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**CASE STUDIES ON POLICY INSTRUMENTS FOR ENVIRONMENTALLY SUSTAINABLE  
BUILDINGS**

For more information, please contact Mr. Takahiko Hasegawa, Environment Directorate, National Policies Division; Tel: +33 1 45 24 14 87; Fax: +33 1 45 24 78 76;  
Email: [takahiko.hasegawa@oecd.org](mailto:takahiko.hasegawa@oecd.org)

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## FOREWORD

OECD's Sustainable Buildings Project was initiated in the spring of 1998 as a four-year project with the objective to provide guidance regarding the design of government policies to address the environmental impact of the building sector. Among various environmental issues related to this sector, the reduction of CO2 emissions, minimisation of construction and demolition waste and prevention of indoor air pollution were selected as priorities of the project.

This report is intended to present the results of case studies of policy instruments for the building sector related to the three environmental objectives. The objective of the study is to examine the experiences of OECD countries in the implementation of relevant policy instruments, and to find empirical evidence indicating the degree of effectiveness and efficiency, etc., of the instrument. In total, 18 policy instruments implemented in 7 countries (Canada, Denmark, Germany, Japan, the Netherlands, the UK and the US) were studied.

The OECD would like to express special thanks to contact persons in seven countries for providing support for the study as well as the Japanese Ministry of Land, Infrastructure and Transport for its financial support of the Sustainable Building Project. Takahiko Hasegawa of the OECD Secretariat prepared the report under the auspices of the Working Party for National Environmental Policies. It is published under the responsibility of the Secretary-General of the OECD.

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## EXECUTIVE SUMMARY

In order to address the environmental impact of the building sector, OECD countries have implemented a wide variety of policy instruments. It is apparent that the experience of governments in the past should provide insights regarding the way to design policies in the future, no matter how successful they might have been.

Case studies have been carried out to get insights for the design of environmental policies for the building sector by collecting information on how policy instruments have been introduced in OECD countries and analysing how well these instruments have performed to improve the environmental performance of buildings or building activities. The study has placed special emphasis on the identification of any form of empirical evidence to help in the evaluation of the instrument by following four criteria;

- Environment effectiveness
- Economic efficiency
- Administrative costs
- Incentives for innovation

To this end, 17 policy instruments from 7 countries (Canada, Denmark, Germany, Japan, Netherlands, UK and US) have been selected for the case study. The choice of instruments was made along three main criteria. First, the instruments should provide a good cross-section of objectives and types of instruments; second, they were chosen from a wide variety of regions, so that the effects of regional context could be reduced; third the instruments should have been implemented for a significant period of time.

Despite some data availability constraints, significant findings regarding effectiveness, efficiency, etc., of the main policy instruments in specified contexts have been obtained by means of the case studies as follows;

### *Reducing CO<sub>2</sub> emissions from new buildings*

- Capital subsidy programs and premium loan schemes could promote the investment in energy efficiency measures, but the scale of impacts of these instruments still remains uncertain.
- It is uncertain to what extent environmental labelling schemes could motivate designers and their clients to improve the performance.

### *Reducing CO<sub>2</sub> emissions from existing buildings*

- The case study could not identify any proof that the information provided with environmental labelling schemes really influenced the decision of owners.

- Only limited energy savings can be expected from capital subsidy programs targeting low-income households in the short run, though the programs could be effective to reduce CO<sub>2</sub> emissions in the long run.
- Information tools that provide information on energy savings potential of buildings may help owners making a decision regarding upgrades to choose a cost-effective option.

*Minimising construction and demolition waste*

- Landfill taxes can be an effective way to increase the recycling rate of C&DW if the tax rate is set at a relatively high level.
- The degree of effectiveness of regulatory instruments, such as a ban on landfill of recyclable waste and mandatory on-site separation of building materials, is still uncertain.
- Some regulatory instruments, such as demolition permission and mandatory reporting, appear to contribute, to some extent, to the prevention of illegal dumping, which is generally regarded as a negative side-effect of the landfill tax.

*Preventing indoor air pollution*

- The experience of some countries apparently indicates that regulation of the use or sale of building materials is the most effective measure to address the problem.
- The introduction of a voluntary environmental labelling scheme could encourage building material manufacturers to shift their emphasis to low-emission type products.
- The administrative cost of implementing the environmental labelling scheme can be reduced by allowing private firms to conduct checks on design documents and on-site inspections, not only for the labelling scheme itself, but at the same time for other schemes that require similar administration procedures.

Regulation on building materials and environmental labelling schemes can improve the indoor air quality of existing buildings as well., even when the introduced instruments target building materials used in new buildings.

## 1. INTRODUCTION

The construction, use and demolition of buildings has considerable impact on the natural and built environment. At present, the building sector is responsible for about 30% of primary energy use in OECD countries. Material flow analyses for some Member countries show that the sector accounts for between one-third and one-half of commodity flows, when expressed in terms of weight. (OECD, 2001a) Furthermore, the indoor air environment largely affects the health condition of occupants.

OECD's Sustainable Buildings Project was initiated in the spring of 1998 as a four-year project with the objective of providing guidance regarding the design of government policies addressing the environmental impact of the building sector. Among various environmental issues related to this sector, the reduction of CO<sub>2</sub> emissions, minimisation of construction and demolition waste and prevention of indoor air pollution were selected as priorities of the project, and to date, various work has been conducted under the project, including a survey of the current situation of policy instruments for this sector, analysis of the environmental impact of the sector, and an analytical study on the barriers to improvement as well as characteristics of main policy instruments.

Government policy can greatly affect the environmental impact of the building sector, and policymakers need to understand the characteristics of policy instruments in order to create effective and efficient policy packages by making appropriate choice of instruments. With the aim of creating an analytical framework to develop discussion on ways to design effective and efficient policies, the recent analytical study looked at the strengths and weaknesses of main policy instruments by examining how theoretical arguments regarding design of environmental policies in other sectors might be applied to the building sector. (OECD, 2001b)

It is often the case that theoretical arguments regarding policy design do not necessarily coincide with what actually happens in the practical implementation of policies. Therefore it is also important to evaluate policy instruments that have been implemented in OECD countries and see if their experiences coincide with the findings of the theoretical study. However, little post-evaluation appears to have been undertaken on policy instruments for the building sector. Against this background, the Secretariat has conducted the case study on policy instruments to address the above-mentioned three environmental issues in collaboration with policymakers and experts in several OECD countries with the aim of examining consequences of policy implementation.

## 2. OBJECTIVE OF THE CASE STUDY

In order to address the environmental impact of the building sector, OECD countries have implemented a wide variety of policy instruments. It is apparent that the experience of governments in the past should provide some suggestions regarding the way to design policies in the future, no matter how successful they might have been. The objective of the case study was to obtain insights for the design of environmental policies for the building sector by collecting basic information on how policy instruments have been introduced in OECD countries and analysing how well the instruments have performed as measures to improve the environmental performance of buildings or building activities.

Since the recent analytical study has examined the theoretical aspect of discussions on the policy design in this area, this study has placed special emphasis on the identification of any form of empirical evidence to suggest the degree of effectiveness and efficiency, etc., of main policy instruments, that may support or contradict conclusions of the recent analytical study. This report is intended to provide the results of all case studies conducted and summarise the main findings from them. The findings from this study will be reflected in the final report of the Sustainable Building Project that will include recommendations on the design of environmental policies for the building sector.<sup>1</sup>

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1. The draft final report of the Sustainable Building Project will be submitted to the April WPNEP meeting next year.

### 3. METHODOLOGY OF THE CASE STUDY

#### 3.1 Scope of the study

##### 3.1.1 Collection of basic information

Evaluation of policy instruments is a complicated process. The same policy instrument can be introduced for different objectives. Furthermore, consequences of policy implementation can be influenced not only by the choice and design of the instrument but also by various contextual factors. A certain policy instrument which has been implemented effectively and efficiently due to the unique context of one country may not be able to work in such a way in other countries. In the light of such complexity, the case study aims to collect a wide range of background information on policy instruments, analysed as follows.

- Outline of the instrument
  - ✓ Who is the principal target of the instrument? (e.g. owners, contractors or designers)
  - ✓ Whether it is an obligatory measure or not.
  - ✓ The scope of the instrument (e.g. new buildings or existing buildings, housing or commercial buildings?)
  - ✓ When the instrument was first introduced and if it is still in place.
- The government's main objective in implementing the instrument
  - ✓ Both the general environmental objective (e.g. reduction of CO<sub>2</sub> emissions) and specific objectives related to the building sector (e.g. improvement of energy efficiency of building envelopes)
  - ✓ The anticipated time-scale for the realisation of general and specific environmental objectives
- Reason why the government chose that type of instrument
  - ✓ Were the likely effects of the instrument evaluated before its introduction?
  - ✓ Were other instruments considered and why did the government not choose them?
  - ✓ What is the perceived barrier to improved environmental performance and how will the instrument overcome this barrier?
  - ✓ Were there any contextual factors (e.g., political constraints, social objectives) affecting the government's choice of policy instrument?

### ***3.1.2 Evaluation of the instruments***

The core part of the study is the evaluation of instruments as a measure to improve environmental performance of buildings and building activities, and the instruments were evaluated according to the following four criteria, which have been commonly used in the evaluation of environmental policies in other sectors. (OECD, 1997)<sup>2</sup> As little post-evaluation has ever been conducted for this sector and the objective of instruments and the difficulty in obtaining reliable data varies between countries, the precise means of evaluation were determined depending on the situation of each country, and any form of empirical evidence which appeared to suggest effectiveness and efficiency, etc., of the instruments was sought. Furthermore, any other noteworthy effects of the instrument that were found in the study were also included in the report.

- Environmental effectiveness

Environmental effectiveness relates to the environmental impact and performance of the instrument studied, i.e., how much the instrument contributes to the achievement of the policy objective (if defined), or to reductions in emissions (if no specific objective was defined).

- Economic efficiency

Economic efficiency refers to the extent to which a policy instrument has enabled a least-cost achievement of an environmental objective. The cost may be described as the direct economic cost - incurred by both businesses and households/individuals - of bringing about the changes in behaviour to minimise environmental impacts that the policy is aiming to achieve.

- Administrative costs

These refer to the administrative cost burden imposed on the public authorities responsible for applying the policy instrument. They also include the administrative burden of environmental policies borne by the private sector.

- Incentives for innovation

Incentives for innovation refer to how much a policy instrument stimulates innovation and diffusion of more cost-effective technologies. In general this depends on whether policies can provide polluters with lasting incentives to reduce their adverse impacts on the environment.

### **3.2 Selection of instruments to be studied**

Among policy instruments that have been implemented in various OECD countries, in total, 17 policy instruments from 7 countries have been selected for the case study. These instruments were chosen, according to the following principles, so that the result of the study could provide useful insights for policy design in this area. (see Table 1)

First, case studies should provide a good cross-section of objectives and types of instruments. By doing this, the results of the study could provide more useful suggestions as to how to choose policy instruments. For instance, it would become possible to compare the effectiveness of a certain type of instrument with

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2. These criteria were also used in the recent analytical study on strengths and weaknesses of main policy instruments. (OECD, 2001b).

other types, and to see exactly how differently a certain type of instrument could work on the achievement of different environmental objectives. As indicated in Table 1, out of 18 policy instruments, 8 were for reducing CO<sub>2</sub> emissions, 6 for minimising C&DW, and 4 for preventing indoor air pollution. In terms of types of instruments, they represented 7 economic instruments, 7 information tools, and 4 regulatory instruments.<sup>3</sup>

**Table 1. Cross-section of selected policy instruments**

	Economic instruments	Information tools	Regulatory instruments
Reducing CO <sub>2</sub> emissions from new buildings	JHLC's Premium loan program (Japan) C-2000 Program & Commercial Building Initiative Program (Canada)	BREEAM (UK)	
Reducing CO <sub>2</sub> emissions from existing buildings	Home Energy Efficiency Scheme (UK) Energy Premium Scheme (Netherlands)	Energy Star Building Program (USA) Energy Labelling Scheme (Denmark) Energy Performance Advice Programme (Netherlands)	
Minimising construction and demolition waste	Landfill tax (UK) Landfill and incineration tax (Denmark) Landfill tax (Netherlands)	Construction and Demolition Debris Program (USA)	Ban on landfill, etc. (Denmark) Ban on landfill, etc. (Netherlands)
Preventing indoor air pollution		Housing Performance Indication Scheme (Japan) Guideline value for indoor air pollution (Germany)	Regulation on building materials (Denmark) Regulation on building materials (Germany)

Building design and building activities are largely influenced by regional context. For example building materials and construction methods differ greatly between regions. Inevitably, effects of government policies may sometimes be influenced by these factors. Therefore it may sometimes be misleading for a case study of the building sector to concentrate on instruments that have been introduced in only one region. Taking this into consideration, these instruments were selected from 7 countries from various regions, including Northern America, Europe and Asia.

Since the main objective of the study was to find empirical evidence to suggest effectiveness, etc., of policy instruments, it was not considered meaningful to analyse instruments that have just been introduced or will soon be introduced. Because little or no empirical data on implementation can be obtained by

3. It should be noted that according to the OECD study, no economic instruments have been implemented for the prevention of indoor air pollution, and no countries have implemented regulatory instruments for reducing the CO<sub>2</sub> emissions from existing buildings that widely covers the sub-sector with exceptions of some states and municipalities in the US. (OECD, 2000a)

studying these instruments. Therefore the study focused on instruments that had been implemented for a reasonable period of time.

### 3.3 Processes of the study

Basically, the case studies relied on information provided by government policy makers<sup>4</sup> in charge of the instrument and their views. The way the case study was conducted varies between countries, but in principle the study began with the preparation of a brief country report by the government policy makers.<sup>5</sup> The policymakers were asked to write the country report in accordance with research questions (see Annex) which had been prepared by the Secretariat. This supplemental information has subsequently been collected by the Secretariat through repeated communications with writers of the reports, and in some cases the Secretariat visited these countries and interviewed them in person. By combining all collected information, case study reports in the next chapter were prepared.

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4. The case study on the BREEAM in the UK was supported by experts of the Building Research Establishment. BREEAM was introduced in 1991 by the Building Research Establishment when the institution was a part of the government. However the institution was privatised in 1998 and has become independent from the government.
  5. In some cases, country reports were substituted by interview with the policy makers. Some of country reports were presented at the OECD/IEA Joint Workshop in the Design of Sustainable Building Policies held on June 2001.

## 4. CASE STUDIES

### 4.1 Policy instruments for reducing CO<sub>2</sub> emissions from new buildings

#### *4.1.1 C-2000 Program & Commercial Building Initiative Program (Canada)*<sup>6</sup>

In order to improve the energy efficiency of newly built commercial buildings, the Canadian government has implemented two programs that provide both technical assistance and financial incentives for prospective owners of buildings since the early 1990's. The C-2000 Program was introduced in 1993 as a small demonstration of very high level of energy efficiency performance with the aim of convincing the relatively conservative construction industry that modern processes and technologies related to high energy efficiency can bring benefits. Under the program, prospective owners of buildings who voluntarily apply for this program are provided with customised technical assistance to help design highly energy efficient buildings. In addition, the program also provides financial support which partly covers the extra capital cost, if the completed buildings meet predetermined requirements, including 50% energy efficiency improvement, in terms of estimated energy cost, over the Model National Energy Code for Buildings (MNECB) level.<sup>7</sup> In operating the C-2000 Program, the government found that the greatest potential for performance improvement occurred very early in the design process and that it was important to help integrate the efforts of architects, engineers, and other experts during the early stages.

On the basis of their experience with the C-2000 Program, the government developed the Commercial Building Initiative Program, which was launched in 1997, for the purpose of delivering incentives to design energy efficient buildings to a larger number of prospective owners. Unlike the C-2000 Program, applicants receive technical assistance only upon use of free building energy use simulation software, and financial support from the government only if the building satisfies predetermined requirements. In order for the program to help a large number of applicants, the new program had to be simplified so that customised technical support would not be necessary. Specifically, this resulted in a reduction of the required performance threshold to a 25% improvement over the MNECB. However, the philosophy of placing emphasis on supporting the design process was retained. In addition to the technical advice on the software, a financial incentive of two times the predicted annual energy cost saving (maximum 60,000 Canadian dollars) is awarded to building owners if they meet the performance threshold.<sup>8</sup> (see Table 2) The flow of procedures in this program is summarised in the Box 1.

The principal perceived obstacle to the improvement of energy efficiency of newly built commercial buildings was the lack of incentives for prospective owners of buildings to improve the performance.

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6. This section is written based on a country report submitted by Nils Larsson of Natural Resources Canada and iiSBE (E-mail: [larsson@greenbuilding.ca](mailto:larsson@greenbuilding.ca)), and communications with him.

7. Studies have shown that the MNECB is approximately congruent with current good practice but, despite this, only a few jurisdictions in Canada have adopted it because of difficulty in enforcement.

8. Applicants got 80% of the incentive when they show design documents and have them approved by the government, and remaining 20% with occupancy permit.

While the costs of high-performance have to be paid during the first year or two of the building's life, the benefits accrue only slowly. It is always the initial owners who are faced with the extra investment for higher performance, despite the fact that the benefits of good design will accrue over the entire life of the building.

**Table 2. Outline of C-2000 Program and Commercial Building Initiative Program**

Program	C-2000 Program	CBIP Program
Number of projects to date	8 built or underway, 14 designed	300+ underway or complete
Annual Budget	Approx. \$200,000 CAD	Approx. \$6 million CAD
Performance areas	Energy consumption Environmental Loading Indoor environment Functionality	Energy consumption Greenhouse Gas emissions
Energy target	45%-50% better than MNECB	25% better than MNECB
Current incentives/support	Varies from \$5k to \$25 k	2 times annual predicted energy cost savings, up to \$60 k

Source: Natural Resource Canada

Consequently, those who invest in the construction of new buildings tend to place much more importance on the capital cost than the running cost, and implement energy efficient measures only when the estimated pay-back period is very short. This problem can be overcome if higher performance could be rewarded by higher re-sale price in the market. However, there is no good mechanism to reflect performance in the re-sale price. Under such circumstances, the subsidy program was chosen as a feasible and relatively effective instrument. It is expected that the provision of economic incentives may change decisions of prospective owners of commercial buildings, who tend to be sensitive to financial incentives.

