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The contribution of the EC energy certificate in improving sustainability of the housing stock

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Abstract. In 2003 the European Commission introduced the EC Directive on the energy performance of buildings in recognition of the importance of energy savings in the urban housing stock. The Directive gives the member states freedom to design the different elements in practice. The energy certificate for existing buildings demanded by the EC Directive can be used as a communicative instrument, or combined with economic or regulatory principles. The authors discuss the anticipated efficiency and effectiveness of different policy approaches in the application of the EC energy certificate for the urban housing stock. They argue that, although energy certificates as a communication instrument for household appliances have appeared to be relatively successful, the different nature of the building sector may mean that their effectiveness here will be rather limited. The combination of energy certificates with tax schemes seems promising, but will have to be coupled with general income taxes or in housing-related taxes in order to prevent regressive social effects. Combination of the energy certificate with subsidies should be limited, because of the 'free-rider effect', and subsidies should only cover innovative products at the beginning of their 'learning curve'. Effective results can probably be expected from the introduction of regulations combined with energy-certificate standards, but this requires a rather drastic approach and needs time to receive sufficient commitment, as has been the case for new buildings where there has been a gradual development of energy regulations over the last thirty years. However, an introduction of energy standards for the existing urban housing stock through the EC energy certificate offers great potential in the realisation of CO_2 reductions. The introduction of an energy standard, by means of the energy certificate in combination with progressive taxes or other economic measures to reward better and punish worse energy-performance levels, seems an interesting approach that needs further research.

1 Introduction

In the Kyoto Protocol, governments of the industrialised countries agreed to reduce total CO_2 emissions from 1990 levels by 5.2% between 2008 and 2012, thus increasing pressure on governments to establish CO_2-reducing strategies. The European Union is preparing to implement the commitment as a community, as it is regarded as a single entity for emissions and restrictions. In absolute terms the largest energy end-users are households and the tertiary sector (EC, 2001). Dwellings yet to be built will constitute 15% of the total housing stock in 2020, and just 5% – 10% of the total housing stock in the Kyoto period 2008 – 12 (Novem, 2002). Consequently, the existing housing stock is an important sector for the reduction of greenhouse-gas emissions according to the Kyoto agreements.

The European Union also recognises the importance of reducing CO_2 emissions in the building sector, and in early 2003 the European Parliament accepted Directive 2002/91/EC on the Energy Performance of Buildings (EC, 2003). One of the four key elements described in the directive is the introduction of energy certificates for the existing building stock. The directive requires that, by January 2006, an energy-performance certificate, not more than ten years old, must be shown to prospective purchasers or tenants when a new or existing building is sold or let. In addition to detailing the current energy efficiency level of the building, the certificate must also include recommendations for cost-effective improvements in energy performance. The directive demands that energy

certificates are issued for the existing building stock, but leaves it for each member state to decide whether certain minimum energy criteria should be met, and whether to combine the energy certificate with economic policy instruments or to use it only for communication purposes. The energy certificate, as demanded by the directive, can, therefore, be seen as a tool that can be used in combination with different types of policy instruments. In a description of energy regulations in eleven EU member states, Beerepoot (2002a) concluded that energy regulations for existing buildings hardly exist, although European research studies show that voluntary energy-certificate schemes for buildings do already exist in a number of European member states (Blaustein, 2000; Van Cruchten, 2003). A combination of an energy certificate and a subsidy scheme exists in the Netherlands, whereas a compulsory energy certificate, without subsidies, is used in Denmark (Van Cruchten, 2003). In an inventory of economic instruments in sustainable-housing policies in Europe, Sunikka (2003a) concluded that none of the fiscal instruments is self-policing, so the instruments need to be enforced by legal means. No study, however, describes the anticipated effects of energy certificates for buildings as a voluntary instrument or when combined with regulations, subsidies, or taxes.

