POLICY BRIEF

OECD

July 2003

Environmentally Sustainable Buildings: Challenges and Policies

Introduction

The building sector is economically important in OECD countries, accounting for a significant proportion of industrial activities and jobs. In fact, the construction industry – buildings and infrastructure such as roads and electricity networks – accounts for around 5%-15% of their gross domestic product (GDP), and 45%-55% of their gross capital formation. The industry also provides 5%-10% of total employment in OECD countries. The building sector also has a great impact on the environment. Building activities such as design, construction, use, refurbishment and demolition all affect the environment, either directly or indirectly.

Against this background, the concept of "sustainable building" – reducing the harmful effect on the environment of buildings and construction activities – has been attracting the attention of stakeholders in OECD countries. This can range from using recycled materials carried by low-polluting forms of transport in construction to maximising energy efficiency in a finished building, for example through improved insulation and solar-powered energy. A recent OECD report describes the environmental and economic impacts of the building sector and the current situation in regard to environmental policies and makes recommendations for designing and implementing policies to encourage environmentally sustainable buildings. ■

How does the building sector affect the environment?

The energy consumed in operating buildings accounts for about 25%-40% of final energy consumption in OECD countries (Figure 1). Such energy consumption has long been on the increase, and it is predicted that this trend will continue. And this is just the energy used by a completed building (heating, lighting, running lifts etc), and does not take into account construction activities, including the manufacture and transport of building materials. Nonetheless, it is building use that accounts for the largest share of energy consumption in this sector and it is therefore crucial to improve the energy efficiency of buildings.

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Buildings, which by their nature shape a large volume of space to satisfy the needs of their users, inevitably require a large amount of materials for their construction. Analyses for Germany, Japan and the United States show that the construction sector accounts for between one-third and one-half of commodity flows when expressed in terms of weight (Figure 2). Building activities also generate a considerable amount of construction and demolition waste (C&DW), which accounts for a significant proportion of total waste generation in many OECD countries. It is important to reduce material use and waste generation in the building sector by promoting reuse and recycling of building materials.

Buildings also significantly affect air quality and human health. Relatively high levels of pollutants, arising from building materials and components (finishes, paints, and backing materials), can pose various health problems, such as irritation of the eyes, nose and throat, headaches and dizziness. Indoor air levels of many such pollutants may be 2.5 times – and occasionally more than 100 times – higher than outdoor levels, a source of concern given that people usually spend as much as 90% of their time indoors. ■

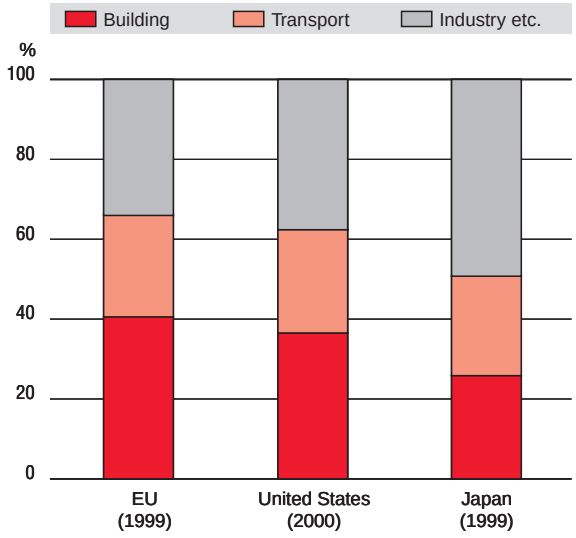
What are governments doing to reduce this impact?

OECD *countries have introduced several types of policy to reduce the environmental impact of the building sector.*

Building regulations, for example, have long played a central role in improving energy efficiency in most OECD countries; although a significant proportion of policy instruments for reducing CO_2 "greenhouse gas" emissions target only new buildings. Government intervention for upgrading existing buildings has been modest and the use of economic instruments remains limited. One area which is expanding is the use of information tools, such as environmental labelling that spells out the environmental impact of a particular product or activity.