With regard to other policy instruments, the government could not identify any other feasible option as effective as the subsidy program. Regulatory instruments can be very effective if well enforced, but it is perceived that they usually define a minimally acceptable level of performance and are therefore normally insufficient to lead the industry towards very high levels of performance. Although development of guidance documents and design tools are also important tools to improve the energy efficiency of buildings, again it is perceived that such measures tend to be used by those in the industry who are already convinced of the need for high performance, and that they tend to have limited penetration, though some recent developments in design process support tools show promise.

Since its launch in 1997, approximately 300 projects have been enrolled in the program. In other words, by March 2002 more than 300 buildings will have succeeded in attaining at least 25% improvement of their energy efficiency over the MNECB level. According to a survey conducted on 35 projects (on average 6,134 m<sup>2</sup>) enrolled in the program, on average 35% improvement over the MNECB level has been achieved. Relative to the buildings usually built by respondents, the construction cost of these buildings are 6.2% higher. (See Table 3) It is noteworthy that there were as many as 7 projects in which 34% or more

energy efficiency improvement over the MNECB was achieved without any incremental cost relative to buildings usually built by the organisations. The average financial incentive provided is in the range of 35,000 Canadian dollars<sup>9</sup>, that accounts for about 9% of the extra construction cost and one third of extra design fee.<sup>10</sup>

**Box 1. Application Procedures of the Commercial Building Initiative Program**

**Step 1**

- Prospective building owners voluntarily submit a form to express interest in this program to Natural Resources Canada.

**Step 2**

- Natural Resources Canada will contact the building owner, or authorized representative, to discuss eligibility for the project and the range of incentives

**Step 3**

- Prospective owners will submit appropriate design documentation

**Step 4**

- Natural Resources Canada verifies that the design qualifies for an incentive and forwards a Contribution Agreement for the owner's signature.
- The signed Contribution Agreement must be returned to Natural Resources Canada.

**Step 5**

- Prospective owners send initial payment request form.
- If all terms and conditions of the program have been met, Natural Resources Canada will forward 80% of the incentive payment to the building owner.

**Step 6**

Final payment of 20% will be forwarded once Natural Resources Canada receives proof of completion of construction according to the design specifications and a final payment request form.

Source: Natural Resource Canada

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9. The maximum amount of incentive for individual projects was 80,000 Canadian dollars and has now been reduced to 60,000 Canadian dollars. The maximum per company (per year) is 500,000 Canadian dollars.

10. The extra construction cost and design fees are estimated based on the results of the survey on this program indicated in the Table. It is important to note that extra cost/fee refer to their increase relative to buildings usually built by applicants.

Having seen the high energy efficiency of buildings that have applied to the C-2000 Program and Commercial Building Initiatives Program, a crucial question that should be examined is to what extent the programs have contributed to the high efficiency. In other words, what proportion of applied buildings are “free riders”? There has not been any analytical study on the baseline situation, but some anecdotal evidence suggests that the program has contributed to the improvement to some extent. Results of a survey on the C-2000 program shows that all designers of buildings applying to the program agreed that application of the integrated design process, which was a requirement of the program, was the main reason why high levels of performance could be reached. Furthermore, according to a survey on 35 projects enrolled in the Commercial Building Initiative Program, 41% of respondents answered that the performance of buildings enrolled in the program was "much better" than buildings usually built by respondent, and another 53% replied that it was "better".

**Table 3. Analysis of the capital cost of projects enrolled in the Commercial Building Initiative Program**

	Normal fee/cost for respondent's organisation (A)	Fee/cost for the project enrolled in the program (B)	Difference (B-A)	Increase in the fee/cost (B/A-1)
Design fees (% of capital cost)	7.1%	8.2%	1.1%	15.5%
Construction cost (Canadian dollar / m <sup>2</sup> )	1,078	1,145	67	6.2%

Source: Natural Resource Canada

**Table 4. Results of survey on applicant's view of changes in performance**

Relative to buildings usually built by respondent, the performance of buildings enrolled in the program is;	Energy	Indoor air quality	Illumination
Much worse ( 1 point)	0%	0%	0%
Worse (2 points)	0%	0%	2.9%
No difference (3 points)	5.9%	28.1%	32.4%
Better (4 points)	52.9%	37.5%	52.9%
Much better (5 points)	41.2%	34.4%	11.8%
Average points	4.4	4.1	3.7

Source: Natural Resource Canada

Despite the wide application of the program, the number of buildings enrolled so far (around 300) accounts for only a small fraction of annual commercial and institutional building starts (around 5,000). And it is

perceived to be infeasible to extend the Commercial Building Initiative Program to, for instance, 25% of new commercial building construction because the required expenditure for such a program would be unacceptably large. This may suggest that it is difficult to expect capital subsidy programs to have a significant impact on a large number of buildings.

Since any additional improvement in energy efficiency would result in an increase of the subsidy, the program presumably helps the cost-effective distribution of efficiency improvement among buildings applying to the program and provides incentives for innovation. However, as this aspect of the program has never been evaluated, no empirical evidence to prove this point has been identified.

The government has prepared 6,000,000 Canadian dollars for financial incentives in this program for fiscal year 2001. Procedures related to the approval of projects and the calculation of the subsidies, etc., have been handled by 12 permanent staff who also deal with many other building-related programs. Two thirds of the technical approvals will be done by private consultants this year, improving industry capacity to stimulate building energy use. The administrative cost directly attributed to each application is estimated to be in the range of 3,000-4,000 Canadian dollars, though the cost of adapting building energy use software for Canadian conditions, developing other design tools, and improving the MNECB is not included.

#### ***4.1.2 Premium loan for energy efficient housing (Japan)<sup>11</sup>***

The Japan Housing Loan Corporation (JHLC) is a housing finance institution established in 1950 by the Japanese government with the objective of improving the living standard in Japan. Since then, the JHLC has provided long-term housing loans with low and fixed interest rates for more than 18 million home buyers with financial resources that come from the postal saving system. In response to the growing public concern over the energy supply after oil "shocks" in the 1970's, in 1980 the JHLC started to offer premiums to those who purchased dwellings satisfying the recommended energy efficiency standards established by the Japanese government. Unlike other OECD countries, the Japanese government did not introduce energy efficiency standards in its building regulation. This was probably because it was perceived that the scope of the building regulation should be limited to issues directly related to the safety of occupants, such as structural safety and fire prevention. Consequently, the JHLC's premium loan has become the main instrument to improve the energy efficiency of housing.

One of the most important perceived obstacles to improvement was that home-buyers tend to refrain from making an extra investment in energy efficiency measures unless they can be sure that the extra capital cost can be recovered within a short period of time. The JHLC's premium loan program for energy efficient dwellings has aimed to overcome this obstacle by providing financial incentives to invest in higher energy efficiency. In line with the diffusion of energy efficient measures and development of new technologies, recommended standards have been revised three times. Today, premiums, in the form of lower interest rates and upgrades of the maximum loan amount, depend on the level of energy efficiency attained. For instance, both the lowest interest rate and additional loans of up to 2.5 million yen can be applied for only those satisfying the most recent recommended standards. (See Table 5)

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11. This section is written based on a country report submitted by Hirohisa Awano of Japanese Ministry of Land, Infrastructure and Transport (E-mail: [awano-h2b2@mlit.go.jp](mailto:awano-h2b2@mlit.go.jp)), and communication with him.

**Table 5. Premium for Energy Efficient Dwellings under the JHLC Housing Loan**

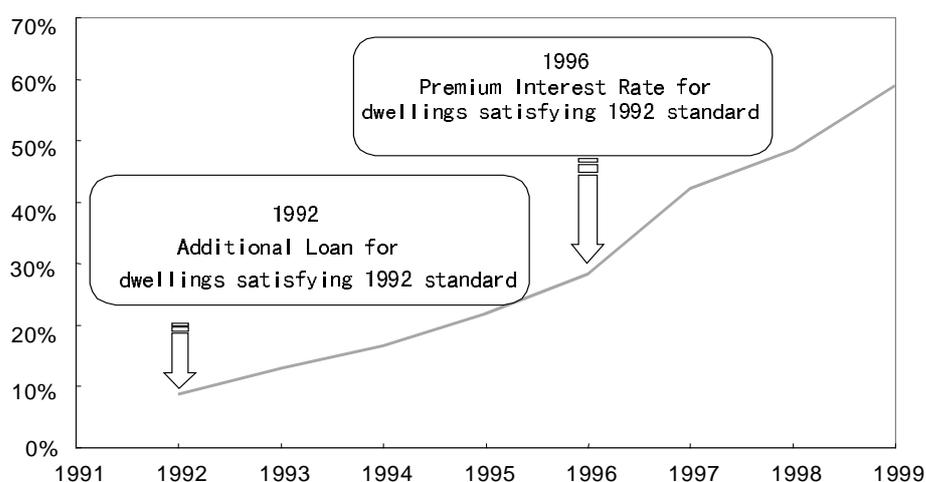
	Interest Rates (June 1 <sup>st</sup> 2001)	Additional Loan
>1999 standard	2.55%	2.5 million yen per unit
>1992 standard	2.55%	1.0 million yen per unit
>1980 standard	2.65%	-----
<1980 standard	(not eligible for JHLC loans)	

Note: Interest rate of the JHLC housing loan is fixed and usually has the term of maximum 35 years.

Source: Japan Housing Loan Corporation.

The JHLC's housing loan has been widely used in the Japanese housing market. In FY 2000, out of 1,213 thousand units of newly built housing, 364 thousand, or about 30%, were financed by the JHLC. In addition, the extra premium for energy efficient housing has been provided for up to 180 thousand units of newly built housing. The effectiveness of such premium loan programs may depend to a great extent on the number of free riders, but unfortunately there has not been any empirical study examining the proportion of free riders. However, the case study has found some empirical data that indicates the impact of the scheme on the energy efficiency of dwellings financed by the JHLC. Figure 1 shows the proportion of JHLC-financed dwellings that satisfy the 1992 recommended standard relative to total JHLC-financed dwellings. The figure indicates that the proportion has been increasing since the premium loan scheme for this level of energy efficient dwellings was initiated in 1992. Moreover, the data also demonstrates that the increase accelerated when the most advantageous interest rate was applied.

**Figure 1. Proportion of JHLC-financed dwellings that satisfy the 1992 standard**



Source: Japan Housing Loan Corporation

It has often been argued that the premium loan program has contributed significantly to the improvement of newly built dwellings that are not financed by the JHLC, as well. Since the premium loan program has been so widely used, most contractors and designers have had to study the recommended standards in detail. Consequently, new energy efficient measures have been smoothly diffused across the building industry, encouraging the use of such measures in the construction of dwellings that are not financed by the JHLC.

It was found that the scheme was designed so as to achieve the overall energy efficiency achievement in an economically efficient way. First, performance-based standards for the premium were provided so that designers and contractors could flexibly choose cost effective options. Furthermore, the scheme provided more premium for dwellings with higher energy efficiency as indicated in Table 1. Although the case study could not identify empirical data that suggest the degree of the economic efficiency, such flexible structures should contribute to the cost-effective improvement of energy efficiency and provide incentives for developing more cost-effective technologies. However, it appears that incentives are not provided once energy efficiency has reached the highest standard, the 1999 recommended standards level.

In order to confirm that design of applied dwellings satisfy the standard for the premium, it is necessary for the JHLC to check design documents and conduct on-site inspections. The JHLC has contracted out this task to local authorities, or private firms that are independent from the house-building industry and have sufficient technical staff. The JHLC is paying 10,900 yen per unit for this task.<sup>12</sup> It is noteworthy that, even in the absence of the premium for energy efficient measures, the JHLC would need to check basic performances of houses in order to make sure that they would not incur great loss in case of repossession.<sup>13</sup> Therefore, extra administrative cost for checking energy efficiency should be limited.

The JHLC has also introduced a premium for the use of recyclable or recycled building materials since 1999. When applicants can prove that their buildings will use more than a predetermined amount of recyclable or recycled building materials, the maximum amount of the JHLC loan can be upgraded by 2 million yen. In comparison with the widely used premium program for energy efficient dwellings, applications for this premium have been limited. In 2000, the number of applications for this premium was as low as around one thousand. This may be because owners of dwellings do not pay as much attention to the issue of recycling as to energy efficiency that is directly related to their energy cost in the future. Furthermore, there are large administrative costs for applicants to prepare proof that a certain amount of recycled or recyclable materials were actually used in construction, and this administrative cost burden may discourage applicants to the program.

#### **4.1.3 BREEAM (UK)<sup>14</sup>**

The Building Research Establishment Environmental Assessment Method (BREEAM) is a voluntary environmental labelling scheme of buildings operated by the Building Research Establishment (BRE) in the UK. The BREEAM was first established in 1991 with the objective of providing independent and practical guidance on minimising the damaging effects of new office buildings on global and local environment. Since then, with three revisions in 1993, 1998 and 2001, the scope of assessment criteria and

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12. This is the fee for checking documents and conducting on-site inspections on a wide variety of performances, including the energy efficiency, of one unit of detached dwelling.
  13. It is also important to note that the JHLC started entrusting this task to private firms, as explained in the section of the Housing Performance Indication Scheme.
  14. This section is written on the basis of a country report submitted by Suzy Edwards and Tim Bevan of the Building Research Establishment and communication with Matt Grace of the Building Research Establishment (E-mail: [GraceM@bre.co.uk](mailto:GraceM@bre.co.uk)).

coverage of buildings has been extended. Today the scheme covers office buildings (new & existing), supermarkets, schools, and houses.<sup>15</sup> Between 1991 and 2001, the number of assessment criteria for new office buildings increased from 20 to 120, covering a wide range of environmental performances of buildings as indicated in Table 6.<sup>16</sup>

**Table 6. Environmental issues covered by the assessment criteria of the BREEAM**

Issue	Description
MANAGEMENT	Overall policy, commissioning and procedural issues
ENERGY USE	Operational energy and CO <sub>2</sub> issues
HEALTH AND WELL BEING	Indoor and external issues affecting health and well being
POLLUTION	Air and water pollution
TRANSPORT	Transport related CO <sub>2</sub> and location related factors
LAND USE	Greenfield and brownfield sites
ECOLOGY	Ecological value of the site
MATERIALS	Environmental implication of building materials
WATER	Consumption and water efficiency

Source: Building Research Establishment

For each of the categories set out above, the building is assessed against performance criteria set by the BRE and awarded "credits" based on the level of performance. The %age of credits achieved under each category is then calculated and environmental weighing is applied to produce an overall score for the building. The overall score is then translated into a BREEAM rating of: pass, good, very good, or excellent.

The certification of the BREEAM rating is conducted by the BRE on the basis of assessment reports submitted by assessors registered with the BRE. The registered assessors usually assess the performances of buildings after the main design process ends and before construction work starts. In the case of new buildings, assessment is done based on design documents and additional interviews with design teams, and on-site inspection is not undertaken.<sup>17</sup> In order to work as a registered assessor, a two-day training course organised by the BRE is required, along with passing an exam at the end of the course. In addition, the organisations to which assessors belong have to get a license from the BRE. Today, 17 organisations have already got licenses for office buildings and another 23 for housing, and about 200 assessors are registered.

Table 7 shows the number of buildings assessed under the BREEAM. According to the estimate of the BRE, some 25% of all new office buildings, in terms of total floor area, have been assessed under the

15. New scheme for industrial buildings is under development.

16. The assessment method for new office buildings has been revised three times.

17. On-site inspection on the management etc. of buildings is usually conducted for existing office buildings.

BREEAM since its launch in 1991. However, less than 1% of existing office buildings have been assessed to date, and applications of other buildings such as houses, superstores and industrial buildings are also quite limited.

**Table 7. Number of assessed buildings under the BREEAM**

Type of buildings	Number of assessed buildings
Office buildings (new)	401
Office buildings (existing)	233
Industrial buildings (new)	60
Houses	7
Superstores	17

Source: Building Research Establishment

Comparison of the estimated annual CO<sub>2</sub> emission from buildings that were assessed under the BREEAM with that of other buildings highlights their high environmental performance. As indicated in Table 8, the average estimated annual CO<sub>2</sub> emissions from 35 BREEAM-assessed office buildings is less than half of that from typical office buildings in the UK. As such it is clear that the BREEAM-assessed buildings have much higher environmental performances than typical buildings. However, due to the lack of the baseline data, it is not quite clear whether, on one hand, the high performance was achieved because the BREEAM provided designers and their clients with incentives to improve the performance, or, on the other hand, the high performance would have been achieved even in the absence of the BREEAM and these buildings applied just to obtain public recognition of their high performance. Although it is theoretically presumed that the labelling scheme may encourage potential owners to choose more environmentally efficient options, the case study could not identify any data or evidence that suggest to what extent this high performance can be attributed to the existence of the BREEAM.<sup>18</sup>

**Table 8. Comparison of estimated annual CO<sub>2</sub> emissions between BREEAM assessed buildings and typical and good practice buildings in the UK**

	Estimated annual CO <sub>2</sub> emissions
BREEAM assessed buildings	56 kg/ m <sup>2</sup> /year
Good practice buildings	77 kg/ m <sup>2</sup> /year
Typical buildings	140kg/ m <sup>2</sup> /year

Note: Typical building: building that has the median level of the energy efficiency of UK building stock. Good practice building: building that has the level of energy efficiency 25% from the top of the UK building stock.

Source: Building Research Establishment

18. In order to examine this point, the BRE and the Secretariat of the OECD are planning to conduct a questionnaire survey to owners and designers of BREEAM-assessed buildings.

If it is proved that higher energy performance certified under the BREEAM lead to higher rent, at the next occasion owners may be motivated to choose more energy efficient design option. According to a survey of owners of BREEAM-assessed buildings<sup>19</sup>, more than 40% of the owners answered that they had achieved a higher rental income due to savings in fuel costs.

The BREEAM is a voluntary scheme, and basically "credits" are given according to the environmental performance achieved. Therefore it appears that the BREEAM has no effect of discouraging the use of either cost-effective technologies or innovation. All of the administrative costs for operating the BREEAM are covered by revenue from assessment fees paid by applicants. The time spent on the assessment and the amount of the fee depends on the scale of the building and complexity of its design. In the case of a typical simple office building, assessors may spend approximately 0.5 days for meeting design teams, 0.5 - 1 day for modelling and 3 days for writing reports. The typical fee for this assessment is between £ 2,500 - 3,000.<sup>20</sup> On receipt of the assessment fee, assessors must pay 15% of it to the BRE, which then uses the revenue for the maintenance and development of the BREEAM. 4 - 5 staff of the BRE are usually involved in this task. Although there may be potential to reduce the overall administrative cost by establishing collaboration with other schemes that require similar checks of design documents by technical experts, such as building regulation and housing insurance, no collaboration has been established thus far.

