solution. Germany too has mass-scale housing in the east that will need to be renovated or demolished due to an ever-diminishing population. Usually renovation is seen as a better option than demolition, which is still rare.

In all five countries, money is the main barrier that has prevented sustainability from really becoming an established part of housing management. Environmental investments are strictly limited by tight budgets and problematic, as social housing providers face the ever-growing challenge of coping in a market where they are not allowed to operate at a loss. 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).

9 Towards an effective policy

9.1 Introduction

Drawing on the comparison between the countries in chapter 8, this chapter focuses on conclusions and research question 4. Section 9.2 presents the conclusions of this study in relation to the national strategies, implementation through legislation and tools, and environmental efforts in the social housing sector. Section 9.3 concludes this report with recommendations for the future.

The conclusions aim to address the following questions:

- What can we learn from public policies and regulations for sustainable building in terms of developing an effective approach?
- What measures for sustainable housing management should we adopt from the environmental efforts in the social housing sectors of the Netherlands, Germany, France, the United Kingdom and Finland?

9.2 Conclusions

9.2.1 Environmental policy: lack of pushing factors keeps strategies vague

Environmental policies and energy strategies form the framework the sustainable building policy, and have direct impact, among other things, on building regulations and subsidy criteria. All five countries consider the construction sector to be a valuable contributor to sustainable development. This sector receives important, though vague, attention in the national strategies. Economic and environmental values are well covered. However, if social and cultural aspects are considered equally important aspects of sustainable development, they must be dealt with more thoroughly in policy.

The fact is that despite co-operative efforts, international progress relating to the environment or social justice lags behind that achieved in international economy. The European Union has the resources to implement an environmental policy as a community. Yet despite several Environmental Action Programmes, research and even an environmental revision of the Amsterdam Treaty, the EU has not managed to create a clear environmental policy capable of pushing its members towards sustainable development. The agreed objective of delinking economic growth and environmental burden is ambitious and appealing. In reality, however, it is difficult to resolve conflicts between sustainability interests and national economic interests. The general problem with the extensive concept of sustainable development is that it is too vague. While this concept should be integrated to every actor's responsibility, none have actually taken responsibility or the lead in this matter.

If social and cultural aspects are considered equally important aspects of sustainable development, they must be dealt with more thoroughly in policy.

9.2.2 National strategies for sustainable building: weak impact on practice

This study examined the national strategies for sustainable building, their similarities and differences in the Netherlands, Germany, France, the United Kingdom and Finland. This was based on their interesting policies, which use comparable, yet different, approaches. All five countries have defined a sustainability strategy for the construction sector. This has either taken the form of an action program, like the Netherlands, the United Kingdom and Finland, or other initiatives, like the HQE concept in France, and building regulations and norms in Germany.

The policy descriptions suggest, that despite differences in national emphasis, these EU countries seem to share a certain consensus about the concept of sustainable building and similar objectives. This provides a solid platform for co-operation and information exchange between the countries. The Netherlands and Germany already have practical experience, quantitative data and fairly sophisticated systems of incentives and information dissemination. Consequently, it is not necessary for other countries to 're-invent the wheel'. However, their strategies could be much more innovative than what they currently are, moving towards a problem-solving approach. France, Finland and the United Kingdom have adopted broad perspective on sustainable building, which could stimulate the more experienced countries to broaden their perspectives once again.

A weakness found among all of the countries was that current policies focus entirely on new construction. Given that annual new construction adds only about 1% to the total stock, no significant results from the construction sector can be expected before the policies are extended to include renovation

and stock management. In order to meet the Kyoto targets in the residential sector, the capacity of all built environments, including existing housing, must be considered.

The country descriptions suggest that the success of the policy may depend on whether the approach is mandatory, such as in Germany and the Netherlands, or voluntary, as it is in France, the United Kingdom and Finland. The latter countries rely on the environmental consciousness of market actors. An interesting question arising from these different approaches is whether the government approach should be mandatory, or rely on market actors. It appears that market actors are still in a weak position to promote sustainable building, because the market demand is still weak, and only a small minority of consumers is prepared to pay extra for environmental measures. This view is supported by the fact that despite information dissemination and research activities, sustainability appears to be progressing very slowly in the construction sector, which often lacks information, long-term views on sustainability, and even a clear definition of the concept. Presumably, environmental improvements will be developed in material, component and building levels, especially if the government creates a demand for these innovations. But most market actors will focus exclusively on what they stand to gain.

In most countries, the public authorities seem to be afraid to use environmental taxation and other strict methods in their environmental policy. They tend to think that voluntary measures are more accepted, and therefore, more efficient. However, in Germany, which maintains a very stringent sustainability policy, people seem to accept such taxation. Consequently, partial results have been obtained with the utilisation of long-term objectives, environmental legislation and taxes. Also, the introduction of financial measures in other countries, such as the Landfill Tax in the UK, has improved conditions.