Most of the instruments used for minimising construction and demolition waste are in fact implemented at the demolition stage, where buildings are demolished. Landfill taxes and regulatory instruments such as bans on landfill and mandatory separation of some building materials, such as asphalt, concrete, stony materials, etc. from other

Figure 1. **Final energy consumption by sector**



materials are widely used in European countries. A relatively small number of countries have introduced policy instruments, such as aggregate taxes and certification schemes at downstream stages, where wastes generated from building demolition are reused/recycled, and integrated into buildings in the next generation. Few instruments were identified at upstream stages, where buildings could be designed so as to minimise the waste generation at demolition stage.

The most widely used instrument for preventing indoor air pollution is setting target values for the concentration of pollutants. Regulations on the quality of building materials have been implemented in four European countries, and environmental labelling schemes covering indoor air quality exist in several countries. ■

How can environmental policies for the building sector be improved?

It is clear that reducing the environmental impact of the building sector would bring great benefit, but various barriers stand in the way. Experiences of OECD countries indicate that it may be difficult to overcome these barriers solely through market mechanisms. Under such circumstances, government policies can play an important role in reducing the building sector's environmental impacts.

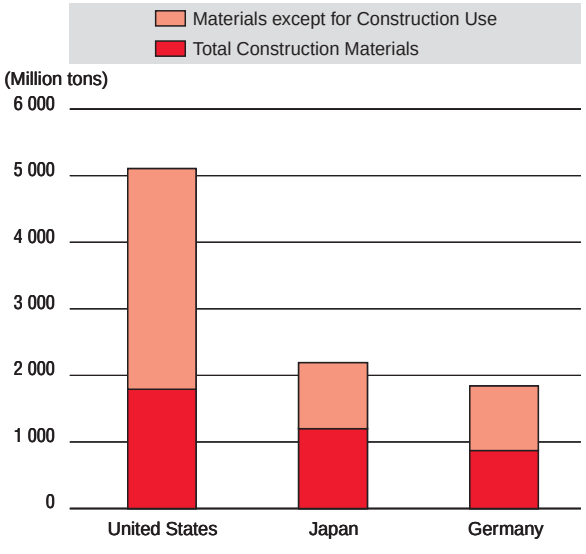
It is important to note that the building sector has several unique characteristics in terms of its products, production processes, and the way its products are used. For one thing, buildings have a significant long-term impact on a particular area since they are fixed in one place and have a lengthy period of service. Furthermore a considerable proportion of buildings are not used by their owners but are rented out to other individuals or firms. These unique characteristics have created specific barriers to improving the environmental performance of buildings and building activities. Investment in some measures to improve energy efficiency of buildings - such as improving air-tightness, adding insulation materials, upgrading electric appliances, etc, - can be paid back in a very short period of time. But other investments may require a long time to produce a good return, depending on the condition of existing buildings and choice of measures. In such cases, investment appraisal may be difficult due to uncertainty over the longer-term evolution of elements such as climate conditions and energy prices. Moreover, the high level of discrepancy between owners and users has discouraged owners of rented buildings from making investments for improving the energy efficiency of rented buildings, because energy costs are usually incurred by tenants. Consequently, discussions on policy design in other sectors are often not applicable to the building sector, and policy makers need to give special consideration to how environmental policies for the building sector can be best designed.

Although many questions have not been sufficiently addressed due to a lack of available data, theoretical and empirical analysis of characteristics of policy instruments demonstrate that each policy instrument has both strengths and weaknesses, and that no single instrument can be a panacea for environmental problems. The effectiveness of policy instruments depends to a great extent on the decisions that policy makers take at every stage of their design and implementation. Policy makers in OECD countries could improve environmental policies for the building sector by adopting the following policy recommendations:

- Establishing a *national strategy* for improving the environmental performance of the building sector should help increase the effectiveness of policy instruments in this area. Such a sector-based strategy may provide specific and useful guidance that fully reflects the unique characteristics of the sector, and help policy makers to implement policies in the building sector in the right direction. The sector-based strategy would be expected to include quantified policy goals with time-scales, which would provide more detailed instruction for policy design, and basic principles of policy co-ordination, and prevent future conflicts between policy instruments for different environmental objectives.

- Establishing a *framework to regularly monitor* the environmental performance of the building sector. Such a framework not only enables governments to set quantified policy targets in a sector-based strategy, but also provides policy makers with information to help them reform policy instruments in the proper way. It is important to note that many policy instruments are not likely to keep their effectiveness without appropriate fine-tuning based on results from monitoring. In order to obtain useful information on the effectiveness of policy instruments, the monitoring framework needs to be based on good data over a period of time, rather than on *ad-hoc*

Figure 2. **Total commodity flow in selected OECD countries, 1991**



Source: World Resource Institute, 1997.

measurements of environmental performance. As the collection of such data is usually time-consuming and costly, it is important to note that such data could be collected at a modest administrative cost by making the best use of the administrative framework established for environmental labelling schemes.