## 4.2 Policy instruments for reducing the CO<sub>2</sub> emissions from existing buildings

### 4.2.1 Energy Labelling Scheme (Denmark)<sup>21</sup>

In 1996 the Danish government announced a new strategy to attain the target set under the Kyoto protocol, 1.6 Mt/year reduction of CO<sub>2</sub> emissions by 2010. In light of the fact that there is great energy savings potential in the existing building sector, in 1997 the Danish government introduced the Energy Labelling Scheme, targeting existing buildings. This scheme is regarded as the principal instrument to reduce CO<sub>2</sub> emissions from the building sector and is expected to contribute to at least 10% of the reduction target for CO<sub>2</sub> emissions by 2010.

The Danish government has made efforts to improve the energy efficiency of existing buildings since the late-1970's. In 1979 the government first introduced a voluntary energy audit program in which consultants assessed the performance of single-family housing and made specific proposals for energy efficiency improvements at government expense.<sup>22</sup> After the program was coupled with a capital subsidy program that helped implement energy efficiency measures in 1981<sup>23</sup>, the number of assessed dwellings rapidly increased and reached 142,000 units per year in 1984. At that time the Danish economy was not in a good shape and this subsidy program was expected to contribute not only to the efficiency improvement but also in providing new employment.

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19. The survey was commissioned to a consulting company in 1996.

20. The BRE has published the recommended level of assessment fee.

21. This section is written on the basis of a country report submitted by Jens Laustsen, Danish Energy Agency and communications with him (E-mail: [JHL@ENS.dk](mailto:JHL@ENS.dk)).

22. One family housing includes detached dwellings, semi-detached dwellings, terrace houses and a unit of flat possessed by its occupant.

23. All energy efficiency upgrades of one family houses which were built before 1979 were entitled to the subsidy program.

In 1985, the government made the energy audit scheme mandatory. All sellers of buildings became obliged to provide energy audit report to buyers before making a sales contract and at the same time the capital subsidy program was abolished. Although the report was basically mandatory, sellers could be exempted from the obligation in cases where the contract said that both parties had agreed that the seller would not provide the report. Consequently, such exemption clauses were incorporated in many sales contracts and the number of assessed buildings rapidly decreased to about 3,000 in 1996. Thus, although the scheme was basically designed as a mandatory scheme, it was, in effect, implemented as a voluntary scheme and not widely applied. In light of this unsuccessful situation, the government introduced a new mandatory scheme, the Energy Labelling Scheme, in 1997. The new scheme differs from the previous scheme in two regards. First, while the proposal of possible energy efficiency upgrades was the main part of the report under the previous scheme, the new scheme provides not only such proposals, but also information regarding the level of energy and water use efficiency expressed in standardised criteria. Second, under the new scheme, sellers cannot escape the obligation to provide the information even when an exemption clause is included in the contract.

As such, an information tool has been chosen as the main instrument to attain reduction of CO<sub>2</sub> emissions in the building sector. This is because lack of information on the demand side has been perceived to be a principal barrier to improvement. Many owners and users of building do not understand how much energy saving potential their buildings have. Therefore, even though there is a large potential, owners do not feel encouraged to make new investment. In addition, since energy efficiency is invisible performance, it is difficult for potential buyers of buildings to tell high performance buildings from low performance ones.

Consequently, the level of performance cannot be reflected in the price mechanism, and in many cases sellers usually have little incentive to upgrade the efficiency of their buildings before placing them on the market. Furthermore, the scheme was made mandatory because Danish experience in the past indicated that applicants for the voluntary scheme were generally limited to those who had relatively high concern regarding the issue and would be more likely to take some action even in the absence of the scheme. Denmark has one of the highest levels of energy efficiency standards for new buildings in its building regulation, but it was perceived that the extension of the coverage to existing buildings would not be accepted by stakeholders. The subsidy program which was widely used in the early 1980's was thought to have had a large impact for a long period of time because it utilised large financial resources and subsidy programs have become unpopular since the 1990's.

The structure of the scheme differentiates between buildings with less than 1,500 m<sup>2</sup> of floor area (hereinafter called "small buildings") and those with more than 1,500 m<sup>2</sup> (hereinafter called "large buildings"). The Energy Labelling Scheme for Small Buildings covers the former category of buildings most of which is one family housing. The latter category is covered by the Energy Labelling Scheme for Large Buildings.<sup>24</sup> Before making sales contracts, sellers of small buildings are obliged to provide buyers with energy labelling reports that are written in a predetermined format. There appear to be two main objectives of the scheme for small buildings. The first is to enable potential buyers of one family housing to compare the efficiency of one house with that of another by providing them information on the level of efficiency expressed in standardised criteria. This may encourage consumers to choose more efficient options and suppliers to provide more efficient buildings to the market. The second objective is to promote energy efficiency upgrades by providing reliable information on the energy saving potential of buildings that they are going to purchase. In the case of large buildings, owners are obliged to have their buildings assessed and to receive energy labelling reports once a year. Since there is a much wider variety of large buildings, the principal objective of the scheme for large buildings is not so much to make it easier to compare the performance between buildings, but, rather, to improve the operation of existing buildings by

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24. Industrial buildings, second houses and other special buildings such as churches are not covered by these schemes.

providing owners with information on how their buildings are performing and how they can be improved by upgrades.

The energy labelling report that is provided for potential buyers under the Energy Labelling Scheme for Small Buildings is composed of three parts, as shown in Box 2.<sup>25</sup> The first part is called "energy label", and explains the current level of energy efficiency. In addition to ranking efficiency in terms of heating, electricity use and water use, the scale of impact on CO<sub>2</sub> emissions is also expressed with 3 ranks. The second part is called "energy plan", which contains proposals for upgrade work. Both capital cost and annual energy cost savings are clearly indicated in the report so that buyers can precisely understand the consequences of possible upgrades. The final part, "documentation", contains detailed information on the present state of buildings with the aim of giving credibility to the report and helping buyers who want to know more about the present situation of the building.

With regard to the implementation of the scheme, it is important to note that the role of the government is limited. Although the government is committed to the development of the framework of the scheme, an important role has been taken by the special council called Registration Council for Energy Label.<sup>26</sup> This council consists of representatives for various stakeholders, including consumers, real estate brokers, building engineers, architects, assurance companies and the power generation industry. Although representatives from ministries are included among the members of the council, they have no vote when making decisions. The council is currently undertaking various tasks, such as the approval of consultants, organisation of training programs for consultants, and dealing with complaints from consumers, etc. This institutional structure may have helped the scheme to reflect the opinions of all stakeholders and encouraged stakeholders to accept the scheme.

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25. Energy labelling reports for large buildings have similar structure.

26. There are two councils, one is for small buildings and the other is for large buildings.

**Box 2. Main components of energy labelling report**

**1. Energy label**

- Ranks of energy efficiency for heating (15 ranks)<sup>27</sup>
- Ranks of energy efficiency of electric appliances (3 ranks)<sup>28</sup>
- Ranks of water use efficiency (3 ranks)
- Ranks of scale of impact on CO<sub>2</sub> emissions (3 ranks)

**2. Energy plan**

- Upgrade work proposal (heating, electric appliance and water use)
- Capital cost of proposed work
- Annual energy savings expressed in quantity of fuel
- Annual energy cost savings
- Estimated lifetime of the upgrade work

**3. Documentation**

- Present situation of walls, floors, windows, roofs, etc.
- Present situation of appliances, etc.

Source: Danish Energy Agency

Only those who are registered as energy labelling consultants by the council are allowed to issue the energy labelling report under the scheme. At present about 700 consultants are registered as energy labelling consultants and many of them belong to small-scale designing or engineering consulting firms. Since the quality of information provided for potential buyers highly depends on the capability of the consultants, the scheme has been designed so as to ensure that incapable consultants are not involved.

First, only those who can meet the requirements indicated in Box 3 can be registered by the council and allowed to issue the energy labelling report. Even after registration, consultants are obliged to take a one-day training course organised by the council every year and receive newsletters from the council containing new information related to the scheme. Furthermore, the council regularly conduct inspections of the quality of energy labelling reports. It chooses issued reports at random and checks whether the report is appropriately written. If the quality of the report is found to be below the acceptable level, the council will withdraw the registration of the consultant who has issued the report. Besides these inspections, the

27. Ranks are decided according to the required quantity of energy (J) per meter square that is necessary to attain the predetermined indoor temperature.

28. Electric appliances that are sold with buildings are assessed. This does not include electric heating equipment under the standardised assumption.

council may discover misdoing of approved consultants through dealing with complaints from consumers or the receipt of inappropriate data under the monitoring system mentioned below. These would also lead to the withdrawal of the registration.

**Box. 3. Requirements for energy labelling consultants**

- Should be engineers, architects, structural designers, etc.
- Should have at least 5 years of experience in the field of building engineering or energy consulting.
- Should have professional liability insurance covering losses as the result of failure or wrong information in their reports
- Should have taken the training course organised by the council and have passed a final test.

Source: Danish Energy Agency

One of the main features of this scheme is its built-in monitoring system. Results of all assessments under the scheme are reported to the council, which put all collected information in its database and help the council and the government to understand how the scheme is actually operated. Findings from the analysis of the database are provided to approved consultants through the training course and the newsletter. The monitoring system can potentially be used for the revision of the scheme itself. If unexpected and undesirable effects of the scheme are identified, the council and government may make some revisions to the scheme in the future.

During the last 3 years, about 50,000 small buildings have been assessed every year. This accounts for about 60% of the annual sales of small buildings. In total, more than 150,000 reports have been issued mainly for one family housing. This means that more than 10% of one family housing in Denmark has already been assessed under the scheme. With regards to large buildings, in 2000, 52% of large buildings in terms of floor space, and 42% in terms of the number of buildings were assessed by energy labelling consultants. In order to evaluate the effectiveness of the schemes, telephone surveys of buildings owners who purchased buildings in recent years were conducted last year. For both small and large buildings, 300 owners of buildings on which energy labelling reports had been issued as well as another 300 owners of those without reports were asked questions about energy efficiency upgrades. As indicated in Table 9, 45% of owners of assessed small buildings conducted heating-related upgrades within one year, while 38% of owners of buildings without reports did so. (Danish Energy Agency, 2001a) The difference between the two is larger in large buildings. (See Table 10) While heating-related upgrades were conducted in 47% of assessed buildings, it was done in only 22% of buildings without reports. (Danish Energy Agency, 2001b)

It was found that, in both cases, most heating-related upgrades in buildings without reports had been done as additional work to, for instance, replacement of kitchen equipment, and most owners of buildings without reports did not appear to understand precisely what kind of work had been done in their buildings. On the other hand, most heating-related upgrades in assessed buildings were done with an aim to improve energy efficiency and the owners had a better understanding of what was done in their buildings. This may suggest that the %ages for buildings without reports in Table 1 and Table 2 may be overestimated and could be, in fact, lower. While there is some empirical evidence to suggest that the energy plan part of the energy labelling reports has been effective in promoting the improvement of energy efficiency, there appears to be no empirical evidence to suggest the effectiveness of the energy label part of the reports, though it is theoretically presumed that providing such information may encourage upgrades.

**Table 9. Result of the telephone survey of owners of small buildings**

	Owners of buildings with reports	Owners of buildings without reports
Have done heating-related upgrade work in the last 1 year.	45%	38%
Have done electricity-related upgrade work in the last 1 year.	27%	22%
Have done water-use-related upgrade works in the last 1 year.	21%	22%
Have not done any work	41%	47%
Do not know	0%	1%

Source: Danish Energy Agency, 2001a

**Table 10. Result of the telephone survey of owners of large buildings**

	Owners of small buildings with reports	Owners of small buildings without reports
Have done heating-related upgrade work in the last 1 year.	47%	22%
Have done electricity-related upgrade work in the last 1 year.	43%	14%
Have done water-use-related upgrade work in the last 1 year.	47%	27%
Have not done any work	29%	56%
Do not know	0%	2%

Source: Danish Energy Agency, 2001b

This scheme does not oblige building owners to implement any specific technologies and owners may choose to implement some measures only when they find that their implementation is cost-effective. Since the final decision regarding upgrades is left to the market, the scheme helps owners to make cost-effective choices by providing reliable information. It is presumed that the scheme can improve the energy efficiency of buildings in a cost-effective way and may have the effect of promoting innovation of more cost-effective technologies. All administrative cost for running the Energy Labelling Scheme for Small Buildings is incurred by the fee that sellers pay energy labelling consultants. The typical cost for issuing reports for one family housing is 300 - 500 Euro. Consultants have to pay 12.5 Euro per report and a yearly fee of 300 KK to the council. Thus, there is little administrative cost directly incurred by the government.

#### 4.2.2 Energy Performance Advice Programme and Energy Premium Scheme (Netherlands)<sup>29</sup>

In order to reduce CO<sub>2</sub> emissions sufficiently to attain the reduction goal set under the Kyoto Protocol, 5.5 Mt of carbon is expected to be reduced in the building sector by 2008-2012 in the Netherlands.<sup>30</sup> When discussing the measures to achieve this goal, the Dutch government paid special attention to the existing building sector. Although it was believed that this sub-sector had great energy savings potential that had not been fully explored, some barriers to the improvement of energy efficiency were also identified. One of the most important barriers was the lack of information regarding the cost-effectiveness of possible options. In addition, owners of existing buildings tend to be averse to the extra capital cost required for upgrade work. Even when adequate information is provided owners and users of buildings they are often not willing to invest in measures unless the expected payback period is very short. Furthermore consumers usually place high value on comfortable and healthy indoor air quality and some may fear, without good reason, that the implementation of energy efficient measures will harm indoor air quality.

In order to overcome these barriers, in January 2000, the Dutch government introduced two policy instruments targeting the existing building sector. The Energy Performance Advice (EPA) Programme aims to address the information-related barrier by providing detailed information on possible options of energy efficiency upgrading in the format of the EPA report as indicated in Box 4. In the light of the Dutch government's past experience of implementing another information tool called Energy Certificate Scheme in the early 90's which turned out not to be successful due to a lack of linkage between the results of rating and the monetary value of the properties, the government has developed a new method to calculate energy efficiency for the EPA programme, which directly indicates the estimated expenditure and the savings in energy cost. If any one of the measures recommended in the EPA report is implemented, a lump sum subsidy which usually covers the cost of issuing the EPA report is provided.<sup>31</sup> This information tool can be seen as a key instrument in this area, and the programme is expected to contribute to the reduction of as much as 3 Mt of carbon by 2008 - 2012. At the moment, the scope of the programme is limited to residential buildings, but the scheme is scheduled to be extended to cover non-residential buildings in the near future.<sup>32</sup> It is noteworthy that the Dutch government is also planning to address owner concerns regarding the possible deterioration of indoor air quality due to the upgrade work by extending the coverage of the EPA report to include explanations of possible effects of such work on indoor air quality.

The other measure introduced is a capital subsidy program called Energy Premium Scheme. The scheme subsidises energy efficiency upgrades of dwellings that were built before 1998.<sup>33</sup> Owner-occupiers, landlords, and tenants are eligible to receive the subsidy. The operation of the subsidy program is entrusted to several energy companies, and a part of the capital cost is subsidised under the scheme.<sup>34</sup> This capital subsidy aims to encourage owners to invest more in energy efficient measures. The program was designed

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29. This section is written on the basis of a country report submitted by drs Doede van Dijk, Dutch Ministry of Housing Spatial Planning and the Environment (E-mail: [doede.vandijk@bd.dgvh.minvrom.nl](mailto:doede.vandijk@bd.dgvh.minvrom.nl)) and communications with him and ir. D. Swart of the same ministry.
30. Out of the 5.5 Mt reduction, 2.5 Mt is expected to be achieved under the business-as-usual scenario, and the remaining 3 Mt reduction is to be attained with additional measures.
31. Since the fee for issuing the report is decided based on agreements between advisors and clients, the fee is sometimes higher than the amount of the lump sum subsidy.
32. EPA primarily targeted at owners of existing buildings constructed before 1998. (e.g. social housing institute, private landlord and owner occupiers).
33. The scheme also subsidises the purchase of energy efficient household appliances, heat pump boilers and solar energy appliances.
34. The proportion of the subsidy ranges from a few % of the total cost to more than 50%, with the average between 15 and 20%.

so as to create significant synergies with the EPA Programme. First, as indicated in Box 4, the EPA report explains in outline the subsidy programs the dwelling is eligible for. It is clearly described in the report how much capital cost can be reduced by applying to the Energy Premium Scheme. Moreover, the grant ceiling of the Energy Premium scheme is upgraded by 25% for applicants who implement energy efficient measures on the basis of the EPA report.<sup>35</sup>

#### **Box 4. Implementation Process of the Energy Performance Advice Scheme**

- Clients applying for the program fill out forms with questions about their houses and energy consumption and send the forms to EPA advisors.<sup>1</sup>
- The advisors survey the building collecting further data on the design of buildings and behaviour of occupants.
- Based on the analysis of collected data with a special software tool, the advisors issue reports in a prescribed format containing the following items,
  - ✓ Energy characteristics of houses expressed in a standardised energy index (EI)<sup>1</sup>
  - ✓ Various options to improve the efficiency with their estimated costs, benefits (reduction of energy consumption) and payback period.
  - ✓ Outline of subsidy programs they are eligible for
  - ✓ Estimated impacts of upgrading works on indoor air quality
- Clients make decisions whether to implement recommended measures. A lump sum subsidy of 158.82 EURO is provided for client if at least one of recommended measures is implemented. In addition clients become entitled to receive 25% more capital subsidy under the Energy Premiums Program if the measures proposed in the report are implemented.<sup>1</sup>
- The advisors send the result of the survey to the Ministry of Housing, Spatial Planning and the Environment, that will use the data for monitoring the overall energy efficiency performance in the Netherlands.

Source: Dutch Ministry of Housing, Spatial Planning and Environment.

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35. If these instruments are found to be not effective by 2004, the government may consider the possibility to introduce the EPA Programme as a mandatory scheme as has done in Denmark.

In the implementation of these two policy instruments, the role of the government is limited to:

- Establishing the conditions that have to be met by EPA advisors.<sup>36</sup>
- Setting the minimum requirements for the content of the final report.
- Developing a standardised method to calculate the cost and benefit of energy saving measures.
- Subsidising the cost for providing advice from the EPA advisors and implementing recommended measures.