The efficiency and effectiveness of the use of the energy certificate for buildings in different policy options are important questions, as the Kyoto aims are dramatic and governments want to obtain the best possible results at least government cost. Although evaluation studies of the existing certificate schemes can indicate some elements of the efficiency and effectiveness of different ways in which certificate schemes can be implemented, the results are rather fragmented (Van Cruchten, 2003). On the other hand, policy-analysis literature contains extensive descriptions of the effectiveness and efficiency of different policy instruments, but this approach has never been applied to building energy certificates (Ekelenkamp et al, 2000; Kemp, 2000; Murakami et al, 2002). In this paper we will, therefore, describe both practical examples of current energy certificate schemes and theoretical notions of policy literature on the effectiveness and efficiency of several types of policy instruments. We examine how the EC energy certificate can improve the energy efficiency of the existing urban housing stock, and how the certificate should be used in combination with regulatory and economic policy instruments to obtain effective results. We aim to answer the research question of how the new EC energy certificate and other policy instruments can be used to improve sustainability in the urban housing stock. With the aid of examples of existing energy-certification schemes and different policy instruments, our aim is to present to EU member states ideas they can make use of when they begin to apply the new directive in their national context.

First, the research approach and definitions are introduced in section 2. In section 3, descriptions of regulatory and economic instruments are linked with examples found in the authors' empirical research. The pros and cons of regulatory and economic instruments are examined in terms of four principal criteria: environmental effectiveness, economic efficiency, dynamic technological incentives (innovation), and administrative feasibility (Murakami et al, 2002). In section 4 the energy-certificate schemes in the Netherlands and Denmark are discussed in detail. In section 5 the expected effectiveness of inclusion of the EC energy certificate in different policy instruments is discussed; conclusions are drawn in section 6.

2 Research approach

In this paper we use information collected by each of us for earlier studies on regulatory and economic policy instruments, and elaborate these ideas further. Beerepoot (2002a) analysed energy regulations for building in eleven EU member states, based on a collection of documents describing energy regulations such as legal documents and manuals.

In a European research project coordinated by the OTB Research Institute, energy-policy instruments for building and their evaluations were collected in five EU member states (Beerepoot, 2002b). The inventory of fiscal instruments in sustainable housing policies in Europe by Sunikka (2003a) was based on the national progress reports addressing the existing policy context and policy instruments of the Third European Ministers Conference on sustainable housing which was held in Genvalle, Belgium, in 2002 (Novem, 2002). Sunikka (2002) also described policies and policy instruments for sustainable building in five EU member states on the basis of an extensive literature review (Sunikka, 2003b). In addition to the empirical data about practical policies on energy saving in buildings, scientific literature on the effectiveness and efficiency of policy instruments in general is used in order to examine the possibility of combining energy certificates with different policy instruments. This paper is focused on housing, because it is the largest sector of the building stock (Sunikka, 2003a).

In this paper, energy certificates for buildings are defined as a tool to be used for assessing the energy quality of a building, either existing or new, residential or nonresidential. Energy certificates can be embedded in different types of policy instruments. Policy instruments can be defined as the myriad of techniques available to a government to implement their policy objectives (Howlett and Ramesh, 1993; Schneider and Ingram, 1990). Different approaches in structuring environmental policy instruments are possible. This paper is based on the most often used typology, following three concepts: direct regulation, economic instruments, and communicative instruments (Kemp, 2000; Murakami et al, 2002). Direct regulation includes policy instruments which, by means of orders, or imposing standards in law, try to impose environmentally benign behaviour. Economic instruments influence the economic attractiveness of environmentally benign behaviour and, because the environment can be considered a public good for which insufficient market demand exists, try to restore market imperfections. Communicative instruments are policy instruments based on communication which try to persuade people to behave in an environmentally benign way, by providing information about the environment or by trying to change opinions and attitudes (Ekelenkamp et al, 2000; Jordan et al, 2000). Energy certification can be used as a communicative instrument as in, for example, the energy certificates for household appliances. Communication instruments can be useful policy tools for addressing information problems, but they are generally considered to be additional policy instruments and not substitutes for economic or regulatory policy tools (Ekelenkamp et al, 2000; Kemp, 2000). In this paper, therefore, we focus on regulatory and economic instruments.