One thing that clearly emerged during this study is that the national strategies are not ambitious enough to achieve really sustainable development as agreed in the UN Rio Conference in 1992, not even in the countries that have achieved partial results. The German Federal Environment Agency has stated that technical progress and resource efficiency are not sufficient to achieve lasting environmental development. That can only be achieved by improving technological efficiency and by changing consumer behaviour and legal and economic structures. The Netherlands has monitored the implementation of its National Environmental Policy Plans. According to the findings, the CO_2 targets are not attainable within set time limits using the methods applied. Thus, even if the countries were to succeed in implementing their policy plans in practice, it is unlikely that the ambition level is sufficient to achieve sustainable development. The current report on the European Environment Agency, EEA, shows that in their environmental policy, most EU member states did not succeed in reducing the dangers of climate change, dying forests or decreasing biodiversity (EEA, 2001).

According to various research reports, the CO_2 targets are not attainable within set time limits using the methods applied. Thus, even if the countries were to succeed in implementing their policy plans in practice, it is unlikely that the ambition level is sufficient to achieve the Kyoto targets.

Nonetheless, all national programmes seem to be fairly optimistic and confident. They are a conventional and careful response to bleak environmental problems. However, various research reports have demonstrated that sustainable development requires a re-orientation of policy: a total change and 'business-as-usual' progress is unlikely to be sufficient to achieve the Kyoto targets. Apparently, governments do not respond to threats that are not instant. For example, climate change has been very slowly accepted as a real phenomenon. A recent OECD study on the Kyoto Protocol stresses that unless the OECD member countries establish more effective frameworks for action now, achieving the Kyoto targets will become difficult and very expensive. National action needs to lay the foundation for even larger reductions over time (OECD, 1999). Unlike the energy crisis in the seventies, today, there seems to be a lack of economic pushing factors to encourage energy conservation. Human health may prove to become an efficient driving force towards change in some areas, such as the choice of materials.

The construction and real estate sector must plan tomorrow's investments today. To make decisions, they need to know - at least to some extent - what they will face in the future. The problem is that although everyone talks

about sustainable building, few people know really much about it. In addition, we do not accept the scope of environmental problems and tend to trivialise the need of ecological building. This has created confusion. As a result, we have no way of predicting how sustainable development, which is in fact a very new concept, will evolve in the future and within what time limits. It is also impossible to say how we will respond to serious environmental problems with new laws, taxes and agreements. Unfortunately, there are no public programmes that can describe future situations, or support the social housing sector in its decision-making for the future.

9.2.3 Implementation of the strategy: neglecting the existing stock

Public policy for sustainable building can be implemented through mandatory legislation, and voluntary initiatives, such as the development of tools.
As the descriptions on building regulations suggest, environmental requirements primarily concern energy saving and waste management, which are also priorities in the national policies. Indoor climate and HVAC systems are also fairly well covered. Water conservation is an issue of concern, as current building regulations and the sustainability policies do not encourage it. The ample supply of water appears to have resulted in careless attitudes towards the use drinkable water, both in industries and households.
All the same, the technology to achieve higher ambition levels than those laid down by current requirements, is already available. For example, thermal regulations in Finland are known to be stringent. Even so, there is enough knowledge to halve that level without really increasing investments. It would be interesting, therefore, to study the option of adapting the Finnish regulations for use in other countries, such as the Netherlands; local structures and costs should be taken into account in order to determine what improvements can be achieved. According to a recent study, if the standards in Swedish regulations were to be applied in UK, they could reduce space heating in new housing by 80% as compared to those built with current UK standards (Lowe & al. 2000).
As German policy relies on legislation, its well-organised structure of regulations and norms sets an excellent example for others. In all five countries, legislation was recently revised to fall in line with EU directives, on which national regulations have been based increasingly. For this reason, the environmental ambition levels in EU directives are very important.
However, it is not evident that building regulations are the right way, as such, to promote sustainable building policy. Building legislation is aimed to ensure minimum quality and safety standards in the average building. The regulations were never intended to set top quality targets, nor are they stimulating for designers. The minimum level cannot be too ambitious, since it is always

It is not evident that building regulations are the right way, as such, to promote sustainable building policy. The regulations were never intended to set top quality targets, nor are they stimulating for designers.

based on a certain measure of consensus. With a few exceptions, building regulations in all countries apply only to new construction. Thus the present regulations can by no means have a direct impact on the environmental performance of the building stock, as the annual volume of new construction is very small. In addition, the impact of the regulations on the social housing sector and stock management, no matter how stringently revised, is of almost of no importance at this stage.
Finnish building regulations require a Maintenance Manual for buildings. This has encouraged the construction sector to shift from focusing on construction costs to a more extensive perspective, one that considers the life cycle costs of buildings. Measures such as this, which emphasise maintenance and improvement of the existing stock, are generally lacking in building regulations, while much effort is invested, for example, in energy requirements regarding almost a marginal percentage of buildings. However, if mandatory regulations are made applicable to the existing stock, serious financial problems may result, as was the case with Germany's new thermal legislation.