- Supporting *environmental research and development,* as well as the diffusion of environmental technologies across the construction industry, as it is characterised by a dominance of small-scale firms which tend to lack R&D investment and to be slow to adopt new technical expertise. By establishing a close partnership with industry associations that have an extensive network of firms, government programmes that support R&D and the diffusion of new environmental technologies could be implemented more effectively, reaching a great number of geographically dispersed firms in the industry. There appears to be wide scope for further developing partnerships between government and industry in the building sector. These instruments could work effectively if they were to target areas where participating firms could receive economic benefits from improving environmental performance.

- Directing *public construction procurement* more towards "greener" or more environmentally friendly buildings. The introduction of a greener public purchasing strategy could have a great impact on the environmental performance of the building sector. Such a strategy would not only improve the environmental performance of government buildings themselves, but, if designed well, may also demonstrate the strengths of newly-developed environmentally friendly technologies on the demand-side and the cost-reduction effects on the supply-side, encouraging wider diffusion in the economy as a whole.

- Eliminating *duplication of administrative processes.* Many policy instruments related to environmental impact of buildings involve significant administrative costs for checking design documents and conducting on-site inspections. When two policy instruments, for instance a subsidy scheme for energy efficient buildings and a labelling scheme based on energy efficiency, require the same administrative process (typically on-site inspection), the total administrative cost could be considerably reduced by covering both in a single inspection procedure. Promoting competition between inspecting bodies to allow new ones in the sector could also help reduce the administrative cost of on-site inspections.

- *Evaluating* the effectiveness of policy instruments once they are introduced to improve policy design, since such instruments often do not work in practice as theoretically predicted. Many unanswered questions remain due to a lack of empirical data to indicate the effectiveness of policy instruments. A good example is the evaluation of environmental labelling schemes. Over the past few years policy makers and building experts have been paying increasing attention to these schemes, yet there appears to be no clear empirical evidence to show how far the introduction of such schemes has improved the environmental performance of buildings relative to what the performance would have been in the absence of the schemes. It is therefore necessary to undertake more studies on how on-going policy instruments are actually working, and to collect more empirical evidence. ■

How to improve energy efficiency and reduce CO_2 emissions?

Although energy efficiency standards of building regulations have long played a central role in improving the energy efficiency of new buildings, it is often difficult to set standards that are strict enough to produce real improvements in a significant proportion of new buildings. Consequently, standards can affect only a limited number of buildings whose energy efficiency would be well below the average level without such regulations. Governments need to combine regulation, which is quite effective for bottom-up influence on the energy efficiency level, with non-regulatory instruments which could improve the environmental performance of those buildings with a relatively high level of performance. In this way such policy packages can affect a wide range of buildings.

Despite its limited impact on buildings with a relatively high level of energy efficiency, building regulation is the most effective measure for upgrading energy performance for new buildings at the

"bottom end" of the scale. But in many countries, there is much potential for further upgrading energy efficiency standards, which should be fully explored. Moreover, in order for these regulations to maintain their current level of effectiveness, the standards have to be regularly upgraded in line with the evolution of average energy efficiency levels. Governments should also continue to make the standards as flexible as possible in order to improve the economic efficiency of the regulation and provide more incentives for innovation.

Economic instruments and information tools could enhance each other's effectiveness if they were appropriately combined for both the new and existing building sectors. A typical example is the coordination of energy audit programmes - in which building owners are provided with information about the cost and benefits of energy efficiency upgrades of their buildings - with economic instruments, such as energy taxes and capital subsidy programmes. Owners of buildings would better understand the impact that economic instruments have on the costeffectiveness of energy efficiency investment if they were coupled with energy audit programmes. In light of this great potential, governments should develop significant synergies for energy efficiency improvement by appropriately coordinating these instruments.