3 Regulatory and economic policy instruments

Direct regulation can be especially useful when dealing with hazardous materials that are dangerous in small concentrations (Ekelenkamp et al, 2000). The disadvantages of direct regulation include: high administrative costs; possible tolerance of noncompliance by local governments; failure to address firms' responsibilities in environmental issues and in terms of economic efficiency; and imperfect allocation of efforts taken by different target groups. Innovation will be limited as there are no incentives for performance which exceeds that required by regulation. Direct regulation can operate by means of standards for singular measures, such as minimum insulation levels for building components, or by means of standards for a general goal, such as the energy-performance approach. The historical development of energy regulations for buildings shows that minimum insulation levels were, in many cases, the first type of energy regulation to be introduced in the 1970s; these were gradually transformed into more integrative approaches, in which the energy demand or energy use of buildings was calculated—the so-called 'energy-performance approach' (Beerepoot, 2002a).

Direct regulation by means of formulating general goals, such as the energy-performance standard, can overcome some of the disadvantages of direct regulation by means of singular measures. Economic efficiency can be improved as it is possible to choose the most economically efficient combination of measures in order to meet the energy-performance goal. Regulation by means of general goals can stimulate innovations in that it encourages firms to find cost reductions in meeting the goals: for example, by developing new, more cost-effective, energy-saving measures. However, this type of regulation still does not provide a continuous stimulation for innovations as performing better than the standard is not encouraged. This disadvantage can be partially overcome by regular tightening of the standard. However, if no long-term ambitions are formulated when the energy-performance standard is introduced, there is a danger that this will be hindered—for political reasons and by pressure from lobby organisations, as has happened in the Netherlands (Tweede Kamer der Staten Generaal, 2002).

No examples are known of countries with energy certificates for existing buildings used in direct regulations in terms of imposing standards (Beerepoot, 2002a). The direct regulation of energy use in existing buildings has only been initiated very recently in some EU member states, by means of standards for singular measures (Gilijamse and Jablonska, 2002). In Germany since 2002 the replacement of certain building components in existing buildings has been subject to minimum insulation levels (Bundesministerium für Wirtschaft, 2001). In England and Wales revised energy regulations introduced in 2002 impose minimum insulation levels for replacement windows and doors in existing buildings, and central heating boilers which are replaced have to fulfil the same efficiency standards as those for new buildings (DTLR, 2001).

Decentralised incentive systems are an alternative to command-and-control policy instruments. Taxes are assumed to achieve the solution involving least cost and to provide continuous incentive to the search for more cost-effective technologies to improve environmental quality (Hasegawa, 2002; Siebert, 1995). However, energy taxes are unpopular with the electorate in general and with industry in particular. In order to create more sustainable practice, the price incentive needs to be relatively high; but, the total environmental costs for the industry, including both abatement costs and tax payments, are also likely to be high, which may induce the government to set the tax at an insufficiently low level. The aggregate amount of pollution cannot be predicted, but depends on the forces of supply and demand. The innovative effects of environmental taxes have scarcely been analysed, but as taxes are usually set at a low level, the innovation effects can be expected to be low (Kemp, 2000). The Environmental Tax Reform that aims to shift taxes away from labour and onto the environment has been implemented in several European countries (Andersen, 1994; Novem, 2002). However, current environmental tax measures are related only indirectly to buildings in terms of energy and CO_2 costs, and only some EU member states have introduced housing-related energy-tax measures (Sunikka, 2003a). The Regulator Energy Tax (REB), for example, applied to Dutch households in 2001, increased energy bills by a third. Research shows, however, that only half the population is aware of the Regulatory Energy Tax, and only 2% take it into account in their electricity use (Van der Waals, 2001).