In 2000, EPA reports were issued on 23,000 units of existing dwellings, accounting for about 0.4% of total existing dwelling stock of 6.5 million units. In order to examine the effectiveness of the EPA Programme, an experimental implementation of the EPA Programme was carried out between 1999 and 2000. The results showed that on average energy consumption at home could be reduced by 30%, 1.8 tonnes of Carbon, through the implementation of measures recommended by EPA advisors. The average cost for the implementation was NLG 2,000, while the annual savings in energy cost from the investment was estimated to be NLG 400. That means the payback period was about 5 years. An evaluation of this aspect has not been undertaken so far and the first post-evaluation of the effects of the EPA Programme will be conducted at the end of this year. In 2000, there were 60,523 applications to the Energy Premium Scheme and in total a subsidy of 4.44 million Euro was provided. Upgrade work based on the EPA reports to which the extra premium was provided accounted for 4.4% of subsidised work.<sup>37</sup>

The EPA Programme does not impose any specific measures on clients and the final decisions regarding upgrade work are left to owners who are provided with detailed information on the cost-effectiveness of possible measures. The relatively short pay-back period of adopted measures in the experimental implementation may suggest that cost-effective options should be chosen by well-informed owners. This may contribute to the economically efficient improvement of energy efficiency across the existing building sector as well as the innovation of technologies.

Besides a lump sum subsidy of 158.82 Euro per dwelling and a capital subsidy for upgrade work, the government prepared a budget of 15.882 million Euro for the implementation of the EPA Programme between 1999 and 2003, such as the development of the standardised evaluation method and software program, training of advisors and publication of the program. It should be noted that this does not include the budget for the lump sum subsidy mentioned above or the capital subsidy (Energy Premium Scheme) for the implementation of energy efficient measures. Since most of these costs have been incurred in establishing the framework of this program, they will not be necessary after the introductory phase of this program will have finished in a couple of years. After that, the required administrative cost, besides that for preparing the EPA reports, will be limited to that for updating software tools, monitoring and evaluation of the program, etc. They are estimated to be about 6 Euro per dwelling.

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36. From 2002, only those who have certifications as EPA advisors will be allowed to issue EPA reports.

37. It is important to note that the proportion of the works based on EPA reports should be underestimated due to the time-lag between the issue of EPA reports and implementation of measures and will probably increase in the near future.

#### 4.2.3 Home Energy Efficiency Scheme (UK) <sup>38</sup>

In the UK, it has been perceived as an important problem that there are many low-income households living in poorly energy efficient dwellings, who need to pay a considerable proportion of their income to make their homes warm enough. The cold indoor environment can cause serious health problems for occupants, and it was estimated in 1999 that there were about 4.5 million fuel poverty households in the UK. (UK Department of the Environment, Transport and the Region, 2001) <sup>39</sup>

The Home Energy Efficiency Scheme (HEES) was first introduced in 1991, on the basis of experience implementing similar and minor programs in the 1980's. The primary objective of the scheme is the reduction of fuel poverty households, and it was believed that the improvement of the energy efficiency of their dwellings was an effective long-term solution to the problem. The scheme was also expected to reduce energy use and increase employment by helping the development of the energy efficiency upgrades market. As outlined in Box 5, the HEES, at that time, aimed to implement a limited number of energy efficient measures in a large number of homes. Between 1991 and 1999, about 3 million homes were improved under the scheme. On average £171 per dwelling was spent with a potential reduction of £45 per year in fuel cost. Between 1991 and 1999, the number of households in fuel poverty decreased by approximately 2.3 million.<sup>40</sup> However it was believed that this decrease was largely due to reductions in energy price, and the contribution of the HEES was limited.

#### **Box 5. Outline of the HEES (1991-1999)**

##### **Eligible applicants**

People in receipt of a qualifying income or disability benefits, or who are aged 60 or over.

##### **Options of measures**

The scheme offers the followings at the expenses of the government:

- One main home improvement measure, chosen from loft insulation, cavity wall insulation, draught proofing or heating control upgrades
- Plus any of the following supplementary measures: two energy efficient light bulbs, a hot water tank jacket, or energy advice.

##### **Grant ceiling**

315 £ per home

Source: UK Department of Environment, Food and Rural Affairs

A review of the scheme conducted in 1999 identified some weaknesses. In particular, it was found that the scheme had not reached many of the fuel poor. Between 1991 and 1996 it is estimated that over 40% of HEES grants went to non-fuel poor households. Furthermore the scheme had not reached those living in

38. This section is written on the basis of communications with Mitesh Dhanak of the UK Department of Environment, Food and Rural Affairs (E-mail: [mitesh.dhanak@defra.gsi.gov.uk](mailto:mitesh.dhanak@defra.gsi.gov.uk)).

39. Fuel poverty households are defined as those which needs to spend in excess of 10% of income on fuel to maintain a satisfactory heating regime.

40. Between 1991 and 1996 there was a fall of 1.3 million , and there was a fall of another 1 million between 1996 and 1999.

the private rented sector. In 1998, while 75% of the grant went to the social rented sector only 4% went to the private rented sector. Another identified weakness was that the measures chosen to be installed in a home has not always been that which gives the most energy-saving benefit. The survey found that the energy efficiency improvement under the scheme during this period had been modest, on average only 4 points expressed in SAP points.<sup>41</sup> (UK Department of the Environment, Transport and the Region, 1999)

In the light of the results of the review, the HEES was revised and the new scheme was launched in 2000.<sup>42</sup> As indicated in the Box 6, the new scheme focuses on those households for whom the health risks are the greatest – the old, those with children and the disabled or chronically sick.<sup>43</sup> Furthermore additional grant scheme for the most vulnerable households, low income over 60s households, was also established.

#### **Box 6. Outline of the New HEES (2000 - )**

##### **Eligible applicants:**

Households with child under 16 and in receipt of one or more of income support, housing benefits etc.

Households in receipt of one or more of working families tax credits, disabled persons tax credit etc.

##### **Options:**

Measures can be co-ordinated from following options:

##### *Insulation measures*

Loft insulation, draught-proofing doors and windows, cavity wall insulation, hot water tank insulation, compact fluorescent lamps

##### *Heating system measures*

Gas room heaters with thermostat controls, electric storage heaters, closed solid fuel fire cassette, electric dual immersion water heater with foam insulated tank, timer controls for electric space and water heaters.

##### **Grant ceiling:**

£700 per home

##### **Additional grant (New HEES Plus):**

Additional assistance for implementing central heating system is provided for low-income over-60s households. When the New HEES Plus is applied, the grant ceiling increases to £ 1,800.

Source: UK Department of Environment, Food and Rural Affairs

41. The Standard Assessment Procedure (SAP) rating system provides a measure of the energy efficiency of space and water heating in new and existing dwellings. SAP rating are expressed on the scale of 1 (poor) to 100 (excellent) and take into account only those aspects of a dwelling which are fixed, such as the heating system, control, insulation levels, double glazing, etc.
42. It is noteworthy that since July 1998 VAT for the installation of energy efficient materials under Government funded grant schemes has been reduced from 17% to 5%.
43. In addition, the new scheme focuses on owner occupied and private rented sector, and another scheme for social rented sector was established. Consequently target number of households supported by the HEES was reduced from 400,000/year in the previous scheme to 230,000/year in the new scheme.

It is also important to note that the new HEES aims to improve the cost-effectiveness of measures. The experience of the previous scheme indicates that one main measure per property does not provide sufficient assistance for very many households and it was also believed that a simple combination of existing measures may also not be sufficient, or appropriate, for all types of properties. Consequently, the New HEES was designed to provide a more comprehensive package of measures, tailored to each property. It is estimated that the New HEES packages will reduce the amount of fuel required by households by between £300-600 per annum, depending on the energy efficiency of the property prior to the improvement.<sup>44</sup> If potential energy saving of £300 - 600 per year is achieved as expected, the pay-back period for the upgrades would be much shorter than those under the previous scheme.

Operation of the New HEES is entrusted to two utility companies that were designated as “scheme managers” by the government.<sup>45</sup> The process of the implementation of the New HEES is outlined in Box 7. In addition to the roles described in Box 7, scheme managers are also making efforts to increase public awareness of this scheme in collaboration with social workers, GPs and NPOs. In the first 9 months of implementation, the New HEES improved 89,000 dwellings. It should be noted that the energy efficiency improvement achieved under the new scheme is much larger than that of the previous scheme. Analysis of the dwellings that have been improved by the new scheme indicates that on average these dwellings were improved by as much as 19 SAP points

**Box 7. Application Process to the New HEES**

**Step 1**

Occupants of dwellings who are interested in the HEES contact scheme managers. Scheme managers check the eligibility of the household and arrange the survey of their dwellings by telephone.

**Step 2**

Surveyors (usually permanent staff of scheme managers) visit applicants’ dwellings and check the current situation of energy-efficiency-related building components, and propose ways to improve efficiency.

**Step 3**

If applicants agree with the proposal, scheme managers choose the contractors by competitive bid. (Since occupants’ concerns with a possible increase of rent was found to be one of obstacles to the diffusion of the scheme in the private rented sector, the New HEES requires owners of rented housing to agree that they will not increase the rent for a predetermined period of time.)

**Step 4**

Chosen contractors contact applicants and conduct the upgrade work.

**Step 5**

Contractors receive fees from scheme managers.

Source: UK Department of Environment, Food and Rural Affairs

44. This can be compared to the potential annual reduction of energy cost under the previous scheme, £40.

45. Scheme managers were chosen on the basis of the results of competitive bids.

When evaluated as an instrument of climate change policy, it appears that the results show a mixed picture. On the one hand, it is quite reasonable, under present financial constraints, to focus on dwellings occupied by low-income households. Many of these dwellings have low levels of efficiency, and in general the energy efficiency of such dwellings can be improved in a more cost-effective way than those with higher performances. Moreover, a program that clearly focuses on low-income households may be politically accepted more easily.

On the other hand, since many low-income households cannot afford to warm their homes to a satisfactory level before upgrade, a significant proportion of the energy savings potential achieved by the efficiency improvement is usually used for the improvement of comfort rather than energy savings. One survey of this scheme conducted by the Building Research Establishment found that the respondents appear to have taken 77% of energy saving potential in improved warmth and only 23% in savings. This may suggest that much energy saving should not be expected through the HEES in the short run, though the scheme could be an effective measure to reduce CO<sub>2</sub> emissions in the long run.

The average amount of grant per household is estimated to be some £600, and £130 of that is administrative cost. It is important to note that the administrative cost includes the cost of conducting on-site surveillance that is essential in making cost-effective proposals. Since surveyors are supposed to choose measures among options listed in the manual provided by scheme managers, the manual should always be updated reflecting recent development of technologies. Otherwise, the scheme may have some negative effect on the cost effectiveness of adopted measures as well as progress in innovation. In order to prevent such negative effects, the manual has been frequently revised under the responsibility of the Department of Environment, Food and Rural Affairs when the effectiveness of new technologies have been certified by the Building Research Establishment. The HEES has apparently contributed to the development of the market for energy efficiency upgrades and presumably promotes the innovation of new technologies. It is estimated that 60% of all insulation work is currently done under the HEES and out of 70,000 condensing boilers installed in the UK in 2000, 30,000 of them were implemented under the scheme.

#### **4.2.4 Energy Star for Building Program (USA) <sup>46</sup>**

In 1991, the US government introduced the Green Lights Program, which aimed to upgrade the energy efficiency of lighting appliances in non-residential buildings. The government established guidelines for performing these upgrades, and provided this information to public and private organisations who had signed agreements with the US EPA to make energy efficient lighting upgrades as Green Light Partners. After its success in getting hundreds of organisations to sign up as Green Lights Partners, in 1995, the Green Lights strategy was extended with the introduction of the Energy Star for Building Program, which goes beyond lighting-only retrofits to focus on whole building efficiency upgrades. The program largely focused on upgrading the large stock of existing non-residential buildings (e.g., commercial buildings, government buildings, schools, etc.), and encourages organisations that own or manage these buildings to plan and measure their building energy performance and adopt energy upgrades. In addition, in 1999 a new performance rating system for commercial buildings that allows the most efficient buildings across the country to be awarded the Energy Star label was introduced with the goal of motivating organisations to grasp the environmental and financial value of improved energy performance. Application procedures of the Energy Star for Building Program are outlined in Box 8. Throughout the process, the government supports the adoption of energy upgrades by providing a benchmarking method and technical guidelines as to the way to improve efficiency, then issuing labels for highly energy efficient buildings.

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46. This section is written on the basis of a country report submitted by Ken Sandler of US Environmental Protection Agency (E-mail: [sandler.ken@epamail.epa.gov](mailto:sandler.ken@epamail.epa.gov)), and communications with him.

An information tool has been chosen as the main instrument to improve the energy efficiency of existing buildings, because it has been perceived that one of the main obstacles to the energy efficiency improvement of buildings was the lack of appropriate information on the user side. Although most decisions that affect the energy use in buildings are made by executives of organisations, they often mistakenly believe that energy cost is not controllable, and do not have enough knowledge about energy savings potential. It is also important to note that the U.S. government began to turn to voluntary, information-based partnership programs in the 1990s as the increasing costs and diminishing returns of regulation raised interest in new approaches to achieving environmental protection. At the same time, the increasing interest of corporations and other organisations in improving their environmental performance and image, both to reduce their own environmental liabilities and to gain public relations benefits, has fuelled the growth of voluntary environmental partnership programs.

Against this background, the U.S government chose this information tool as one of its main measures to improve the energy efficiency of buildings. This program aims to overcome the above-mentioned barriers by helping educate decision-makers about the link between energy performance and financial performance, giving them a way to evaluate both their energy performance and the financial savings they can gain from improving it.

Although Energy Star for Buildings is a voluntary program, the program has been applied to a large number of buildings. According to the 1999 Annual Report of the Climate Division of the US EPA, by the end of 1999, more than 5,500 organisations had signed a letter of partnership with the US EPA to improve their energy performance, committing over 10 billion square feet or 15% of the total commercial, public, and industrial building market. Over 2 billion square feet of investor-owned commercial real estate property joined Energy Star, representing over 25 % of the investor owned commercial real estate market. More than 1,000 buildings were benchmarked using the performance rating system and 90 were awarded the Energy Star label.

With regard to the effectiveness of the program, the most detailed analysis was conducted of the former Green Lights program. The study of the impact of the Green Lights program and other similar programs on the diffusion of electronic fluorescent ballasts carefully identified and isolated factors causing the diffusion with the aim of clarifying the actual impact of the programs. The study concluded that the programs were quite effective in energy efficiency improvement, estimating that Green Lights was responsible for preventing emissions of over 5.6 MMTCE annually through the year 2000. (Horowitz, 2001) There has been no such detailed study on the effectiveness of the Energy Star for buildings program. However the 1999 annual report of the US EPA suggests that the program had a large impact on the energy efficiency of buildings by referring to the fact that the program impact succeeded in saving a total of 22 billion kWh of emissions and thereby preventing emissions of 4.5 million metric tons of carbon equivalent (MMTCE).

Comparison between the first 90 Energy Star labelled buildings and samples of the 1995 Commercial Building Energy Consumption Survey indicates the potential of this program. The Energy Star labelled buildings were found to have 44% lower site energy intensity than average buildings in the survey. Consequently, energy labelled buildings were found to have a 30-33 % lower energy cost intensity than average buildings. Thus, it is obvious that the labelled buildings have amazingly high energy efficiency, but due to the difficulty of finding information on the baseline condition, it is not certain to what extent the high efficiency can be attributed to the scheme. Although this study suggests the impact of the program on the labelled buildings, the case study could not identify any empirical evidence to suggest how much the energy efficiency rating method has contributed to the energy efficiency improvement of non-labelled buildings or innovation of new energy efficiency measures. The total administrative cost for operating the program, such as providing contractor support, is approximately 12 million dollars annually. It is important to note that the cost includes employing 25 permanent staff for the program, who are responsible for the development of design and measurement tools, education of experts, evaluation of the program etc.

### **Box 8. Application Procedures of the Energy Star for Building Program**

#### ***Step 1: Signing-up as a participant***

Organisations that possess or manage non-residential buildings voluntarily sign a Partnership letter with the US EPA that acknowledges the importance of, and steps for, improving the energy performance of their buildings. (Organisations are allowed to receive technical support from the government in the following steps even if they do not sign up as a Energy Star Partner)

#### ***Step 2: Benchmarking***

The participants are expected to measure the energy efficiency of their buildings with a computer tool developed by the government, Portfolio Manager, which evaluates the efficiency relative to a baseline level and assigns a score of 0-100.

#### ***Step 3: Adopting five stage energy upgrade***

Technical experts of the government provide guidelines, manuals, and answers to questions on the way to improve the energy efficiency of buildings using a 5-step approach. . The initial focus on load-reduction in Stages 1-3 is expected to reduce the size and cost of equipment associated with Stages 4 and 5.

##### **Stage 1: Green Lights**

Reduce electrical and cooling loads by using more energy efficient lighting technologies.

##### **Stage 2: Building Tune-up**

Improve the maintenance and operation of the buildings to reduce the heating, cooling and electrical loads

##### **Stage 3: Other Load Reductions**

Identify other ways to reduce the heating, cooling and electrical loads

##### **Stage 4: Fan System Upgrades**

Optimise the design of fan systems based on the load reduction in the previous stages

##### **Stage 5: Heating and Cooling System Upgrades**

Optimise the design of heating and cooling systems based on the load reduction in the previous stages

#### ***Step 4: Receiving the Energy Star label***

Buildings are assigned a score of 75 or higher by the Portfolio Manager, representing the top 25% in energy performance, along with a healthy indoor environment is eligible to receive the Energy Star label for buildings.

Source: US Environmental Protection Agency.

It should be noted that the program has been operated with full attention to the potential for conflicts with other environmental objectives. The most obvious potential for conflict is between the goals of energy efficiency and indoor air quality. Buildings that are designed to be tight for energy efficiency purposes without being well-ventilated run the risk of lowering the quality of indoor air. To guard against this

problem, good indoor air quality is an explicit requirement for award of the Energy Star label for building label and the program includes guidance on how to provide proper ventilation within the confines of an energy-efficient building. Another potential conflict is the treatment of used fluorescent bulbs. Since the bulbs contain small amounts of mercury, the disposal of large amounts of them can be subject to hazardous waste regulations. Faced with this conflict, the US EPA has attempted to resolve this issue by exempting the recycling of the bulbs from the hazardous waste rules, as a way to encourage increased recycling - and reduced disposal - of them.