Another option for adopting policy plans in daily construction practice is to encourage the use of environmental assessment tools. Four different tools currently used in each country were compared and examined in light of their capacity to support sustainability in stock management. It was concluded

that most of these tools focus on the environmental impacts of new construction, and on the building level. A European tool, EPIQR, is one of the few methods available to support sustainable renovation. The Dutch Duwon is useful in developing a strategy for sustainable housing management, even though it was developed for large-scale housing management purposes, and is thus better suited to conditions in the UK and the Netherlands, rather than countries like Finland.

It appears to be impossible, without data adaptation, to apply tools in another country; however, the underlying structure of these tools can be exchanged for mutual benefit. For example, German tools, such as Legoe and Ecopro, have linked environmental data to cost impact, an aspect largely ignored in the other countries' tools. Current tools also tend to neglect social and cultural aspects. However, French and Finnish tools use very extensive criteria with semi-environmental properties, such adaptability and safety, whose management can be interesting to the countries that have not used these criteria in the evaluation. Regarding evaluation results, British tools, such as BREEAM and ENVEST, are well suited for marketing purposes, and their commercial value could prove interesting to the other countries.

Nevertheless, the methods are not used to their full potential in daily construction and management, regardless of how advanced or basic they were. This is not because appropriate tools do not exist, but because nobody is prepared to pay for the evaluation costs. Yet one of the main barriers preventing sustainability from becoming a real focus in actual practice has been a lack of knowledge about environmental impact of different managerial measures.

This has given rise to an essential question: how can the government encourage the use of tools also suited to educating users? For instance, integration of cost properties in current tools would undoubtedly increase their appeal to housing managers. In addition, the government should encourage, or even require, environmental impact assessments, for instance as a part of the construction permit application process. One example of this approach is Viikki, an experimental ecological community in greater Helsinki, where construction projects were required to meet certain minimum PIMWAG criteria in order to qualify for a building permit.

All five countries have developed indicators for sustainable development, part of which are related to construction. However, links between national indicators and environmental assessment methods are presently lacking. By establishing a relationship between indicators and tools, we can standardize the methods more in terms of their indicators. This, in turn, would improve the co-ordination between - and consistency in - methods.

One practical issue of concern is that when the use of evaluation tools and Environmental Management Systems becomes more common, they will face the same problem that Quality Management Systems do now. If a certain level entitles to environmental certification or classification, it is seldom

exceeded without extra benefits: the minimum is also the maximal value. Avoiding this requires an assessment system consisting of different environmental levels or a flexible structure, where requirements can be updated on a regular basis. The tools should also have the capacity to broaden their approach from standard structures to different design options and forms.

9.2.4 The social housing sector: will a positive, but doubtful attitude help achieve results?

This study examined environmental efforts in the social housing sector in order to determine how it has responded to the national strategy. As the descriptions of the umbrella organisations suggest, implementation of sustainability measures in all five countries in the social housing sector is still in its beginning stages. Environmental agreements have been concluded between the government and the social housing sector. The umbrella organisations 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. If the government expects results from the social housing sector in the future, it must set clear and specific environmental objectives for that sector. If possible, to the government should also support environmental improvements with subsidies.

However, even though systems of social housing differ between countries, certain measures can be transferred. In the Netherlands and the United Kingdom, where housing associations manage large stocks, the trend has shifted towards strategic management. Government influence in both countries is also decreasing. In short, their conditions are similar enough for mutual adaptations. Aedes has developed tools that can help the UK and other countries; it has also monitored environmental performance at the housing association level. The Dutch government has introduced subsidies for green investments in the social housing sector. The 1997 agreement with the government, and the monitoring process are also interesting, especially for the Housing Corporation whose own environmental policy has remained rather vague. However, the Corporation has developed a compelling innovation programme and a database of model projects to encourage sustainable housing.

In addition to environmental agreements, an effective way to push social housing towards sustainable construction and management is to include environmental quality as a main criterion for housing subsidies. In Germany, this is already a reality, and the environmental level of the subsidy criteria is higher than what building regulations prescribe. The volume of German social housing is relatively small, but these norms could be adapted and applied very successfully in another country, where the volume of social rental housing is larger.

Households will continue to diminish in size, which will result in an ever-greater demand for small, affordable apartments. Also, the integration of ethnic minorities, who form a large percentage of the tenants in social housing, is a great challenge for the future.