A subsidy is a transfer of purchasing power from society to the industrialist or individual, conditional on it being spent on the particular investment. As a politically attractive instrument, most European countries have introduced subsidies for energy efficiency in buildings (Novem, 2002; Sunikka, 2003a). Subsidy programmes can encourage energy-efficiency investment, both for new and for existing buildings, but it is unlikely that such programmes would have a large-scale impact because they

require tax-revenue expenditures (Hasegawa, 2002). In the Netherlands, several research studies have examined the effectiveness of investment subsidies on investment decisions: the free-rider problem, where environmental subsidies can benefit parties who would have applied the option anyway, has been revealed. In 1978 the Dutch government established a large investment subsidy programme for improving energy efficiency in the existing housing stock—the National Insulation Programme (NIP). Research by Kemp (1995) showed that there was only a weak positive relationship between the subsidy for thermal home improvement and the diffusion of thermal-insulation technologies. The programme mainly provided receivers with a 'windfall gain'—a situation comparable to having the wind behind them, helping them in the direction they were already planning to take. This result was confirmed by Beumer et al (1993), and also seems to be common with other environmental subsidies (Tweede Kamer der Staten Generaal, 1987; Vermeulen, 1992). It is unclear to what extent subsidies encourage innovation but, given that the subsidies scarcely influenced adoption decisions, the innovation effects are likely to be small (Kemp, 2000). Vermeulen (1992) suggests that environmental subsidies can perform a useful supporting function, but only if they are applied as part of a combination of instruments, financed by direct or indirect environmental taxes that are paid by the same group of polluters, and not used as compensation for environmental costs.

4 Energy certificate schemes in the Netherlands and Denmark

In 2000 the Netherlands introduced the Energy Performance Advice tool (EPA) to stimulate housing owners, both private and professional, to improve the energy performance of their dwellings. It is a voluntary system, and costs about €150–200 per dwelling, although this charge is almost entirely subsidised. An EPA consists of a collection of input data from a survey of the location which, as well as building characteristics, includes the heating, hot water, and electricity consumption of pumps and fans, an assessment of the 'Energy Index' and energy-saving measures, advice, and a digital EPA report and monitoring data. The Regulatory Energy Tax (*Regulerende Energiebelasting*, REB) on energy use should have a positive influence on the calculation of the payback times of the energy-saving measures proposed in the EPA. The development of the EPA tool was commissioned by the Ministry of Housing, Spatial Planning and Environment, and carried out by the administrative agency Novem; it aims to be the most important tool in the achievement of CO_2-reduction goals for the existing building stock in the Netherlands. Evaluation of the performance of the EPA tool so far has indicated that the realisation of the Kyoto goals by means of the EPA are dependent on a number of uncertain factors. Uncertainty exists concerning the number of EPAs that will be issued, and the amount of energy saving that will be realised by them, as the tool is voluntary (Jeeninga et al, 2001). A promotion campaign is currently trying to increase the general public's awareness and knowledge of the tool. The subsidy paid to the homeowner for having an EPA performed has been raised to €200. There is also uncertainty about the number of consultants needed to perform the EPAs. The target of 60 000 EPAs a year requires about 100 man-years to carry out the work involved (Jeeninga et al, 2001). The energy savings that are realised through the measures taken by means of the EPA are also uncertain. The basic idea of the EPA is that it should result in additional energy-saving efforts over and above the autonomous development in home improvements that would be realised anyhow, such as replacement of a central-heating boiler at the end of its lifespan. It is, however, very difficult to say what the additional energy-saving measures are, or what energy-saving measures would not have been taken without the EPA. A contradiction exists in that the approach aims to perform EPAs at 'natural moments', for example, when a

dwelling is being renovated, or a central-heating boiler is being replaced (Jeeninga et al, 2001). The EPA tool is, in fact, an economic instrument, particularly based on subsidies for energy-saving measures. The EPA is voluntary, but can help in obtaining extra subsidies for energy-saving measures (although subsidy is also available without the EPA). The question can therefore be posed as to what extent the free-rider effect is present in the EPA subsidy scheme (see section 3). The fact that the EPA approach aims to perform EPAs at 'natural moments' suggests that the subsidy is, in many situations, used for investments that would have been made anyway. Subsidy schemes for energy-saving measures in housing have in the past proved rather inefficient, as we have seen from the discussion of economic instruments, because of the free-rider effect (see section 3). We therefore argue that the EPA subsidy scheme probably also suffers from a large number of free-riders benefiting from the subsidies and, as a consequence, results in a rather inefficient allocation of government finance.