### 4.3 Policy instruments for minimising the construction and demolition waste

#### 4.3.1 Landfill and incineration tax and regulation on the treatment of the construction and demolition waste (Denmark)<sup>47</sup>

Until the 1980s, most construction and demolition waste (C&DW) was brought to landfill or incineration sites in Denmark, which is one of the few countries where more than 90% of C&DW is recycled today. In light of the large environmental impact of C&DW, the government examined various options of instruments and a landfill tax was introduced in 1987, together with an incineration tax. Like in other countries, this tax was intended to shift the destination of waste, including C&DW, from landfill sites to recycling facilities by making the choice of landfill sites less economically attractive. Since C&DW had accounted for a significant proportion of the waste being brought to landfill sites, C&DW was obviously one of the main targets of the tax.

In Denmark, only waste carriers approved by the government are allowed to bring waste to landfill sites or recycling plants, and demolition work is usually conducted by specialised demolition contractors that are different from waste carriers. When waste carriers bring waste to landfill sites<sup>48</sup>, a landfill tax must be paid to the operator of the site by owners of the waste together with gate fees.<sup>49</sup> The received tax is then passed on to the tax authorities of the government. As indicated in Table. 11, the tax rate was first set at approximately 5 Euro per tonne. The rate for landfill has been increased several times since and has reached the highest level of Member countries, 50 Euro per tonnes. This rate is at least three times as much as typical gate fees for pure concrete (5.5 – 16 Euro per tonnes) or mixed asphalt and concrete (9 – 16 Euro per tonnes).

The other important element of the Danish policy in this area is regulation on the treatment of C&DW. In 1995, the Danish government sent a circular to all of 275 municipalities, which have responsibility for waste policy under the Environmental Protection Act, and required them to implement local regulations as follows.

- Owners of buildings must submit reports including the following items to municipalities at least 4 weeks before the start of demolition work if the weight of the generated waste is estimated to be more than 1tonne.
  - Address and name of buildings

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47. This section is written on the basis of communication with Lone Kielberg of Danish Environmental Protection Agency (E-mail: [LKI@MST.DK](mailto:LKI@MST.DK)).

48. In Denmark all of landfill sites are operated by municipalities.

49. In the case of the C&DW, owners of demolished buildings are usually regarded as owners of wastes.

- Kinds of wastes to be generated by demolition
  - Quantity of waste
  - Timing of waste generation
  - Name and address of waste carriers
  - Destination of the waste etc.
- Some building materials, including asphalt, concrete, stony materials etc, must be collected separately from other materials on sites and recycled.

**Table 11. Danish waste tax rates (EUR/Tonnes)**

	1987	1990	1993	1997	1999	2001
Recycling	0	0	0	0	0	0
Incineration (combined heat and power production)	5	17	21	26	37	44
Incineration (only heat production)	5	17	21	28	44	44
Landfill	5	17	26	38	50	50

Source: Danish Environmental Protection Agency.

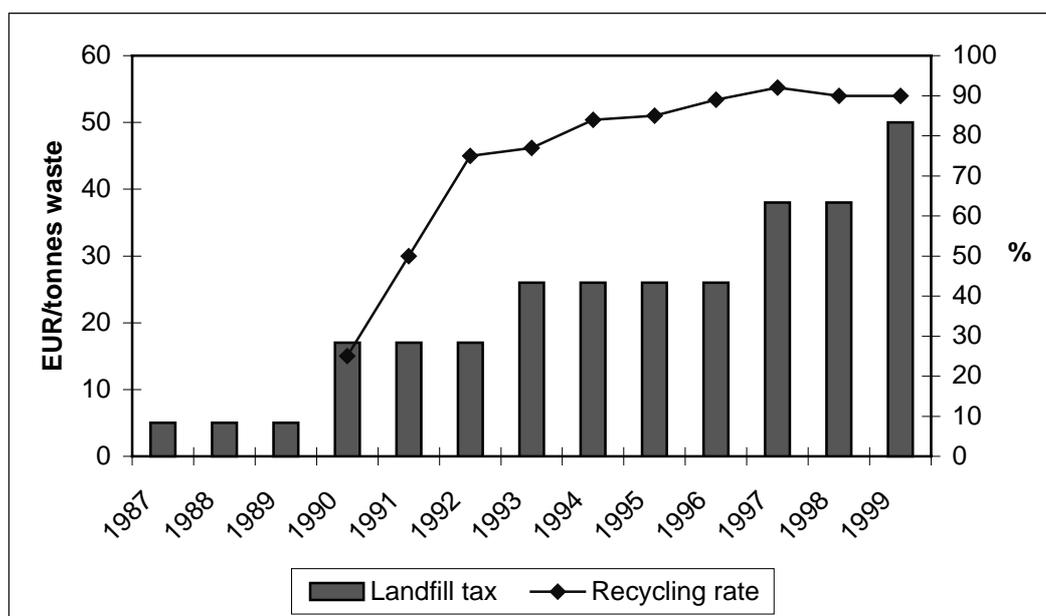
Consequently all municipalities have implemented these regulations as local regulation. Although the Act empowers municipalities to implement extra regulations on the treatment of waste, such efforts have been made for the minimisation of C&DW in few municipalities. All municipalities have established databases to which all received information regarding demolition activities, destination of the waste, etc., are inputted. These databases have enabled municipalities to have tighter control of the treatment of C&DW. This may be one reason why the problem of illegal dumping, which has arisen in some other countries upon the introduction of economic or regulatory instruments, has not become a big problem in Denmark. Furthermore in 1997 the government issued a statutory order regarding waste management. This order banned all sorts of wastes that can be incinerated from being brought to landfill sites.

In line with the implementation of these instruments, the government has made efforts to establish a broad consensus to reduce the final disposal of C&DW among stakeholders. Consequently, in 1996 the government made a voluntary agreement with the Danish Contractors Association on selective demolition. The agreement states that C&DW shall be separated at source in clean fractions, so that, for example, bricks and concrete are not mixed. This agreement developed good grounds to facilitate the further recycling of C&DW, and established the environment where the statutory order would be accepted by stakeholders in 1997.

Analysis of the relationship between landfill tax rates and recycling rates of C&DW clearly indicates that the tax has contributed greatly to the increase in the recycling rate. (Danish Environmental Protection Agency, 2001a) Although the tax did not appear to be effective for the first three years when the rate was as low as 5 Euros per tonne, the recycling rate began to increase rapidly after the rate was more than tripled in 1990, and the recycling rate has kept on rising in line with the increase in the tax rate. (See Figure 2)

Analytical study by the government on the effectiveness of the instruments also found that municipalities, which are directly responsible for the management of C&DW, believed that the successful increase of the recycling rate could be attributed mostly to the tax.<sup>48</sup>

**Figure 2. Recycling rate for C&DW and the landfill tax rate in Denmark**



Source: Danish Environmental Protection Agency, 2001a

While the recycling rate of C&DW is lower than the rate of other waste in many other countries, the rate of C&DW is much higher than other wastes in Denmark.<sup>50</sup> The increase in the recycling rate in the late-1990's may be partly attributable to the regulations and the voluntary agreement, though there is no empirical evidence to suggest the scale of their impacts. It is also important to note that the landfill tax and incineration tax have prepared an environment where new regulatory instruments or voluntary agreement can be accepted by stakeholders. Although no official data regarding the scale of the administrative cost for implementing the tax or regulatory instruments was found, it can be presumed that the administrative cost of the landfill tax scheme may be modest because the tax is collected from landfill sites that are operated by municipalities and the number of the sites is limited. The case study could not identify empirical evidence related to the economic efficiency of the instruments. With regard to incentives for innovation, it is generally perceived that these instruments have contributed to the innovation of technologies related to the recycling of building materials, though no clear evidence could be identified.

According to the Danish government's waste management plan for the period 1998-2004, the target of the recycling rate of C&DW was set at 90%. Amazingly, this goal was already achieved in 1997. Consequently, the focus of the policy will probably be placed on improvement of the recycling process. One of the important issues that the government has to address in the long run may be the increase in the use of the recycled building materials in building construction, because even in Denmark, most recycled building materials are currently used as foundation for pavements and roads. In order to reduce the use of

50. For instance the recycling rate of domestic waste was 15% in 1997.

primary materials in building constructions, the quality of recycled materials may have to be improved in the long run.

#### 4.3.2 Ban on landfill, landfill tax and Building Material Decree (Netherlands) <sup>51</sup>

The Netherlands is one of the countries that have the highest level of recycling/reuse rate of C&DW among OECD countries. The rate today is as high as 90%, but it is important to note that the rate had already reached a relatively high level, 73.5%, in 1990 when the government had not yet implemented main policy instruments for minimisation of C&DW. This high rate may be partly explained by the unique situation of the supply and demand of building materials in the Netherlands. While there has been a limited supply of primary building materials, construction of buildings in the Netherlands, due to its unique geographic location, has required larger amount of materials for ground works than it does in other countries. Consequently, there has been relatively large demand for recycled building materials.

With an increase in public awareness of environmental issues, the government introduced three principal policy instruments to minimise C&DW in the mid- and late 1990's. The first instrument that the government introduced was a landfill tax. The tax was introduced in 1996 with the aim of making the disposal of waste in landfill sites more economically unattractive and to promote recycling. At the time of introduction, the landfill tariff, including a tax for non-combustible wastes such as C&DW, was set at around 12 EUR/ton. After repeated minor increases, the rate was largely increased in 2000 to a level of 70 EUR /ton as indicated in Table 12.

The principal problem the government faced in the implementation of the tax was not related to C&DW, but to municipal waste. As the tariff for combustible waste, like typical municipal waste, is much higher than that for non-combustible waste, like C&DW, much municipal waste was brought to landfill sites, claiming to be C&DW. In order to address such false reporting, the government has revised the tax scheme so that only waste whose weight/volume ratio is less than 1,100kg/ m<sup>3</sup> can be treated as combustible waste.

**Table 12. Landfill tax and tariff rates in the Netherlands (2000)**

	Landfill tax	Tariff of landfill (including the tax)
Combustible wastes	70 EUR/ton	110-120 EUR/ton
Non-combustible wastes	13 EUR/ton	70 EUR/ton

Source: Dutch Ministry of Housing, Spatial Planning and Environment.

One year after the introduction of the tax, a new regulation was enacted in 1997. The new regulation banned some sorts of recyclable and combustible wastes from being brought to the landfill sites. Under the regulation, landfill sites operators<sup>52</sup> are allowed to receive wastes only when there is a certificate<sup>53</sup>, issued by licensed sorting plants or demolition contractors, that prove that more than 85% of materials in the

51. This section is written on the basis of a country report submitted by Jeroen van der Waal, Dutch Ministry of Housing Spatial Planning and the Environment (E-mail: [jeroen.vanderwaal@minvrom.nl](mailto:jeroen.vanderwaal@minvrom.nl)), and communications with him.

52. Most of operators are municipalities.

53. The certificate is called "landfill marks".

waste are composed of materials other than those defined as recyclable or combustible in the decree. Such a tight control system appears to have contributed to the effective enforcement of the regulation.

It should be noted that there is another regulation on demolition activities at the local level. In 1993, various stakeholders in the management of C&DW, such as national, provincial and municipal governments, contractors, sorting plant operators, recycling facility operators, building material manufacturers, etc., made a voluntary agreement to take efforts to promote the careful separation of recyclable building materials on demolition sites. On the basis of the agreement, all municipal governments introduced a new local regulation immediately. The local regulation has obliged demolition contractors to separate recyclable materials on demolition sites. Furthermore, owners of large buildings, who are to demolish their buildings, are now obliged to submit reports regarding the way buildings are demolished and to obtain permission for the demolition from municipal governments. Although it is reported that the local regulation has not been enforced quite effectively, it appears that the voluntary agreement and subsequent local regulation have contributed to create the circumstances where the government could introduce new regulation, the ban on landfill. It is also important to note that the ban on landfill is currently not in effect (from the beginning of 2000) because there was a large shortage of capacity at incineration sites.<sup>54</sup>

The third instrument, the building material decree, was introduced in 1999, with the principal objective of preventing the contamination of soil and groundwater with organic compounds leached from building materials. Under the decree, some materials, which have high risk of the leaching, have been banned as building materials, and some other materials are allowed to be used in building construction only when appropriate preventive measures are implemented. Owners of buildings are obliged to be able to provide proof of compliance during all the service lives of their buildings.<sup>55</sup> This decree is applied to both primary and secondary materials in the same way, and it was expected that the decree would get rid of fears that the use of secondary materials might cause any problem related to leaching. (Dutch Ministry of Housing, Spatial Planning and Environment, 2000)

In the Netherlands it is widely believed that the landfill tax is the instrument that has contributed the most to the high recycling rate of C&DW. As indicated in Table 13, the yearly trend of the recycling rate illuminates the impact of the landfill tax on the recycling rate. The rate exceeded 90% in 1995 when the introduction of the landfill tax was announced and the other instruments had not yet been implemented.

It is also important to note that even after the ban on landfill ceased to be in effect (since the beginning of 2000), the recycling rate reached its highest level in 2000 with the increase of the tax rate. This appears to be another evidence that the tax has played a more important role than the regulation in the promotion of recycling. Although the recycling rate of C&DW is high, as in other countries, most of it is used in construction work that requires lesser quality than its original use, such as foundations of roads, etc. Since the demand for materials to be used in groundwork is great, it is not yet strongly perceived that the use of secondary building materials in building construction should be promoted.

**Table 13. Recycling rate of construction and demolition waste in the Netherlands**

	1985	1990	1995	1996	1997	1998	1999	2000
Recycling	49.5%	73.5%	91.6%	91.5%	92.5%	93.0%	92.1%	94.3%

54. The shortage was estimated to be around 2 million-ton per year.

55. Only stony materials are covered by this decree.

Incineration	0.9%	1.3%	1.1%	1.1%	1.5%	1.4%	1.2%	1.1%
Landfill	49.7%	25.2%	7.3%	7.4%	6.0%	5.7%	6.8%	4.6%

Source: RIVM

Illegal dumping is sometimes a negative side effect of instruments such as landfill taxes and bans on landfill. However, in the Netherlands there has not been much increase in illegal dumping perceived since the introduction of these instruments. It may be partly because municipal governments have information on the generation of C&DW due to the national and local regulation, and this has become a deterrent to illegal dumping.

With regards to the impact of the building material decree on the promotion of recycling, there were a lot of discussions before implementation. While it is widely believed that the decree will contribute to the promotion of recycling, some observers are concerned with the possible negative impact of the decree. The concern is that the decree might obstruct recycling in the short run because the quality of primary materials, in some cases, can be checked with standardised methods more easily than that of secondary materials. The decree has a very short history of implementation and no empirical study has yet been conducted.<sup>56</sup> Therefore the impact of the decree on recycling is still uncertain.

The case study could not identify estimates of the administrative cost of the landfill tax. However, since the number of landfill sites has largely decreased from more than 200 in 1990 to 35 today, and most of these sites are operated by municipal governments the cost for collecting the waste appears to be modest. The implementation of the ban on landfill incurs the administrative cost of issuing certificates. In the case of non-combustible waste, the fee for issuing a certificate on waste of 24 m<sup>3</sup> is around 200 Euro.<sup>57</sup> In addition, provincial governments, which are responsible for the implementation, are incurring some costs for monitoring enforcement. Although the case study could not identify any estimate of the administrative cost of the Building Material Decree, the cost may not be modest. Since the decree itself requires owners to keep proof of the quality of building materials, the direct administrative cost<sup>58</sup> may be basically limited to that of preparing the proof of materials that is usually provided by contractors to owners. However, the contractors should ask manufacturers of the building materials for similar proof to avoid the liability risk; this is also the case between the manufacturers and those who supply materials to them. Consequently, this decree may require a relatively large amount of administrative cost throughout the supply chain of buildings and building materials. With regard to the impact of these instruments on the innovation of technology, it is widely believed that the ban and landfill tax have promoted the innovation of recycling facilities and sorting plants since their introduction, and that such innovation would not have occurred without the instruments.

#### 4.3.3 Landfill tax (UK)<sup>59</sup>

The UK government introduced a landfill tax in 1996 as a response to increased public concern about the environmental impacts of waste disposal. It was a key element of the National Waste Strategy published at

56. The first study to evaluate the impact of the decree will be conducted by the end of this year.

57. 24 m<sup>3</sup> is the typical volume of a container in the Netherlands.

58. Besides the cost for monitoring the situation of the enforcement.

59. This section is written on the basis of communications with Bob Davies of UK Department of Trade and Industry (E-mail: [Bob.Davies@dti.gsi.gov.uk](mailto:Bob.Davies@dti.gsi.gov.uk)).

the same time, and coincided with reforms to the waste licensing regulations. The aims of the tax set out in the Strategy were:

*To ensure that landfill costs reflect environmental impact, thereby encouraging business and consumers, in a cost effective and non regulatory manner, to produce less waste; to recover value from more of the waste that is produced; and to dispose of less waste in landfill sites.*

It was expected that the tax would have an effect of reducing final disposal of C&DW and promoting recycling of building materials. It was estimated in the early-1990's that some 70 million tonnes of demolition and construction waste were generated each year in the UK, and some 63% - or 44 million tonnes - were recycled. (Howard Humphreys & Partners, 1994) However, it was also estimated that the majority of the material which is recycled is employed in either low level uses on (or near) the site of arising, or in landfill engineering, and the quantities which are recycled to secondary aggregate constitute only 4% of the total estimate.

The case for the tax, and the levels at which it was set were based on an economic valuation of the environmental costs of landfilling or incinerating waste. This was the first UK tax both to seek directly to internalise the external costs of environmental damage and to provide earmarked funds for environmental spending. The tax was set to reflect the different levels of environmental damage caused by two types of waste. There was a higher rate for non inert waste so as to include all organic waste which on decomposition would lead to the emission of methane, a powerful greenhouse gas; and a lower rate for all other, inert waste. Initially these rates were set at £7 per tonne and £2 per tonne<sup>3</sup> respectively. C&D waste was nearly all classified as being inert and was, therefore, charged at the lower rate.<sup>60</sup> It is the obligation of landfill site operators to pay the tax to authorities depending on the weight of wastes they receive. Usually they pass on the tax to their clients.<sup>61</sup>

The landfill tax is one of the main policy instruments for changing behaviour away from landfill. The licensing system for UK landfill sites has been in operation for many years, although it was modified around the time the landfill tax itself was introduced. It should be noted that there have been some sites, designated "unlicensed sites", which are exempted from waste licensing requirements and from the landfill tax. They include sites where waste is used for the provision of recreation facilities, such as golf courses, the construction, maintenance or improvement of buildings etc.

