

Discussion on the potential impact of the energy certificate on existing housing: the UK as a case study

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Abstract

In 2003 the European Commission introduced the Energy Performance of Buildings Directive (EPBD) in recognition of the importance of energy savings in the urban housing stock. One of the key elements described in the Directive is the introduction of energy certificates in a property transaction. This article discusses the anticipated efficiency and effectiveness of the application of the energy certificate on the existing building stock in the UK. The thesis for discussion is that although energy certificates as a communication instrument for household appliances have appeared to be relatively successful, the different nature of the building sector can mean their effectiveness here will be rather limited. Incentives need to be introduced to support taking up the improvements recommended by the energy certificate. Effective results can probably be expected from introducing regulations combined with energy certificate standards, but it requires a rather drastic approach and needs time to receive sufficient commitment.

Introduction

In early 2003 the European Parliament accepted Directive 2002/91/EC on the Energy Performance of Buildings (EPBD) that aims at greenhouse gas emissions reduction and compliance in energy requirements between the Member States. One of the four key elements described in the Directive is the introduction of energy certificates for the existing building stock. The Member States have to ensure that, by January 2006, an energy performance certificate, not more than 10 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 (European Commission, 2003).

The Directive leaves it open for each Member State to decide whether to combine the energy certificate with economic policy instruments, or to use it only for communication purposes. The energy certificate can, therefore, be seen as a tool that can be used in combination with different types of policy instruments. In the description of energy regulations in 11 EU Member States, Beerepoot (2002) concludes that energy regulations for existing buildings hardly exist. European research studies show that voluntary energy certificate schemes for buildings already exist in a number of European Member States (Blaustein, 2000; Van Cruchten, 2003). No study, however, describes the anticipated effects of energy certificates for buildings as a voluntary instrument or when combined with regulations, subsidies or taxes.

This paper discusses the potential impact of the energy certificate, Article 7 of the Directive. The potential of the energy certificate to motivate incremental, low-cost energy efficient improvements in existing housing and the consequent carbon savings are estimated. The UK, which has one of the oldest and least efficient housing stocks in Europe, is taken as a case study. The UK government has set a target of a 60% reduction in carbon dioxide emissions by 2050. The target cannot be met unless there is a change in the quality of the existing housing stock and current policies seem inadequate to the scale and urgency of the task.

This paper addresses the following theses for discussion: What can be the anticipated impact of the energy certificate on existing housing in the UK? How large are the additional savings associated with combining the energy certificate with other policy instruments? The implementation of the Directive is first set in a European context thorough a comparison of the implementation in the Netherlands and in Finland.

The EPBD in the UK, the Netherlands and Finland

The Netherlands and Finland have been selected as international reference for the situation in the UK because they both have already an established policy system for sustainable building (Sunikka, 2002). Table 1 compares the implementation of the Energy Performance of Buildings Directive in the UK, the Netherlands and Finland (Warren, 2003; Haakana, 2004; Van Ekerschot, 2004).

Table 1 Readiness for the implementation in the UK, the Netherlands and Finland in December 2004

UK	NL	FIN
Articles 3-4: Adaptation of a methodology and energy performance requirements		
Partly satisfied. Energy performance based regulations: Standard Assessment Procedure (SAP), an energy cost based rating.	Partly satisfied. Energy performance based regulations: Energy Performance Coefficient (EPC) , including CO ₂ emissions.	Not satisfied. The method is being developed, energy performance indicator has not been decided yet. Heat recovery is mandatory in practice.
Article 5: Renewable energy sources		
Partly satisfied.	Partly satisfied.	Not satisfied.
Article 6: Existing buildings		
Partly satisfied. Installation, replacement and substantial alteration/extension of systems are all subject to the provisions of Approved document L2 (for non-domestic/residential buildings).	Partly satisfied. Replaced building elements should comply with minimum insulation level, but in practice this is hard to control because e.g. replacing windows does not require to notification to building control.	Not satisfied, but local authorities can demand updating to new construction standards. EPBD is the first to affect existing buildings and requirements depend on the general targets and approach regarding the existing stock.
Article 7: Energy performance certificate		
Mandatory energy certification scheme SAP is already in use for new dwellings and linked to building regulations since 1994, but not for other dwellings. 180,000 new dwellings are labelled every year this way. Also the National Home Energy Rating (NHER), BREEAM for office buildings and EcoHomes by BRE.	Most probably now voluntary Energy Performance Advice (EPA) for residential buildings will be the energy certificate. The development of EPA for utility buildings is in the final stage. EPA consists of energy evaluation by the EPA advisor, a suggestion of improvements and costs. Certificate for new dwellings needs to be developed.	Not satisfied, no certification scheme in use. Environmental classification of buildings and energy auditing exists only on a voluntary basis. Development of the certificate has not yet started.
Article 8-9: Inspection of boilers and AC systems		
Does not satisfy. New regulation is being prepared.	Legislation for boilers over 100 kW. Most boilers are gas-fired heating systems. New regulation is needed for few non-gas fired boilers and boilers older than 15 years.	Does not satisfy, but regular chimney sweepings are compulsory and boiler inspections are likely to be connected to it.
Article 10: Independent experts		
Does not satisfy.	Does not satisfy. Will probably be connected to the current systems like EPA advisors.	Does not satisfy. Possibly done by energy auditors (who do audits now) or by condition auditors combined with condition assessments (when buying a house). In new construction one of the design documents, made by a HVAC designer.