In Denmark, a mandatory energy certification scheme for all existing buildings (*Energie Maerkningsordningen*) is defined in the Act on the promotion of Energy and Water Conservation in Buildings, and has been applied since 1997. The main energy audit scheme consists of the annual energy certification of large buildings, or energy management (ELO); energy certification of small buildings, which applies only when they are sold; and the CO_2 scheme for industry. Our research has focused on the energy-certification scheme for small buildings, including single-family houses and owner-occupied flats, as the new EC energy certificate most closely resembles this. Energy certification in small buildings consists of a standardised energy rating, including information about energy and water consumption and CO_2 emissions in comparison with a similar reference building. The energy plan presents proposals for further energy and water savings, estimations of the investment costs and annual savings, and the expected economic lifetime of the saving measures. When the building is sold, energy certification is carried out by a trained appointed energy consultant. The energy consumption is calculated by means of a standardised method, for standardised conditions and consumer habits. The evaluation costs are paid by the seller, and amount to €300–€500 for a single-family home (Vekemans, 2003). The Danish Energy Authority and the energy consultants are responsible for publicising the certification scheme, and the Registration Committee for Energy Rating is responsible for administrating the scheme. The evaluation of the Danish energy-certification scheme suggests that it increases energy savings to a small extent, but it has not been possible to make an exact calculation of the energy-saving effects of the scheme, or the realised costs of the CO_2 reduction and shadow prices (COWI consult, 2001). This is because the saving measures implemented are not recorded in the certification-scheme database, making it impossible to define the exact saving resulting from the scheme. The act focused on the recording of energy consumption and energy-saving measures, and only indirectly addresses whether the measures are actually implemented. The act on energy savings sets a combined goal for the Energy Management Scheme and the Energy Rating Scheme. The targets for 2005 are: heat savings of 4–6 PJ, electricity savings of 300–600 GWh, water savings of 5–10 million m^3, and CO_2 savings of 0.6–0.8 Mt. Up to now, the recorded heat-saving potential for 66 000 housing units is 315 GWh, or 1.1 PJ. This corresponds to 745 GWh, or 2.6 PJ, for all 156 628 housing units in the scheme (COWI consult, 2001). According to the 2001 evaluation, despite the fact that the energy-certificate scheme is made mandatory by the act, only 50%–60% of buildings are covered by the scheme, and there are great regional differences (COWI consult, 2001). Despite the legal status of the programme, sanctions have not been issued. Furthermore, over 40% of the certificated buildings show improvements in the first year, but significant energy-saving potential remains unused (Laustsen, 2001). According to the evaluation,

many building owners are not aware of the certification requirements, which tend to get buried in the other paperwork involved when a building is sold, whereas sellers and real-estate agents may see the certification as just another obligation without clear benefits (Laustsen, 2001). Homeowners show a very poor knowledge of the scheme, which is more a result of the lack of promotion of the scheme than of the quality of the information material (COWI consult, 2001). The buyer should be provided with the information on the 'energy condition' of the property before purchase but, in practice, the competition between potential buyers makes this difficult. It is, therefore, necessary that the certification be made mandatory. The Danish Energy Agency plans further information dissemination to buildings not currently participating in the scheme to increase adoption of the certificate and to begin follow-up initiatives to ensure that more improvements are realised.

5 Discussion

We began this paper with a commonly used typology of three types of policy instruments: regulatory, economic, and communication instruments. The EC Directive 2002/91/EC proposes mandatory energy certificates for buildings when a building is sold, but it does not impose energy standards. This implies that the energy certificate will be mainly a communication instrument, as the idea is to try to persuade people to adopt environmentally benign behaviour voluntarily. Policy literature states that communication instruments can be useful policy tools for addressing information problems, but they are generally considered to be *additional* policy instruments—and not substitutes for economic or regulatory policy tools (Ekelenkamp et al, 2000; Kemp, 2000).