According to the review of the tax conducted by HM Customs & Excise in 1998, the vast majority of respondents (waste management industry, waste producers, local authorities, environmental groups and other interested parties) to the review claim that the tax is responsible for significant shortfalls in the disposal of inert materials, mainly C&DW, at landfill sites. To a great extent, respondents to the review have forcefully expressed the concern that this change is attributable largely to an increase in the transportation of waste to unlicensed sites.

A review on the operation of the landfill tax conducted by the Select Committee on Environment, Transport and Regional Affairs concluded in 1999 showed similar results. The review concluded that the £2 per tonne tax on inert waste has had a significant effect, though there had been no significant change in the disposal of active waste.<sup>62</sup> The review also suggested that the reduction of C&DW brought to landfill

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60. This figure can be compared to the general gate fee of landfill sites for inert wastes, £1-2 per tonne. (estimated on the basis of a survey conducted in 1994) (Howard Humphreys & Partners, 1994)

61. Default on payment by a client would allow this to be written off as a bad debt.

62. The memorandum submitted by the Department of Environment, Transport and Regions noted that there is a clear perception that there has been a drop in the quantity of the C&DW going to landfill.

sites may be largely attributable to the diversion of the wastes from licensed landfill sites to unlicensed sites, and there has been significant concern over the increase of inert wastes brought to unlicensed sites.

The reduction of C&DW after the introduction of the tax was more clearly identified. The quantity of inert wastes brought to landfill site is imputed from tax returns submitted to HM Customs and Excise indicating that the amount decreased by 15% from 1997-1998 to 1998-1999. (ECOTEC, 2001) With regards to the increase of inert waste brought to unlicensed sites, there has been significant concern. It is estimated that there are about 6,000 such sites, many of which may accept wastes that should not be accepted. (ECOTEC, 2001) One of the identified negative side effects of the tax is the increase of illegal dumping of waste in general. It was widely perceived that illegal dumping has increased since the introduction of the tax. A survey carried out in July, 1997 showed that 78% of responding stakeholders believed that illegal dumping had definitely or probably increased as a result of the tax. (UK Select Committee on Environment, Transport and Regional Affairs, 1999)

Although these two reviews concluded that the tax has contributed to the reduction of C&DW brought to landfill sites, and the UK government has made a decision not to increase the tax rate for inert waste while the rate for non-inert waste was increased to 10 £/ton in 1999 and will be further increased to 15 £/ton by 2004 (See Table 14), the case study could not identify good evidence suggesting the degree of effectiveness of the landfill tax.<sup>63</sup> The review by HM Customs & Exercise pointed out that another possible driver of the reduction of C&DW brought to landfill sites is the increased price of landfilling arising from new regulation on management of landfill sites. The study by ECOTEC pointed out other initiatives that may have assisted in the reduction as follows:

- The increase in transport costs (owing to fuel duty escalator in the UK).
- The desire of the primary aggregates industry to be seen to be 'doing something' under the threat of an aggregate tax.
- The combined effect of a number of initiatives started by the government and by industry to promote changes in building practice (ECOTEC, 2001).

**Table 14. Landfill tax rates in the UK (£ per tonne)**

	1996-1999	1999 April	2000 April	2001 April	2002 April	2003 April	2004 April
Inert waste	2	2	2	2	2	2	2
Non-inert waste	7	10	11	12	13	14	15

The diversion of C&DW to unlicensed sites has contributed significantly to the reduction of C&DW brought to landfill sites. Therefore, it appears that the landfill tax has not contributed much to the promotion of recycling of secondary materials in building construction. The case study could not find estimates of the administrative cost of the tax, but presumably the cost may be higher than in other countries, because landfill sites are generally operated by private companies and this may require the government to take measures to monitor the operation of the sites.

63. The problem is that the UK government has not established a monitoring system to regularly provide yearly data on the amount or recycling rate of C&DW.

#### ***4.3.4 Construction and Demolition Debris Management Program (USA) <sup>64</sup>***

Over the last decade, the US Environmental Protection Agency (US EPA) and state and local governments have tackled many significant waste challenges, such as the development of comprehensive "cradle-to-grave" hazardous waste regulations and municipal waste landfill and incinerator standards. As one sign of progress, the United States municipal solid waste recycling rate has increased from about 16% in 1990 to approximately 28% in 1999 (the latest year for which final data is available). As a result, greater attention is now being paid to previously neglected waste issues, including that of construction and demolition (C&D) waste.

The US EPA's involvement with the issue of building-related C&D waste reduction, recovery and management began in the early- 1990's as these issues began to receive heightened attention from solid waste journals and state and local solid waste officials. In general, the environmental challenges of C&D waste relate to its large volume and related resource conservation issues, rather than to acute hazards it may present to human health or to the environment. Therefore, the majority of landfills for construction and demolition wastes are not closely regulated. The only EPA regulation directly affecting C&D landfills is a 1996 rule requiring that C&D landfills either set up a system to ensure that even minute amounts of hazardous waste are screened out, or else meet certain minimum landfill standards (e.g., including siting restrictions and groundwater monitoring). The lack of any other national C&D regulations (other than relatively broad standards applicable to all landfills) leaves state and local governments free to impose their own regulations if they so choose. Many states and localities regulate other types of landfills more strictly, but usually impose less stringent regulations on C&D landfills.

According to the US Geological Survey, construction materials account for 60% of non-food, non-fuel, raw material consumption in the U.S. In 1998, EPA estimated an annual generation rate of 136 million tons per year of building-related C&D waste in the U.S. In addition to the impacts of these resources being depleted, their extraction and processing exact a considerable cost on the environment, whether in the form of forest ecosystems being damaged by tree harvesting, large amounts of land being disrupted due to mining, or the various forms of air and water pollution and solid waste produced through the manufacture and transport of building products.

In response to these varied concerns, the US EPA has, since 1994, developed a C&D Debris Management Program. The program contains a wide variety of measures to minimise construction and demolition waste from the building sector, and principle measures include the research and demonstration of best practices and the dissemination of technical information to the industry. This instrument was chosen because the lack of reliable technical information about ways to minimise C&DW has been seen as a main barrier to waste minimisation in light of the fact that the sector is characterised by a great number of small scale builders, plus many other players (architects, local code officials, etc.) without easy access to such information. The US EPA has not adopted regulatory instruments which are widely used in European countries, because the federal government has a limited statutory mandate and funding in this area, and it is not easy to enforce regulations on the huge number of actors involved in the treatment of C&DW.

One of the main features of the US EPA's approach is collaboration with the industry. For example, the US EPA initiated research and development activities through grants with a research institution affiliated with the National Association of Home Builders (NAHB), the largest house-builders organisation in the U.S. This research focused primarily on residential building and provided various useful guides and information related to waste management for homebuilders and remodelers. Information from all of these projects has been disseminated to a number of audiences. Publications produced in partnership with the

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64. This section is written on the basis of a country report submitted by Ken Sandler of US Environmental Protection Agency (E-mail: [sandler.ken@epamail.epa.gov](mailto:sandler.ken@epamail.epa.gov)), and communication with him.

NAHB have been distributed to approximately 30,000 members of the building community, in addition to being available over the Internet. Beyond this type of information dissemination, the US EPA has begun to develop partnerships with members of the building industries and the "green building" movement, to promote the implementation of C&D waste reduction practices. In 1999 and 2000, EPA co-sponsored a Green Building Conference aimed at educating mainstream homebuilders about "green building" practices; also in 2000, EPA developed the "Guide to Developing Green Builder Programs", a comprehensive manual to help localities develop their own voluntary "green building" programs, based on the experience of the first six local voluntary programs then identified.

To date, EPA's C&D Debris Program has been a small program with modest funding. There has never been more than the equivalent of one full-time staff person dedicated to this program, and cumulative expenditures on grants and contracts in support of this program between 1994-2001 have equalled approximately \$1.5 million, or an average of over \$186,000 per year. Due to the modest size of EPA's C&D program and limited funding available for program evaluation, it has been difficult to judge its overall impact. Although it is presumed that above-mentioned guides may be distributed to as many as 30,000 house builders, it is difficult to judge the extent to which the program has impacted management of construction and demolition waste in the field.

In 1999 the first conference intended to provide housebuilders with information regarding the management of C&DW was organised as part of the program in collaboration with the NAHB. A survey was conducted, asking nearly 400 attendees what environmentally-friendly changes they might make to their building practices as a result of their attendance. The result of the survey indicated that such information provisions may have an impact on waste generation. On average, nearly 20 tons of building materials per year per house builder was estimated to be reduced or recycled. The report also estimated impacts of EPA's publication "Guide to Developing Green Builder Programs". Assuming only 10 localities used the guide to develop their own green builder programs, the report projected that a total of 42,432 tons of materials per year could be reduced or recycled. In fact, since the guide's publication, the number of local green building programs existing or under development in the U.S. has grown to over 20 nation-wide.

#### **4.4 Policy instruments for preventing indoor air pollution<sup>65</sup>**

##### **4.4.1 Regulation on building materials (Denmark)<sup>66</sup>**

Formaldehyde is one of the most common indoor air pollutants in OECD countries. The pollutant source is usually contained in pressed wood products or urea formaldehyde insulation foam, and could be emitted indoors. Relatively high concentration of the pollutant may sometimes cause health problems such as irritation of the eyes, nose, headaches and dizziness. Since dwellings in Scandinavian countries have been relatively airtight, the issue of formaldehyde-related health problems had been reported even before the 1970's. In the mid-1970's, one Danish university conducted research on the impact of indoor formaldehyde pollution on human health. The research concluded that the 0.15 mg/ m<sup>3</sup> should be the maximum acceptable level of pollutants for most occupants, and the government introduced a new provision on the

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65. This section will focus on the health problem caused by the emissions of formaldehyde from building materials.

66. This section is written on the basis of communication with Ove Nielsen, Ministry of Housing and Urban Affairs (E-mail: [ovn@bm.dk](mailto:ovn@bm.dk)).

use of building materials containing formaldehyde together with a minimum standard for ventilation in 1979 in its building regulation.<sup>67</sup>

The main objective of this new regulation was to ensure that the concentration of formaldehyde in the air did not exceed 0.15 mg/m<sup>3</sup>. However, indoor concentration is affected by a wide variety of factors, including temperature, humidity, frequency of open windows, building materials, and materials of furniture, and it is difficult to enforce the concentration level standard in a great number of rooms. Rather, the regulation is aimed to ensure that chipboards, wood-fibre and ply-wood panels and similar materials containing synthetic binder that emit formaldehyde, would be used in building construction only when it was proved that their use in buildings under the standardised assumption do not lead the concentration level to exceed the acceptable level.

Since the amount of the chemical contained in building materials is invisible and difficult to control, the government has established a new quality control system on pressed wood products in order to enforce the standard effectively. Under this system, the government does not directly check the quality of the products but checks the reliability of the quality control system. The government has approved an inspection and testing scheme for the production of wood products operated by the Danish Control Organisation for Wood-Based Panels. (Danish Ministry of Housing and Urban Affairs, 2000)

Under the quality control system, a special label was put on wood products that were approved as compliant with the provision. Municipalities in charge of building control usually do not check whether labelled products are actually used in buildings. However, municipalities are allowed to conduct on-site inspection to check the quality of building materials and this has become a good deterrent to the use of non-labelled products. Another product that may affect the indoor concentration of formaldehyde is furniture. Even if only formaldehyde-free materials are used in building construction, the concentration could still be high if occupants purchase furniture which contain much formaldehyde. In the consideration of the large influence of furniture on indoor air quality, the government has introduced a similar regulation on furniture materials. Furthermore, thermal insulation materials are also regulated in the same way. Thermal insulation materials, which are made by foaming urea and formaldehyde, may only be used provided they are subject to a control scheme approved by the Danish Ministry of Housing.

The Danish experience clearly demonstrates that regulation on material use may be the most certain way to address the issue of indoor air pollution. Soon after the introduction of the regulation, manufacturers of engineered wood products and insulation materials stopped the production of products that did not comply with the new regulation. Consequently, it became almost impossible to find products that did not meet the standard in the Danish market. The introduction of the regulation has improved not only the performance of newly-built buildings covered by the building regulation but also that of existing buildings, because the same materials have been used in their refurbishment or remodelling.

While many other Member countries are struggling to cope with the issue of indoor formaldehyde concentration, the issue is generally perceived as a "solved problem" in Denmark and there are few reports of health problems caused by formaldehyde in recent years. Although municipalities may sometimes have done on-site inspections of materials shortly after the introduction of the regulation, they soon became almost unnecessary, because manufacturers stopped production of low-quality products. As a result, municipalities rarely do such inspections today, so there is almost no administrative cost directly incurred by the government. The only administrative cost burden comes from quality control of engineered wood

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67. Like in most of other member countries, Danish building regulation basically covers only newly-built buildings and existing buildings are required to comply with the standards only when large-scale refurbishment or remodelling works have been conducted.

products. Since it is a limited number of factories rather than a number of building sites that should be checked under the quality control scheme, the administrative cost for the quality control may be modest.

It is sometimes argued that regulation regarding indoor air quality may be misleading, because the enforcement of the minimum standard in the regulation cannot completely ensure that no one will suffer health problems. For instance, even a low level of concentration at 0.15mg/m<sup>3</sup> might cause certain health problems to some sensitive people. However the case study could not identify such criticism among stakeholders in Denmark. With regard to economic efficiency, the Danish approach may not be seen as an efficient approach, because flexible trade-offs between the level of ventilation and the choice of materials is not allowed. However, as explained above, performance criteria for approval of engineered wood products, etc., have been introduced in an effort to minimise the negative effects of the regulation on the flexibility of building design, and again the case study could not find any criticism of this negative effect among stakeholders.

#### ***4.4.2 Guidelines on indoor air pollution and regulation on building materials (Germany)***<sup>68</sup>

In the 1970's, due to the increase of oil prices, the energy efficiency of buildings in Germany was upgraded through the improvement of insulation and airtightness. Consequently, the air exchange rate of buildings decreased and a growing number of building-materials-related health problems were reported. The most common pollutant source was formaldehyde contained in engineered wood products such as particleboard and plywood. With the objective of providing guidance about the risk of formaldehyde emissions, the Federal Health Agency published guidelines that set the target value of formaldehyde concentration at 0.1 PPM.

Though the announcement of the target value can be seen as one of the most important steps in the development of German IAQ policy, the target value, by itself, could not provide good practical guidance how stakeholders should behave to achieve the target. Because the concentration of formaldehyde is affected by a wide variety of factors, such as building materials, materials of furniture, temperature, humidity, ventilation, etc. After the announcement of the target value, practical ways to achieve the target level were sought. Since it has been widely argued that the most effective way to address the problem is to remove the pollutant sources, some studies examined the relationship between the quality and quantity of building materials and indoor concentration, and established a reliable test method to determine the health risk of emissions from building materials. On the basis of the achievement of these studies, the government added a new provision regarding formaldehyde to the relevant ordinance in 1986.

In Germany there are two ordinances that aim to address the risk of hazardous substances. The first one is called the Ordinance on Hazardous Substances and prohibits the use and production of substances on the list of the Ordinance. The second one is called the Ordinance on Bans and Restrictions on the Placement of Dangerous Substances and Products on Market, and mainly prohibits the sale of listed harmful substances or products containing such substances. It is important to note that these ordinances cover a wide range of products, including those which can be used as building materials. For instance, asbestos is listed in both ordinances. That means the first ordinance prohibits the production of products containing asbestos in Germany, and the second ordinance prohibits the sale of such products, including imported products, in Germany. Other listed substances which are often used as building materials include organostannic compounds, tar oils, cadmium, PCB and PC. Formaldehyde is listed in the second ordinance by a provision

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68. This section is written on the basis of communications with Gerhard Günther and Wolfgang Ornth of German Ministry of Transport, Building and Housing (E-mail: [wolfgang.ornth@bmvbw.bund.de](mailto:wolfgang.ornth@bmvbw.bund.de)), Norbert Englert of German Federal Environmental Agency and Doris Kirchner of DIBt (German Institute of building and civil engineering).

indicated in Box 9. It is important to note that the regulation does not require the formaldehyde concentration be kept below the target value.<sup>69</sup> Instead, the ordinance prohibits the sale of products which contain so much formaldehyde they may potentially lead the concentration level to exceed 0.1 PPM in the standardised test chamber. It is also noteworthy that the regulation covers not only engineered wood products themselves, which are widely used as building materials, but also furniture that use these products.

**Box 9. Ordinance on Bans and Restrictions on the Placement of Dangerous Substances and Products on Market**

- (1) Coated and un-coated derived timber products (particleboard, wood core plywood, veneered board and fibreboard) must not be placed on the market if the estimated concentration of formaldehyde resulting from the derived timber products in the air of a test chamber exceeds 0.1ml/ m<sup>3</sup> (PPM). The estimated concentration is to be measured in accordance with test procedures that reflect the state of the art. The Federal Environmental Agency, in agreement with the Federal Institute for Material Research and Testing and after hearing experts, publishes the list of test methods that satisfy these requirements.
- (2) Items of furniture containing derived timber products that do not satisfy the requirements of Paragraph 1 may not be placed on the market. Paragraph 1 shall, however, be deemed to be fulfilled if the items of furniture comply with the equilibrium concentration specified in Paragraph 1 in a whole-body test.

Source: German Federal Ministry of Transport, Building and Housing, 2001b

Under this regulation, manufacturers of engineered wood products are required to be able to prove that their products satisfy the requirement indicated in the ordinance. Although German model building code has a general requirement, saying “construction work must be done in such a way that chemical, physical and biological influences do not cause danger or unacceptable discomfort”, the building regulation is not directly linked to the ordinance.<sup>69</sup> Therefore, those who are going to construct buildings do not have to submit proof to authorities in charge of building permission, and the ordinance also does not require the manufacturers to submit proof to authorities or buyers. It should be noted that, even in the absence of such control systems, the ordinance has been well enforced. It is perceived that this is because the risk of making headlines or product liability has been an effective deterrent to illegal activities.