source: Warren, 2003; Van Ekerschot, 2004; Haakana, 2004.

The UK, the Netherlands and Finland are all coping with timing problems in the implementation of the Directive and have not taken the final decisions yet. Development of an energy performance based methodology and establishment of energy certificate and boiler inspections has a priority at this stage. The ambitiousness of the energy requirements and the energy performance indicator depend on the national context. The Netherlands and the UK have already performance-based energy regulations, but in Finland this means more changes in the design and construction practice. In case of a lack of 'qualified and/or accredited experts' the Member States can have an extra three-year transition period to apply the Articles 7-9 of the Directive and most countries are likely to use this option.

Compared to the UK and Finland, the Netherlands seems to be furthest forward in the implementation of the Directive. It has had performance based energy regulations since 1996 and a (non-mandatory) energy labelling system. In new building regulations, the Energy Performance Coefficient (EPC) includes the carbon dioxide emissions depending on

the energy use. Some requirements for the existing buildings exist already in the building regulations, but they are difficult to control. Energy labelling is carried out through the Energy Performance Advice scheme (EPA), targeted to encourage energy saving in retrofits and up to now about 50,000 EPA evaluations have been undertaken (0.76% of the total housing stock), conducted by 500 registered EPA consultants. The evaluation costs € 150-200. The energy certificate for existing dwellings is likely to be based on the EPA, while the certificate for new construction has not been developed yet. The EPA is widely known and relatively used in the Dutch housing sector, but the evaluations do not necessarily motivate the implementation of the suggested improvements in practice. In the beginning, the energy audits and some of the suggested improvements were supported by government subsidies but they were stopped in 2003 because of budgetary reasons and the free-rider effect (Beerepoot and Sunikka, 2004). After cutting the subsidies, the number of EPA evaluations dried up.

No overall regulatory impact assessment has been carried out about the implementation of the Energy Performance of Buildings Directive in the Netherlands. Regarding new construction, the EPBD is estimated to affect from 60,000 to 70,000 dwellings a year (Van Ekerschot, 2004). As for new commercial buildings, the Directive is expected to affect 10 Million-m² a year and regarding the existing buildings, eventually 500,000 dwellings and 7,500 commercial buildings a year. The Ministry for Housing, Spatial Planning and the Environment estimates that the EPBD, as it is going to be implemented now, is unlikely to have a carbon dioxide reduction effect in the Netherlands. Nevertheless, the Directive is going to increase the effect of the existing policy instruments, which may have to be adapted. Because of the already present policy instruments in the Netherlands, the Ministry is prepared for some citizens and companies nevertheless seeing the EPBD as increasing their burden by causing more hassle -and possible extra costs- in construction, renovation or property transactions (Van Ekerschot, 2004).

Due to climatic reasons, Finland already has very demanding thermal requirements and the Finnish example suggests that considerable sharpening in thermal regulations in the Netherlands and the UK is feasible. In the 2004 version of Finnish building regulations, thermal requirements were sharpened by 30% and heat recovery from exhaust air became mandatory. Energy certificates, however, are voluntary in Finland, based on piloting systems and mainly used by forerunners in the construction sector and the building regulations account for new construction (Sunikka, 2002).