Energy-labelling schemes for household appliances, which appear to be effective, directly address information problems encountered in purchasing decisions. Energy efficiency can be one criterion for choosing a certain product, and by means of the energy label this aspect can be taken into consideration in the purchasing decision. Manufacturers of household appliances use the energy label as a marketing instrument. The market for household appliances and the building market, however, differ greatly and building markets show big differences from country to country. In the Netherlands, the building market seems to have a structural market failure in terms of supply and demand, where, for a long time, the demand for housing has exceeded the supply. At the same time, there is often considerable governmental influence on the housing market, and building production can be very complex and involve a number of different bodies—for example, architect, building firms, and a municipality. In case of existing housing, the manufacturer is not known. In the building market, lack of information is therefore only one of several market failures. Therefore, an energy label is not likely to influence purchasing decisions in housing as the buyer does not have a variety of choice, neither is it likely to be used as a marketing instrument as there are no obvious manufacturers.

The energy certificate for buildings includes energy advice as part of the certificate. It is therefore assumed that, because the information is provided, the buyer will be encouraged to carry out energy-saving measures. It is not clear, however, whether the provision of information alone will sufficiently encourage people to carry out work that they would otherwise not have done. The payback times of energy-saving measures are high with the current, relatively low, energy prices. The energy-certificate scheme as proposed in the Directive 2002/91/EC seems an exact copy of the Danish energy-certificate scheme. Our discussion of this scheme suggests that it is not possible to give an unambiguous answer about the size of savings obtained by the labelled buildings, as saving measures implemented in practice are not recorded in the energy-certificate database (COWI consult, 2001). The evaluation study did suggest, however, that a large

energy-saving potential remained unused (Laustsen, 2001). On the basis of these considerations, we think it is worthwhile exploring the possibilities of combining energy certificates for buildings with regulations or economic incentives.

The question remains open as to whether energy certificates can be combined with minimum energy standards. We have discussed two approaches in energy regulations: regulations formulated as singular measures; and regulations formulated in global standards, such as performance standards. The second approach is in general preferred as it offers most design freedom and, if the standards are tightened on a regular basis, it can provide incentives for realising innovations. To date there is virtually no experience of the imposition of energy standards for existing buildings. Direct regulation of energy use in existing buildings has only been initiated very recently in, for example, Germany, England, and Wales, by means of standards for singular measures (Gilijamse and Jablonska, 2002). The question of control is a very important issue in this matter, as house owners do not currently require permission to carry out such activities. In England and Wales, energy regulations for existing buildings are controlled by means of self-certification schemes. The issue of control for existing buildings is partly covered by Directive 2002/91/EC, which demands that imposition of the energy certificate is mandatory and will therefore need a legal basis. In most member states homeowners do not have to cope with building regulations and building control when selling their house, so a more logical legal basis might be in the notary transactions involved when selling a house. A notary having to approve an energy certificate as part of the documents necessary for selling a house seems only a small step away from a notary having to record a certain energy standard derived from the energy certificate.

It is possible, however, that such a radical step in improving the energy efficiency of existing housing by means of imposing energy-performance standards is currently one step too far. As we can see from the development of energy regulations for new buildings, it took about thirty years before singular energy regulations were transformed into global standards. It is possible that a similar gradual development will be required to establish general acceptance of energy-performance standards for existing dwellings. This would imply that a first step could be to impose certain 'obvious' standards in regulations by means of singular measures, such as insulation levels or boiler efficiencies, such as happens now in England, Wales, and Germany. After this stage, the approach could move towards regulations by means of general goals, such as a mandatory 'B level' in an energy label. Tightening the criteria of such a B level on a regular basis would then be necessary to guarantee sufficient incentives for innovation (Kemp, 2000). Control is a very important issue in this matter, and could be guaranteed by means of privately organised self-certification schemes or by means of control by notary procedures.

That energy savings be made financially attractive for households remains a precondition for real action towards energy-saving measures. The REB, introduced in the Netherlands in 2001, has had limited success in reducing household energy consumption, but it does shorten the payback time of energy investments. Therefore, combining an energy tax with the energy certificate could support the implementation of investment plans to fulfil the potential energy improvements included in the EC certificate. On the other hand, it can be argued that the EC energy certificate, which we have concluded is a communicative tool, can reinforce the effectiveness of other policy instruments that remain unknown to consumers, such as the Energy Tax in the Netherlands. The policy-instrument literature and empirical data for this research show that higher taxes on electricity seem effective in reducing a household's energy consumption although, thanks to the current low costs, such an approach is unlikely to have large-scale impact. The question remains, however, as to how taxation on energy