Sustainable housing management in Finland and France is fairly outdated. However, in France the volume of social housing is massive, and supported with education of the inhabitants and its political nature, it offers great potential to promote sustainable building. In Finland, several development activities are underway in this area.

In the future, the Kyoto Protocol will place pressure on the residential sector to make a contribution towards reducing CO_2 emissions. The most effective way to reduce energy consumption in the residential sector is to renovate the existing stock to become more energy efficient. Nevertheless, it is more difficult to improve old buildings than it is to design new constructions. Moreover, renovation projects are often very expensive. Thus, sustainable renovation must be planned as part of the maintenance process in order to ensure its economic feasibility. This approach would serve to combine environmental improvements with maintenance work, which would be carried out anyway. That, together with the advantages that tools offer sustainable management, maintenance and renovation, could keep costs within reasonable limits. In France, VAT can be reduced for renovation projects. According to the French umbrella organisation, this provision has enabled important investments in energy efficiency. In Finland, the strategy is to bring the renovated dwellings up to modern standards. If social housing can afford this approach, it can attract and retain higher-income families.

However, with all ambitious and well-meaning objectives, forcing the sector, which provides housing for low-income families, and struggles increasingly to cope in the free market, involves a serious conflict between environmental and economic values. Tightened building regulations and introducing environmental taxes are not possible as measures only, as someone has to pay for them. 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

In addition to environmental agreements, an effective way to push social housing towards sustainable construction and management is to include environmental quality as a main criterion for housing subsidies

immigrants, the unemployed or young families. These tenants, who often receive housing allowances, do not have extra money to invest in environmental improvements. In addition, the social problems that can arise in social housing neighbourhoods can be more direct and urgent than some abstract concept of sustainability. The social dimension of sustainable building is very important, and the integration of ethnic minorities, who form a large percentage of the tenants in social housing in all five countries, is a great challenge for the future.

9.3 Future recommendations

Government should sharply lead sustainable building (and renovation)
The government should continue to lead the way towards sustainable building, instead of leaving it to the discretion of profit seeking market forces. Now that the concept of sustainable development has actually been introduced, measurable objectives and concrete targets should be addressed to specific target groups, such as the social housing sector. However, public policies should be prepared in co-operation with the construction industry and strive to promote environmentally friendly consumption values. In addition, if responsibility is delegated to local governments, such as is the trend in many countries, they must be guaranteed sufficient resources, funding and knowledge to realise the tasks entrusted to them.
Currently, the environmental potential of the existing stock has been neglected, both at the policy level, and consequently, in practice. Additional research is needed to determine what measures to introduce in policy regarding existing housing.

Regulations must be more ambitious, with tool backup

Despite current revisions in legislation, we must recognise that building regulations can never affect the majority of buildings, since they apply primarily to new construction. Moreover, their adaptation to the existing stock is problematic and cannot be recommended as a means of effecting environmental improvements in the construction sector. The ambition level of the current standards should, nevertheless, be raised considerably, as recent research findings have indicated that much more can be achieved without increasing investment costs.

The development of tools for supporting sustainability in decision-making is important, especially in areas that building regulations cannot currently cover, such as renovation and stock management. As it is difficult, if not impossible, to cover the social and cultural aspects of sustainable development in legislation, tools should support these aspects. In addition, the integration of cost information related to environmental choices is essential, and would give housing managers more incentive to use tools. It may prove impossible to integrate descriptive issues into current systems, in which case, separate, differently structured methods are needed.

Focus on sustainable management in the social housing sector

The national strategies for sustainable building identify subsidised housing as one of the target groups of the policy, but do not address environmental targets for it in particular. In order to draw on the great potential of the social housing sector, the government must establish clear objectives for it and extend current policy to include renovation and stock management. The most efficient way to make social housing more environmentally friendly is to shift from voluntary activities towards a more mandatory approach, and to integrate environmental requirements in subsidy criteria.

The most effective way to reduce energy consumption in the residential sector is to invest in making the existing housing stock more energy efficient. It is, however, more difficult and complicated to improve old buildings than it is to design new constructions. This is why more sophisticated policies and measures are needed. Realistically speaking, environmental improvements cannot be successfully introduced in the public sector without subsidies.

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In recent years a great deal of research has been focused on sustainable building. However, ambitious policy plans and research findings are adopted very slowly in daily practices in the construction industry, where the concept still remains vague and peculiar. Also, the importance of the existing stock is very slowly recognised.
To offer a better understanding of the entire process involved in launching an effective government policy, this research report describes one chain of actions and impacts: sustainable building policy, its implementation through mandatory building regulations and voluntary tools, and its potential impact on the social housing sector. It concludes with a comparative analysis of the Netherlands, Germany, France, the United Kingdom and Finland.
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