It appears that health problems from formaldehyde emission, with which many other OECD countries are still struggling to cope, have been almost solved in Germany. Some experts argue that the introduction of minimum standards in this area may mislead consumers, because there are some sensitive people for whom even 0.1 PPM of concentration may cause health effects. However, in Germany such criticism has not been perceived to be sufficiently convincing to lower the target value. In light of the fact that direct control of the concentration level itself is quite difficult, the German approach of controlling the sale of potentially harmful products may be one of a few practical methods to achieve the target concentration value in a large number of buildings.

Apparently, the regulation has contributed to the improvement of indoor air environment, but it is important to note that the improvement can also be attributed to other non-regulatory measures. It is

69. In Germany there is a variation in the way buildings are regulated between regional governments.

reported that manufacturers had already improved the formaldehyde-emission-related performance of their products even before the introduction of the regulation. It appears that the announcement of the target value and subsequent studies on the way to avoid the risk of health problems encouraged manufacturers to place healthier products in the market.<sup>70</sup> It is noteworthy that there have been various voluntary measures taken by the industry itself.

Theoretically speaking, regulatory instruments like the ban on the sales of certain products, in the context of building materials, may not allow for flexibility across design elements,<sup>71</sup> be economically inefficient, and have a negative effect on the innovation of relevant technologies. (OECD, 2001b) However, there appears to be no criticism on this. This may be because the removal of the pollutant source has actually been a cost-effective way to reduce the pollutant level relative to alternative methods.

One of advantages of the German approach is that the standards for materials, that can be used as building materials, have been enforced without complicated administrative processes. This may be because it is not the use of potentially harmful materials<sup>72</sup> in buildings but the sales of such materials that is being regulated. In the former case, in order to enforce the regulation effectively, technical experts may have to visit individual building sites and check whether appropriate materials are actually used. However, in the latter case, it is factories that should be checked, and it should be easier to control standardised production processes at a limited number of factories than poorly standardised construction processes at a large number of building sites. More importantly, the ordinance targets a small number of large-scale engineered wood products manufacturers, who should pay attention to their public image among consumers, rather than a great number of small-scale contractors or designers. In practice, the regulation is well enforced though it does not require any inspection of factories. Therefore the administrative cost for this regulation should be very modest.

#### **4.4.3 Housing Performance Indication Scheme (Japan)<sup>73</sup>**

In Japan it has long been argued that the lack of information on the consumer side is one of the main obstacles to improvement of housing quality. From the viewpoint of potential buyers, it is not easy to compare the performances of one dwelling to those of another one.<sup>74</sup> Because many important performances such as energy efficiency, indoor air environment, sound insulation and structural strength, are not visible and there is a great variation in the design of dwellings which are usually supplied in a custom-designed manner.<sup>75</sup> It has also been believed that the quality of housing, including environmental

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70. It is also possible to think that the announcement of guidelines and subsequent studies had established the environment that enabled the government to introduce the regulation.

71. For example, if highly effective ventilation methods were introduced in buildings, the target value of 0.1 PPM could be achieved even though prohibited engineered wood products were used.

72. Though building regulation has a general requirement that healthy materials should be used in buildings.

73. This section is written on the basis of a country report submitted by Hiroto Izumi of Japanese Ministry of Land, Infrastructure and Transport and communications with Hirohisa Awano of the same ministry.

74. The results of a survey conducted by the Japan Housing Loan Corporation in 1998 indicates that out of 3,800 consumers who had bought housing sometime during the last five years, 60% of them felt that they had not sufficient information on the quality of the housing at the time of transaction. (Japan Housing Loan Corporation, 1999)

75. It is widely argued that the feature of the housing market in Japan has made the situation worse. In comparison with other countries, a wider variety of houses, in term of materials and structural method, are supplied in Japan. Furthermore in relative to annual average household income, average housing price is relatively high, and this may have prevented consumers from participating in the market frequently and

performances, could be improved by providing sufficient information to potential buyers. Because under such circumstances, consumers would choose dwellings with better performances<sup>76</sup> and suppliers would be encouraged to supply those with better performances. With the aim of overcoming this obstacle, the Japanese government introduced the voluntary labelling scheme of housing, called Housing Performance Indication Scheme, in 2000. Although the primary objective of the scheme is to enable consumers to make the most cost-effective decision by providing reliable information of housing performances, it is also expected that the scheme will contribute to the improvement of environmental performances of dwellings.

The Housing Performance Indication Scheme is a voluntary scheme for newly built housing, so the scheme is used on the basis of agreements between buyers and sellers<sup>77</sup> of housing. If they agree to apply to this scheme, sellers have to provide information regarding the performances of dwellings they are going to sell at the time of making contracts. In order to enable consumers to make a comparison between options of dwellings, the performances have to be expressed in standardised criteria established by the government in a predetermined format. As indicated in Table 15, most performances are expressed with ranks. It is important to note that performance items are not limited to environment-related ones, such as the safety of indoor air pollution, energy efficiency, and ease of maintenance, but also cover other important performances that buyers may take into consideration, such as earthquake resistance, sound insulation and fire safety. These performances were selected by the government on the basis of the results of a survey of buyers' attention to housing performances.<sup>78</sup> Since the scheme covers a wide range of performance items and buyers place varying emphasis on each of items, the scheme does not incorporate evaluation of "overall" performance, which is widely introduced in other labelling schemes of buildings. (International Construction Information Society, 1999)

In order to ensure that reliable information is provided to consumers, the scheme requires sellers to take third party inspection by private inspection bodies approved by the government. The approved inspection bodies check the design document, conduct on-site inspections and issue two certificates of evaluation that are expected to be handed over from sellers to buyers. The first certificate is issued when checks on design documents are finished and usually before the start of construction work, and the second one is issued when on-site inspections during and after construction work are finished. As such, the role of government under the scheme is limited to the development of assessment criteria, etc., and approval of inspection bodies, etc.

Between its launch in October 2000 and July 2001, more than 26,000 dwellings have been evaluated under the scheme.<sup>79</sup> Since the scheme has a short history of implementation, no large-scale survey has been conducted on the impact of the scheme, so it is not certain to what extent the scheme can encourage consumers to choose more environmentally friendly dwellings. However the case study has identified some evidence that suggests that the scheme has already had an impact on the suppliers' side. The impact was identified most clearly in the area of indoor air pollution. Among various pollutant sources, the scheme targets formaldehyde, which has been regarded as one of the most troublesome indoor pollutants in Japan. Under the scheme, the degree of health risk from such emissions is expressed with 4 ranks. In order to get the top rank of evaluation, dwellings should incorporate only engineered wood products (e.g., particleboard, plywood) that have been certified as containing the lowest amount of formaldehyde

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obtain knowledge about performances of housing from experiences of transactions. (Japanese Ministry of Construction, 2000)

76. Under the assumption that the price of houses are the same.
77. Includes contractors that have a contraction contract directly with consumers.
78. Recycling-related performances are not included in performance items because the survey showed that consumers are paying little attention to them.
79. It is likely that the number of houses evaluated under the scheme will increase as more house builders get prepared to use the scheme and more consumers become aware of the scheme.

("E0" level under the Japan Industrial Standard scheme). Figure 3 shows the breakdown of the Japanese particleboard market by the amount of formaldehyde contained.

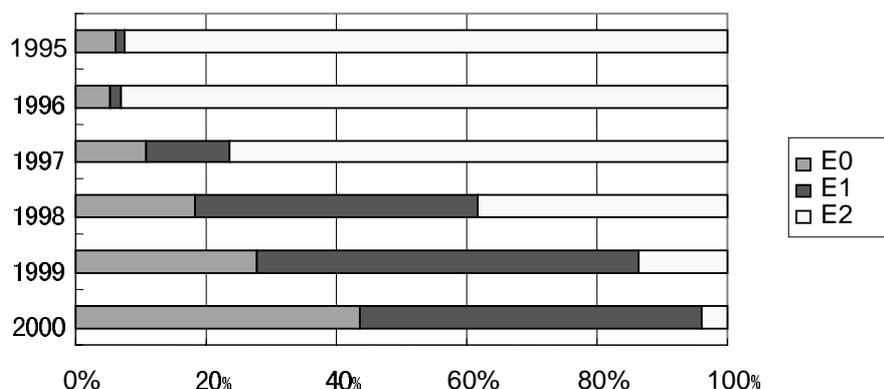
**Table 15. Main performance items of the Housing Performance Indication Scheme**

Performance items	Indication criteria	
Earthquake Resistance	Rank 3	- 1.5 times as strong as the building code level or more
	Rank 2	- 1.2 times as strong as the building code level or more
	Rank 1	- the building code level or more
Durability	Rank 3	- can be used throughout three generations or more
	Rank 2	- can be used throughout two generations or more
	Rank 1	- can be used less than two generations
Energy efficiency	Rank 1-4	( in accordance with the scale of heating/cooling burden)
Fire safety	Rank 1-4	(in accordance with how long components can resist fire)
Safety against indoor air pollution	Rank 1-4	( in accordance with the quantity of estimated emissions of formaldehyde from interior finish and backing)
Sound insulation of floors	Rank 1-5	(in accordance with the thickness of floor slab, types of finish on floor, etc.)
Ease of maintenance	Rank 3	- pipes for sewage, water supply and gas can be maintained without damaging structural parts and finish
	Rank 2	- pipes for sewage, water supply and gas can be maintained without damaging structural parts
	Rank 1	- pipes for sewage, water supply and gas can not be maintained without damaging structural parts
Lighting	XX%	proportion of total area of windows which receive sunshine to the floor area of the room
Elderly-friendly	Rank 1-5	(in accordance with the width of corridors, difference in levels of floor, equipment of handrails in bathrooms, entrance and staircases, steepness of staircases, etc.)

Source: Japanese Ministry of Land, Infrastructure and Transport.

The figure indicates that the market share of particleboard that is certified as E0 level has been rapidly increasing since the government introduced the Housing Performance Indication Scheme in 1999. It is widely argued that the scheme has had the effect of encouraging particleboard manufacturers to produce more low-emission type products. It is important to note that low-emission particleboard is used not only for newly-built dwellings but also for other kinds of new buildings and refurbishment or remodelling of existing buildings. Therefore the positive impact of the scheme is not limited to the newly-built housing sector.

**Figure 3. Breakdown of Japanese particle board market by the amount of formaldehyde contained**



Source: Japan Particleboard Manufacturers Association

Note: Under Japan Industrial Standards, particleboard which contains the lowest level of formaldehyde is categorized as "E0". In order for buildings to be evaluated as being in the top rank of safety for indoor air pollution, this category of boards must be used. Boards categorized as "E2" contain the largest amount of formaldehyde.

It is sometimes argued that labelling schemes may potentially mislead stakeholders to apply technologies which are not cost-effective if they have inflexible technology-based assessment criteria. In order to prevent such negative effects, the scheme was designed to have flexible performance-based assessment criteria, so that any new technologies could be properly evaluated. Although there is no clear empirical evidence, the scheme appears to be encouraging the innovation of new technologies. It has often been reported that new building materials such as low-emission interior finish, etc., were developed and launched targeting house-builders and developers that are planning to use the scheme.

Since the involvement of the government in the operation of the scheme is limited, besides the cost for developing and maintaining assessment criteria, the government itself directly incurs little administrative cost. Assessment of buildings by approved inspection bodies accounts for a significant proportion of the total administrative cost of the scheme, and this is incurred by the assessment fees paid by applicants. It is noteworthy that the inspection systems for this scheme were designed so as to minimise administrative cost. Even before the introduction of the Housing Performance Indication Scheme, checks on design documents and on-site inspections had been done by technical experts under three schemes and programs, building regulation, JHLC's housing loan, and housing insurance schemes.<sup>80</sup> It is apparently inefficient that four different experts visit the same building site at four different times, and labour costs should be largely reduced if one expert dealt with all of these tasks. For the purpose of promoting such an efficient method, the government has revised relevant laws and allowed private firms approved by the government to work for all four of these programs and schemes.<sup>81</sup> Furthermore the number of approved inspection bodies is not

80. 10 years insurance for all major defects of houses.

81. In the case of Ibaraki prefecture, it is estimated that the total inspection fee would be about 15% lower if applied to the same inspection body.

limited<sup>82</sup> and the level of assessment fee is left to the market with an expectation that the cost-effective service will be provided for users through competitions in the market.

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82. By September 2001, 83 bodies have been approved by the government.

## 5. MAIN FINDINGS

Despite some data availability constraints, significant findings regarding effectiveness, efficiency, etc., of the main policy instruments in specified contexts have been obtained by means of the case studies in the previous chapter, and will be summarised in this chapter. These findings may help us draw conclusions on general characteristics of policy instruments for the building sector. More analytical work will be undertaken in the next step by comparing these findings with those from the previous analytical study, and will form the core of the final output of the Sustainable Building Project, Synthesis Report, the draft of which will be prepared early next year.

### *Reducing CO<sub>2</sub> emissions from new buildings*

Building regulation has long played a dominant role in the improvement of energy efficiency of new buildings in most of OECD countries. However, since minimum energy efficiency standards in building regulation, in effect, can have an impact on only a limited number of new buildings, it has been argued that more flexible non-regulatory instruments be developed to improve buildings whose efficiency is already above the minimum level. (OECD, 2001c).

The case study analysed two types of economic instruments in this area. The first instrument is the capital subsidy program in Canada which aims to encourage investment in energy efficient measures by reducing the capital cost burden through a subsidy. The second instrument is the premium loan program in Japan, which provides special premiums such as lower interest rates and upgrading the maximum limit of loans for dwellings with high energy efficiency. With regard to their environmental effectiveness, the Canadian study found that the buildings that were subsidised under the Commercial Building Initiative Program have much higher energy efficiency than average buildings in Canada. Most of the applicants to this capital subsidy program estimated that applicant buildings have "much better" or "better" efficiency than buildings usually built by them. However it remains uncertain what proportion of these buildings may be "free riders" and to what extent the program has contributed to the high efficiency. The Japanese case study found that the share of energy efficient dwellings increased after the introduction of the premium loan scheme and that the rate of the increase was accelerated with the introduction of better premiums for such dwellings. This may, more or less, support the argument that the premium loan has had an impact on improvement, but the scale of the impact is similarly still uncertain.

The Canadian study also suggests that there may be a limitation to what subsidy programs can achieve in this area. Due to restrictions on tax revenue expenditure and the relatively high administrative cost burden, it is difficult to extend capital subsidy programs to cover a large proportion of newly-built buildings. In this regard, the Japan Housing Loan Corporation's premium loan program may be exceptional in that the program has provided premiums for a considerable proportion of newly-built housing in Japan. In 1998 the premium was provided for about half of newly-built owner-occupied dwellings. However it is important to note that the scheme has been established on the basis of Japan's unique financing systems which have provided advantageous financial resources to the JHLC, and the same scheme can not be easily transferred to other countries which have different systems.

The third instrument analysed in this area is the environmental labelling scheme for buildings in the UK. Theoretically such schemes are expected to enable potential buyers to compare the environmental

performance between buildings or design options, and encourage them to choose more energy efficient options. The estimates of buildings assessed under the BREEAM environmental labelling scheme in the UK, show their annual CO<sub>2</sub> emissions to be less than half of that from typical buildings. Despite the large difference in energy efficiency between applicant buildings and other buildings, neither study could identify any clear evidence to prove that the high efficiency was achieved because the scheme motivated designers or their clients to improve the performance.

Although the assessment of office buildings under the BREEAM requires an administrative cost burden of as much as £2,500- 3,000 pounds, the cost is generally covered by the application fee paid by applicants. It is noteworthy that even though the BREEAM is a voluntary scheme in which applicants have to bear such costs, as much as 25% of newly built buildings have been assessed under the scheme since 1991. Although the degree of environmental effectiveness remains unknown, British experience suggests that this voluntary instrument could potentially improve a great number of buildings with little administrative cost burden borne by governments.

None of the three instruments imposes any specific technologies on applicant buildings. Furthermore, it was found that much attention had been paid, in the design of instruments, to encourage the adoption of cost-effective measures and not to hamper the innovation of relevant technologies. For instance, the Commercial Building Initiative Program in Canada was designed to provide capital subsidies in proportion to the amount of estimated energy savings. In the BREEAM, the environmental performance of buildings is assessed mainly with performance-based criteria, and this may prevent the scheme from misleading use of inefficient measures. In the same way, the JHLC's premium loan has performance-based standards for the premium and provides more premium for dwellings with higher efficiency, though any improvement from the most recent standard level cannot be rewarded under the scheme. However the case study could not find any quantified data to illustrate these aspects of the instruments.

### *Reducing CO<sub>2</sub> emissions from existing buildings*

It is widely agreed that there is much energy savings potential in the existing building sector. (OECD, 2001c) However, the OECD's survey indicated that fewer policy instruments have been developed for the existing building sector than the new building sector, (OECD, 2001a) and many governments are currently developing new policy framework to improve the efficiency of existing buildings. Regulatory instruments are generally difficult to introduce into this sub-sector, and the case study analysed three approaches that some OECD countries have taken. The first approach, adopted in the Netherlands and Denmark, is to provide owners of buildings with information on the specific energy savings potential of their buildings, including concrete upgrade proposals as well as their estimated capital cost and expected energy cost savings. Similarly, in the US, benchmarking methods and technical guidance as to ways to improve efficiency have been provided for owners of non-residential buildings.

The second approach is the labelling of the energy efficiency of buildings, in which the level of energy efficiency is clarified by predetermined standardised criteria. Like labelling schemes for new buildings, they are expected to motivate owners to upgrade the efficiency of their buildings with an expectation of a decrease in energy cost or increase of resale value, etc. This approach has been adopted in Denmark and the US. The third approach is to provide a subsidy for the upgrade of efficiency. In the UK, a large-scale subsidy program has been implemented targeting low-income households. In the Netherlands an information tool is supplemented by a capital subsidy program.

Denmark is the only country that obliges sellers of buildings to provide potential buyers with reports that explain both the current level of energy efficiency and energy savings potential with upgrades. The Danish study on the Energy Labelling Scheme suggests that the mandatory provision of information on energy savings potential can influence the decision of owners regarding energy efficiency upgrades. Telephone

survey of owners demonstrate that owners of buildings are more likely to conduct upgrades if they receive reports on the energy savings potential of their buildings.