can be increased without hitting low-income households, which account for a minor share of total household demand, with higher energy prices. These households have fewer financial resources to invest in energy-saving measures. As the prices increase, low-income households save energy whereas high-income households living in large dwellings seem not to react. It has been argued, therefore, that, if it causes greater inequality between rich and poor households, heavy taxation of end-user energy, which can be regarded as a necessity, is neither an advisable nor a politically viable option (Anker-Nilssen, 2003). To make the financial pressure more equal regarding low-income households, the energy tax should be based on the value of the dwelling or on the income of the household, that is, it should be progressive. In this way the energy certificate can be used as one factor in determining the value of the housing. Energy consumption could also be taken into account in an advisory capacity on the allowed rents, a system that exists, for example, in the Netherlands.

Kemp (2000) states that a combination of standards together with economic instruments is particularly useful as it combines effectiveness with efficiency. He takes as an example the US corporate automobile fuel economy standards, which set progressive fuel-economy targets for automobile manufacturers in 1979–85 under penalty of a fine of US $50 per car for each mile per gallon shortfall. This system of combining an economic incentive for an excellent energy performance with an economic sanction for failing to perform at a standard level could, in principle, be adapted to the energy certificate.

When studying existing energy-certificate schemes and possible combinations of policy instruments, we found that a combination of energy certificate and subsidy scheme exists in the Netherlands. Here the costs involved in the procedure of obtaining an energy certificate, and a number of energy-saving measures, are almost entirely subsidised. We found that, in general, the effectiveness and efficiency of subsidy schemes are often disputed. In a number of earlier evaluation studies of subsidy schemes for energy-saving measures in housing, it was concluded that in only a very limited number of cases was the subsidy the reason for carrying out the energy-saving measures, such as insulation, high-efficiency condensing boilers, or high-efficiency double glazing—all products that are not new on the market and should be sold without subsidies. In the case of innovative new products, where unit costs are still high but are expected to decline with cumulative production, subsidies can help tackle market failure. The Dutch energy-certificate scheme continues to subsidise measures such as insulation, and simultaneously enforces the disadvantages of subsidies by aiming to perform the energy certificate at so-called 'natural moments'—such as replacement of boilers or renovation of a house. Often in these situations people are already planning to take measures and will profit from a 'windfall gain' under the subsidy scheme. It is therefore expected that combining energy certificates with a subsidy scheme for energy-saving measures can only be efficient and effective for innovative products, in order to increase demand and production and bring costs down.

6 Conclusions

Renovation of the existing housing stock can reduce energy costs and demand, forestall an increase in demand for new housing, and improve the indoor air quality. Current policies and policy instruments for sustainable building, however, are only slowly reorientating from new construction to the existing housing stock. Using practical examples of current energy-certificate schemes, and theoretical consideration of policy literature, in this paper we have examined how the introduction of the EC energy certificate in combination with regulatory and economic policy instruments can be used to improve the energy efficiency of the existing urban housing stock. The energy

certification of household appliances has been successful and has increased the sales of energy-efficient products. We have discussed the expected efficiency and effectiveness of energy certificates for buildings.

We argue that the use of the energy certificate as a communication instrument addressing information problems, as is now suggested in the EC directive, is not likely to be very effective as information problems are only one of many market failures in the complex building market. The combination of energy certificates with tax schemes seems promising, but will have to be linked to general income taxes or housing-related taxes in order to prevent regressive social effects. The combination of the energy certificate with subsidies should be limited because of the free-rider effect, and subsidies should cover only innovative products at the beginning of their 'learning curve'. Effective results can probably be expected from the introduction of regulations combined with energy-certificate standards, but this requires a rather drastic approach and needs time to receive sufficient commitment—as for new buildings, where there has already been a gradual development of energy regulations over the last thirty years. Because communication tools are more likely to be effective when combined with regulatory or economic instruments, we believe that the introduction of an energy-performance standard by means of the energy certificate, in combination with progressive taxes punishing worse energy performance levels and subsidies rewarding better performances, may be a promising approach that needs further research.

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