Although policy instruments for the reduction of CO_2 emissions have emphasised the new building sector, this sub-sector accounts for a small proportion of the total building stock (Table 1), and there is a greater potential for energy saving in existing buildings. As investments in the energy efficiency of buildings generally have a diminishing rate of return, investment in the existing building sector becomes a relatively more cost-effective option as the energy performance gap between new and existing buildings widens. Energy efficiency policy should nonetheless place more emphasis on the existing building sub-sector. Despite some difficulties in implementing effective measures that are specific to existing buildings, energy efficiency policies should nonetheless place more emphasis on this sub-sector. Since there is no existing regulatory framework to cover existing buildings in most OECD countries, non-regulatory instruments are expected to play a more important role here than they do in the new building sector.

Few studies have been conducted on the economic efficiency of policy instruments, and it is not yet clear, for instance, to what extent the shift from building regulation to flexible economic instruments can contribute to the reduction of overall compliance cost in the building sector. Therefore it is necessary to conduct an extensive analysis of the cost-effectiveness of energy efficiency measures

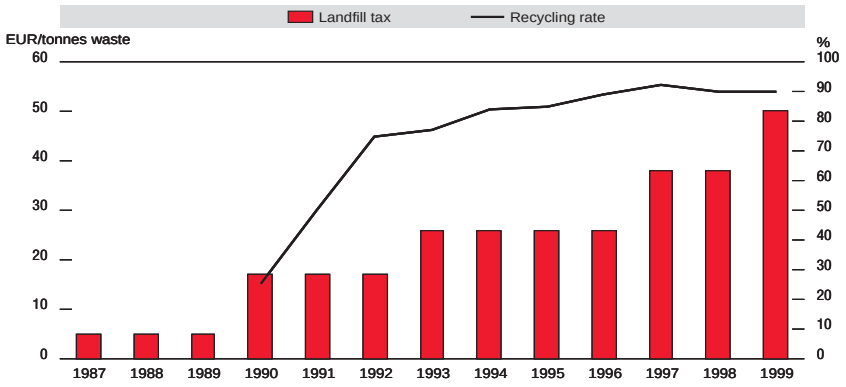
Table 1. Housing starts/housing stock ratios in selected OECD countries

	Housingstarts (A) 000s	Housingstock (B) 000s	(A/B)
Australia	107 (1998)	7,012(1997)	1.7%
Canada	150 (1999)	11,768(1999)	1.3%
France	286 (1995)	27,807 (1995)	1.0%
Germany	473 (1999)	37,984(1999)	1.2%
Japan	1,215 (1999)	43,922(1997)	2.8%
UK	199 (1995)	24,442 (1995)	0.8%
US	1,667 (1999)*	115,253(1999)	1.4%

Notes: * privately owned housing only.

Source: Australian Bureau of Statistics, Canada Mortgage and Housing Corporation, Statistics Canada, European Commission, Japanese Ministry of Construction, US Census Bureau, German Federal Ministry of Transport, Building and Housing.

Figure 3. **Recycling rate for C&DW and the landfill tax rate in Denmark**



Source: Danish Environmental Protection Agency.

according to various categories of buildings. The results of such an analysis should have many useful implications for improving policies to reduce CO_2 emissions from the building sector. ■

Reducing waste is also important

Both construction and demolition of buildings produce a huge amount of waste which must be disposed of and which can be damaging to the environment. The immediate policy target at the demolition stage is usually the reduction of the amount of final waste that is presently being generated by both activities. Policy instruments at the demolition end of the cycle may be applied to increase the use of recycled building materials in the sector. At the construction stage, instruments may contribute to improving the waste-generation-related characteristics of new buildings. Although principal policy goals may generally differ between stages, it is important to note that the policy instruments which are implemented at different stages are closely inter-related. For instance, instruments at the demolition stage, such as a landfill taxes, may indirectly promote the use of recycled building materials by reducing the cost of collecting recyclable waste. Conversely, instruments at downstream stages could make it easier to control the flow of demolition waste by making the recycling option more economically attractive. In light of these relationships, governments should create a synergy for the minimisation of construction and demolition waste by co-ordinating policy instruments at different stages so that they can mutually reinforce their effectiveness.

Empirical evidence clearly demonstrates that landfill and incineration taxes may be among the most effective instruments for reducing the amount of waste needing final disposal, if the tax rates are set at a relatively high level. For instance, the recycling rate of construction and demolition waste in Denmark started to sharply increase when the rate of the tax was more than tripled in 1990 (see Figure 3). The use of some regulatory instruments at the demolition stage, such as bans on landfill and mandatory separation of building materials, could have great potential to reduce final disposal, although there appears to be no empirical evidence that clearly proves their effectiveness. Governments should properly co-ordinate these instruments so as to have the greatest impact on reducing the amount of construction and demolition waste needing final disposal.