On the other hand, the effectiveness of voluntary schemes to provide such information remains uncertain. In the Netherlands it was estimated that the energy consumption of dwellings could be reduced, on average, by 30% under the Energy Performance Advice Programme, if proposed measures are implemented, but the case study could not identify clear evidence to suggest the degree of effectiveness. As to the provision of information regarding the current energy efficiency level, the case study could not identify any proof that the information provided really influenced the decision of owners, as theoretically expected. In the US, it was estimated that Energy Star labelled buildings have 44% lower site energy intensity than average buildings, but the study could not find an answer to the question how much the labelling scheme accounted for such high efficiency.

Analysis of the effectiveness of the Home Energy Efficiency Scheme, the capital subsidy program targeting dwellings occupied by low-income households, shows mixed results. Since the scheme has focused on low-income households, whose energy efficiency, in general, can be largely upgraded with modest cost, the energy efficiency achievement can be achieved in a cost-effective way. However, as many low-income households cannot afford to warm their homes to a satisfactory level before the upgrade, a significant proportion of the energy savings potential achieved by the efficiency improvement is usually used for the improvement of comfort rather than energy savings. This may suggest that much energy savings should not be expected through the HEES in the short run, though the scheme could be seen as an effective measure to reduce CO<sub>2</sub> emissions in the long run if sufficient financial resources could be provided.

Information tools that provide information on energy savings potential of buildings, like the Energy Labelling Scheme in Denmark or Energy Performance Advice in the Netherlands, may help owners making a decision regarding upgrades to choose a cost-effective option. However, it is important to note that owners cannot be informed of all possible options, and only a few options are usually chosen by technical experts. Therefore, the cost-effectiveness of proposed measures may largely depend on the ability of the experts. The Danish study found that the qualifications of experts who write reports for owners is tightly controlled. Only those who meet predetermined requirements and are registered as energy labelling consultants are allowed to issue reports under the Environmental Labelling Scheme. For the same purpose, a similar scheme is going to be introduced under the Energy Performance Advice Programme in the Netherlands from 2002.

It was also found that the design of information tools to provide information on current energy efficiency levels or energy savings potential should reflect recent technical developments. Otherwise, such information tools may mislead applicants to use inappropriate measures, and hamper the development of technologies in the long run. It is noteworthy that the Energy Labelling Scheme in Denmark has a monitoring system under which results of all assessments are collected and analysed so that the scheme can be rapidly revised when necessary.

The British experience reviewing and revising the HEES demonstrates that the design of a capital subsidy program largely affects the cost effectiveness of energy efficient measures adopted. Previously, in principle, only one measure could be implemented under the scheme, but after the revision, a wide variety of measures can be co-ordinated depending on the specific situation of dwellings. As a result, the cost effectiveness of the program has been largely improved. This appears to suggest that flexibility in the choice of measures is key to improving the cost effectiveness of energy efficient measures. Furthermore, it was found that in order to reflect recent development of technologies, a manual for surveyors has been frequently updated.

One general finding in this area is that the administrative cost is not quite modest, regardless of the type of instruments. This is because on-site investigation of the specific situation of individual buildings is, in most cases, unavoidable, in order to tailor instruments to encourage cost-effective measures.

### *Minimising construction and demolition waste*

Case studies in this area have analysed two types of instruments that are currently implemented as main measures to promote the recycling of C&DW. The first instrument analysed was a landfill tax that aims to make the option of bringing waste to landfill sites less economically attractive and promotes recycling. The second approach is the use of regulatory instruments such as a ban on landfill of recyclable waste and mandatory on-site separation of building materials.

The experience of countries that have implemented the landfill tax appears to prove that a landfill tax is an effective way to increase the recycling rate of C&DW if the tax rate is set at a relatively high level. Denmark and the Netherlands are two of only a few countries where the recycling rate of C&DW has exceeded 90%, and both countries have implemented both landfill taxes and regulation on the disposal of waste. Analysis of the instruments in the two countries concludes that the high recycling rate is mostly attributable to the implementation of a landfill tax. In Denmark, it was found that the recycling rate started to increase after the tax rate was more than tripled in 1990. Although the rate was less than 20% in 1990, it exceeded 80% even before the government introduced regulatory instruments in the late-1990's. In the Netherlands, again the recycling rate of C&DW reached a level of 90% in 1995 when the introduction of the tax was announced and regulatory instruments had not yet been implemented.<sup>83</sup> It is also noteworthy that even though the ban on landfill was not in effect at the beginning of 2000, the recycling rate reached its highest level in 2000 with the increase of the tax rate.

An increase in the recycling rate was also identified in the UK, which introduced the tax in 1996 and has not yet introduced regulation on the treatment of C&DW, such as a ban on landfill. However, the scale of the impact was not clear due to the lack of yearly data on the recycling rate. Although the case study could not identify any data on the economic efficiency of the landfill tax, it was found that the tax has presumably promoted the innovation of technologies related to sorting and recycling facilities. Despite not finding any quantified estimates of administrative cost, the case study concludes that the cost may not be so significant, because the number of landfill sites is not so large. In countries where landfill sites are operated by municipalities, like Denmark and the Netherlands, the cost of monitoring landfill activities should be relatively modest.

In both Denmark and the Netherlands, regulation on demolition and disposal activities, such as a ban on landfill of waste that can be incinerated and mandatory separation of building materials on sites, was introduced after the landfill tax had been implemented for some time. Therefore, it is difficult to evaluate the impact that regulatory instruments alone have had on the promotion of recycling.

Although the degree of effectiveness of regulatory instruments is still uncertain, some regulatory instruments appear to contribute, to some extent, to the prevention of illegal dumping, which is generally regarded as a negative side-effect of the landfill tax.<sup>84</sup> For instance, in Denmark, with the introduction of local regulation, municipalities can now receive information regarding the generation of C&DW which can potentially be used for tracking whether the waste was appropriately handled. It is important to note that while a large increase of illegal dumping was reported after the introduction of the landfill tax in the UK,

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83. Though it is also important to pay attention to the fact that the introduction of regulation sometimes affects the behaviour of regulated bodies even before the actual introduction.

84. It should be noted that many other factors such as geographical conditions, cultural background, etc., may affect the incidence of illegal dumping.

which does not have such a regulation, such an increase of illegal dumping has not been found in Denmark.

The case study could not identify any quantified estimates of administrative cost, but it was found that the management of C&DW may be more easily controlled when waste is brought to a limited number of landfill sites rather than when buildings are demolished on a number of building sites. The Dutch experience of implementing local regulation that has, not quite successfully, obliged demolition contractors to separate recyclable materials on demolition sites, suggests that the regulation of activities at a great number of demolition sites is difficult to enforce without significant administrative cost burden. Although, theoretically, such regulations may limit flexibility in the ways of treating C&DW and can have a negative effect on economic efficiency and innovation of related technologies, the case study could not find any evidence to support such an argument.

The US government has been taking a different approach to the issue of C&DW. The main instrument in the US is the provision of reliable technical information to contractors regarding ways to recycle C&DW. Estimates of the impact of the program suggest that such an approach may have some potential to change the behaviour of stakeholders in the industry with modest administrative cost. However, the scale and impact of the program is so small that it is still uncertain how much potential this approach has as a measure to promote recycling of C&DW. Another finding from the US case study is that the establishment of partnerships with industries may help effective implementation of policies. It was found that technical information has been efficiently diffused under a partnership with the National Association of Home Builders (NAHB). The importance of such partnerships is also illuminated by the Danish experience. The collaboration between the government and industry in Denmark led to a voluntary agreement on the minimising C&DW, which has helped in the introduction of a ban on landfill.

One general finding in this area is that policy instruments at the demolition stage, such as a landfill tax and bans on landfill, do not necessarily increase the use of recycled materials in building construction. Even in Denmark and the Netherlands, which have the highest levels in recycling rates of C&DW, a significant proportion is used for construction projects that can use materials of lesser quality, such as foundations of roads. In the UK, it has been pointed out that the reduction of C&DW brought to landfill sites after the introduction of the landfill tax is due to the increased use of waste for landscaping leisure facilities such as golf courses. These consequences may suggest that instruments at the demolition stage have to be supplemented by those at upstream stages to establish a closed loop of building material flow. However, few policy instruments have been introduced for this purpose in the countries studied.

#### *Preventing indoor air pollution*

The case study focussed on the issue of formaldehyde emissions mainly from engineered wood products, and two types of instruments were analysed. The first is the regulation of building materials which contain formaldehyde. The second category is information tools such as environmental labelling schemes and the announcement of guidance values for indoor concentration levels.

The experience of Germany and Denmark apparently indicate that regulation of the use or sale of building materials is the most effective measure to address the problem. It has been argued that standards for the concentration level cannot be effectively enforced because there are various factors that can affect the level and it is difficult to monitor the concentration level of a great number of buildings. Both countries have successfully overcome this difficulty by focusing on the quality of building materials as a target of the regulation. With the introduction of the regulation, manufacturers of engineered wood products immediately changed production methods and improved the formaldehyde-emission-related performance of their products. As a result, it is perceived that the problem of formaldehyde emission has been mostly

solved in these two countries, while many other OECD countries are still struggling to find a good solution.

This type of approach may potentially obstruct the flexible trade-off between building design elements and have a negative effect on the progress of innovation in the long run. For instance, a low level of concentration could be attained without improvement of the quality of materials, only by improving ventilation methods. However, it appears that such a potential problem has not been raised in either country, probably because there has not been a more cost-effective method to prevent the pollution than the control of building materials. It is noteworthy that the administrative cost for implementing the regulation is modest. The enforcement of standards for the quality of engineered wood products does not appear to be very difficult because they are produced by a limited number of relatively large-scale manufacturers.

While the effectiveness of the regulation was demonstrated, the potential of information tools in this area was also revealed. The introduction of a voluntary environmental labelling scheme for dwellings in Japan has strongly encouraged manufacturers of particleboard to shift their emphasis to low-emission type products. Another important finding from the Japanese case study is that the administrative cost for implementing the environmental labelling scheme can be reduced by allowing private firms to conduct checks on design documents and on-site inspections, not only for the labelling scheme itself but at the same time for other schemes that require similar administration procedures, such as building regulation, housing finance, and housing insurance, and by facilitating competition between firms.

It is also important to note that the announcement of target values of indoor formaldehyde concentration and subsequent provision of information on ways to achieve this level of the concentration in Germany had the effect of improving the performance of engineered wood products even before the introduction of the regulation.

The Danish and Japanese case studies indicate that even when the introduced instruments target building materials used in new buildings, the instruments can improve the indoor air quality of existing buildings as well. Because the instruments have the effect of making it difficult to find low-quality products in the building materials market. As such, the results of the study in this area suggest that the structure of the industry targeted by policy instruments greatly affects the consequences of implementation and that policy instruments should pay close attention to this aspect in the design of environmental policies.

## ANNEX 1. RESEARCH QUESTIONS IN CASE STUDIES ON POLICY INSTRUMENTS FOR ENVIRONMENTALLY SUSTAINABLE BUILDINGS

### 1. Description of policy instruments and their objectives

#### a. Describe the main characteristics of the instrument.

- The outline should address the following matters.
  - who is the first target of the instrument (e.g. owners, contractors or designers)
  - whether it is an obligatory measure or not
  - what is the scope of the instrument (e.g., new buildings or existing buildings, housing or commercial buildings?)
  - when the instrument was first introduced and if it is still in place

#### b. What was the government's main objective in implementing the instrument?

- Both the general environmental objective (e.g., reduction of CO2 emissions) and specific objectives related to the building sector (e.g., improvement of energy efficiency of building envelopes) should be indicated.
- The anticipated time-scale for the realisation of general and specific environmental objectives should be clarified.

#### c. Why did the government choose this type of instrument?

- Were the likely effects of the instrument evaluated before its introduction?
- Were other instruments considered and why did the government not choose them?
- What is the perceived barrier to improved environmental performance and how will the instrument overcome this barrier?
- Were there any contextual factors (e.g. political constraints, social objectives) affecting the government's choice of policy instrument?

### 2. Evaluation of policy instruments (for each instrument)

An evaluation of the policy instrument should be conducted according to the criteria listed below, relying on empirical evidence to the greatest extent possible. As the objectives of instruments and the difficulty in obtaining reliable data varies between countries, details of the means of evaluation should be determined by the case study authors. Where possible, it should be mentioned how the instrument chosen compared with other potential instruments considered.

#### a. To what extent has the instrument been environmentally effective in attaining the objective mentioned in 1.b?

- Environmental effectiveness relates to how much the instrument contributes to the achievement of the environmental objective. Both long-term effects and short-term effects should be evaluated.

#### b. To what extent has the instrument been economically efficient?

- Economic efficiency refers to the extent to which the instrument has enabled a least-cost achievement of the environmental objective.<sup>1</sup>

#### c. How much administrative cost burden has the instrument imposed on the administrative body?

- Administrative costs relate to the administrative cost burden imposed on the public authorities responsible for applying the instrument. Where relevant, administrative costs for the private sector should also be discussed.

#### d. To what extent has the instrument provided incentives for innovation for the building industry?

- Incentives for innovation refer to the extent to which the instruments stimulate innovation and diffusion of technologies for reducing the adverse impact of buildings on the environment.

#### e. Have there been any unforeseen side-effects of the instrument?

- Examples of side-effects may include positive and negative effects on other environmental aspects of buildings and the construction sector, as well as impacts on economic and social issues.

### 3. Other issues

- a. How is the government monitoring the effects of the instrument and making use of the results? It should be indicated if monitoring is conducted on a regular basis and what kinds of data are collected.

## REFERENCES

- Baldwin, R, Yates, Howard, N and Rao, S (1998), *BREEAM 98 for offices*, BRE, Watford.
- Bell, M., Lowe, R. and Roberts, P. (1996), *Energy Efficiency in Housing*, Aldershot, Avebury.
- Brechling, V., Helm, D. and Smith, S. (1991), “Domestic Energy Conservation: Environmental Objectives and Market Failures” in Helm, D. (ed.) *Economic Policy Towards the Environment*, Blackwell, Oxford.
- Danish Energy Agency (2001a), Evaluation of Energy Labelling for Small Buildings, Danish Energy Agency, Copenhagen.
- Danish Energy Agency (2001b), Evaluation of Energy Labelling for Large Buildings, Danish Energy Agency, Copenhagen.
- Danish Environmental Protection Agency (2001a), *Landfill tax on construction and demolition waste*, Danish Environmental Protection Agency, Copenhagen.
- Danish Environmental Protection Agency (2001b), *Waste Statistics 1999*, Danish Environmental Protection Agency, Copenhagen.
- Danish Ministry of Housing and Urban Affairs (2000), *Building Regulation 1995*, Danish Ministry of Housing, Copenhagen.
- Dutch Ministry of Housing, Spatial Planning and the Environment (2000), *The Building Material Decree Affects The Entire Building Industry*, Dutch Ministry of Housing, Spatial Planning and the Environment, The Hague.
- EUROTEC (2001), *Study on the Economic and Environmental Implication of the Use of Environmental Taxes and Charges in the European Union and its Member States*, on-line document, [http://europa.eu.int/comm/environment/enveco/taxation/environmental\\_taxes.htm](http://europa.eu.int/comm/environment/enveco/taxation/environmental_taxes.htm)
- German Federal Ministry of Transport, Building and Housing (2001a), *Guidelines for Sustainable Building*, German Federal Ministry of Transport, Building and Housing, Berlin.
- German Federal Ministry of Transport, Building and Housing (2001b), *German laws, Regulations, Administrative Provisions, Technical Specifications and Other Requirements with regard to health and environment related aspects of construction products*, German Federal Ministry of Transport, Building and Housing, Berlin.
- Horowitz, M, J. (2001), “Economic Indicators of Market Transformation: Energy Efficient Lighting and EPA’s Green Lights” in *The Energy Journal*, vol.22, No4. IAEE
- Howard Humphreys & Partners (1994), *Managing Demolition and Construction Wastes*, HMSO, London.
- Institute of Building Control (1996), *Review of European Building Regulations and Technical Provisions*, Epsom, The Institute of Building Control.

- International Construction Information Society (1999), *Environmentally –Responsible Specifying*, ICI Report 3.
- Japanese Ministry of Construction (1999), *Housing Starts Statistics*, Japanese Ministry of Construction, Tokyo.
- Japanese Ministry of Construction (2000), *International Comparison of House Price/ Household Income Ratios*.
- Japan Housing Loan Corporation (1999), *Establishing an Institutional Framework for the Housing Market with Housing Loans*, Japan Housing Loan Corporation, Tokyo.
- NOVEM(2001), *Energy Performance Advice*, NOVEM, Sittard.
- OECD (1997), *Evaluating Economic Instruments for Environmental Policy*, OECD, Paris.
- OECD (2001a), “Analytical Report on the Design of Sustainable Building Policies: Scope for Improvements and Barriers”, OLIS document, ENV/EPOC/WPNEP(2001)5
- OECD (2001b), “Policy Instruments for Environmentally Sustainable Buildings”, OLIS document, ENV/EPOC/WPNEP(2001)5
- OECD (2001c), “OECD/IEA Joint Workshop on the Design of Sustainable Building Policies”, OLIS document, ENV/EPOC/WPNEP(2001)32
- Powell, J and Craighill, A.(1997), “The UK Landfill Tax” in O’Riordan, T.(ed.) *Ecotaxation*, Earthscan, London.
- Seifert, B.(1990), “Regulating Indoor Air”, a paper presented at the International Conference on Indoor Air Quality and Climate.
- Seifert, B, Englert, N, Sagunski, H, Witten, J (1999), “Guideline Values for Indoor Air Pollution”, a paper presented at the 8<sup>th</sup> International Conference on Indoor Air Quality and Climate.
- Symonds (1999), *Construction and Demolition Waste Management Practices, and Their Economic Impacts*, Report to DGXI, European Commission.
- UK Department of the Environment, Transport and the Region (1999), *Fuel Poverty : The New HEES*. UK Department of the Environment, Transport and the Region, London.
- UK Department of the Environment, Transport and the Region (2001), *The UK Fuel Poverty Strategy*, UK Department of the Environment, Transport and the Region, London.
- UK Department of the Environment, Transport and the Region and HM Customs and Excise (1998), *Joint Memorandum to the Select Committee on Environment, Transport and Regional Affairs*.
- UK Select Committee on Environment, Transport and Regional Affairs (1999), *Thirteenth Report on the Operation of the Landfill Tax*.