A significant proportion of such waste that is recycled at present is not used for new buildings, but rather in construction projects that require materials of lesser quality, typically road construction. As the generation of construction and demolition waste is predicted to sharply increase in coming decades, and the demand for recycled waste in road construction is not certain in the long run, governments need to promote the use of recycled building materials in building construction and establish a sustainable material flow within the building sector. Among various policy options discussed

in the new OECD report, a virgin materials tax may have great potential to provide economic incentives to use recycled building materials if the tax rate is set high enough. A major obstacle for increasing the use of recycled building materials is a lack of information on the quality of these materials on the user side. Information tools such as certification schemes for recycled building materials, as well as specifications that take the use of recycled materials into account, may encourage the development of a market for recycled building materials.

Improving site management, for example by reducing surplus materials, could significantly reduce the amount of waste generated through construction processes and this reduction could, in many cases, lead to economic benefit. However, in general, contractors in the building industry tend to be slow to adopt new technologies and/or knowledge which are necessary to improve their waste management. It is therefore important to encourage contractors to become more proactive via technology diffusion programs and voluntary instruments.

Improving the waste-generation-related characteristics of buildings at the construction stage may have the potential to greatly increase the recycling and reuse of building materials in the long run. But so far there does not appear to be any very promising policy instrument to improve the waste-generation-related characteristics at the design stage. The use of public procurement policies to help create a demand for buildings with better waste-generation-related performance can be seen as one of few realistic and effective policy instruments in this area. Although this is a very challenging issue, governments should continue efforts to explore possible measures to improve these performances. ■

How can indoor air pollution be reduced?

Building materials that emit pollutants can greatly contribute to indoor air pollution. It is therefore important to improve the quality of these materials so that health problems caused by indoor air pollution can be addressed. Building material manufacturers generally have great capacity to rapidly respond to changing circumstances, and governments should exploit this capacity to improve indoor air quality. For instance, a regulation on the quality of building materials may be a reasonable option when there is clear evidence that the concentration of a certain pollutant is the cause of a health problem. This could effectively improve the quality of these materials at a modest administrative cost.

The establishment of target values for indoor pollutant concentration is an important step for raising awareness of health problems due to indoor air pollution, and for developing other policy instruments. In fact, many policy instruments are designed with the aim of keeping the pollutant level below the target value level. However, it is sometimes argued that announcing target levels could give a misleading impression of risk and confuse consumers. When setting such target values, governments should therefore provide supplemental information in order to ensure, for example, that the meaning of the target values can be easily explained to consumers.

Indoor air pollution is a complex issue. A wide variety of factors affect the indoor concentration levels of pollutants, and the impact of the same pollutant level on human health depends largely on the sensitivity of each person. As a result, in some cases, it is not clear how building design is linked to indoor air pollution. It is therefore very important to collect empirical data to clarify the relationship between building design, indoor pollutant levels and their implications for human health. This is a time-consuming and costly task, but these results should provide much useful insight for designing policy instruments in this area.

A number of new building products become available every year, and sometimes they may cause unpredicted health problems. Indoor air pollutants are invisible and the health problems they cause are often mistaken for other types of illness. It is therefore usually difficult for governments to correctly identify such health problems before a large number of people have reported them. In order for governments to be able to identify newly emerging health problems at an early stage and quickly take the necessary measures, it is important to establish a framework under which user complaints linked to building performance can be widely collected and analysed. ■

For further information

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For further reading

- **Environmentally Sustainable Buildings: Challenges and Policies,** 2003
  ISBN: 92-64-19825-3, €40, 196p.
- **"Design of Sustainable Building Policies: Scope for Improvement and Barriers", General Distribution Document: ENV/EPOC/WPNEP(2001)5/FINAL, 2001**
- **"Case Studies on Policy Instruments for Environmentally Sustainable Buildings", General Distribution Document: ENV/EPOC/WPNEP (2001)33/FINAL, 2001**
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Public Affairs and Communications Directorate.
They are published under the responsibility of the Secretary-General.

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