Preliminary evaluations about the impact, and cost implications, of the Energy Performance of Buildings Directive have been made in Finland on the inspection of boilers and AC systems and the implementation of the energy certificate. The Finnish Ministry of the Environment considers a cost-benefit analysis of the EPBD essential and emphasise that the energy certificate has to be acceptable for ordinary consumers. According to the Ministry, the current implementation of the Directive is likely to have a small impact on the carbon dioxide emissions in Finland, but it is likely to change design and construction practice because of new kind of methodology that is based on an overall energy performance (Haakana, 2004). The Ministry is prepared for some criticism from the field once the implementation of the EPBD is far enough advanced to be really open for discussion because a lot of investments in energy efficiency have taken place already in recent years. Until now, however, there has not been much lobbying by the construction industry or other parties. The Directive is also expected to have positive economic impacts for example for the insulation and window industries that are likely to increase their sales considerably.

Assumptions on the impact in the UK

A number of assumptions had to be made in the prognosis. It is not a forecast and several factors should be considered in reading the analysis:

- No firm decisions have been taken about the implementation of the Directive in the UK. The assumptions are based on probabilities and include uncertainties like any attempts to describe the future.
- This study is focused on the impact of the energy certificate on motivating low-cost energy efficient improvements in the existing housing stock in the UK (Article 7 of the EPBD). It is not an impact assessment of the complete Energy Performance of Buildings Directive, nor is it applicable to other countries.
- This study focuses on energy savings in space heating because it is relatively easy to foresee the developments in fabric construction. Domestic hot water or electricity demand for household appliances and lighting are beyond the scope of this analysis. Neither does this study address boiler inspections because in the UK, energy efficient boilers have long payback times compared to insulation and energy reduction produced by replacing an old boiler varies greatly in the existing housing stock being smaller in a better insulated than in a poorly insulated house. The use of low and zero carbon technologies in energy supply is not assumed here.
- All savings are based on delivered energy and presented as carbon. It should be considered that all carbon savings in renovations are always assumptions due to the variety of the housing stock. The savings will be greater if the assumptions in this research are too conservative.

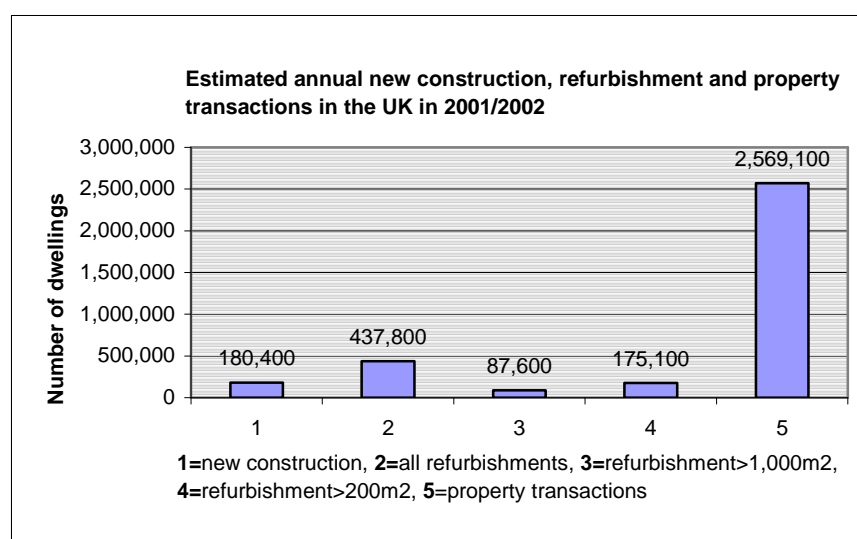
- The established rate in the installations of cavity wall and loft insulation and double-glazing is assumed to continue at the current rate. This autonomous development is referred to as business-as-usual and the carbon savings resulting from the energy certificate are added to it.
- An optimistic assumption has been made that households and owners accept long payback times for energy efficient investments. It is also presumed that there are no capacity problems in the industries supplying insulation and installations, there are enough contractors needed to implement the measures, all inspections can be done and the adopted energy efficiency measures are implemented in a way that enables the planned savings.
- On the basis of other Directives and developments in similar energy audit programs for example in Denmark, it is realistic to presume that the EPBD will be sharpened in the future. This is enabled in Article 11 where it is set out that the Commission shall evaluate this Directive in the light of experience gained during its application and, if necessary, make proposals with respect to, complementary measures referring to the renovation in buildings with a total useful area <1,000m² and general incentives for further energy efficiency measures in buildings. Its impact would, therefore, change as well but this has not been assumed in this research.

In this research, the impact of the energy certificate was assumed to depend on the annual property transactions, tenure, compliance (dependent on the supporting policy instruments), the labelled households taking action (dependent on the supporting policy instruments) and comprehensiveness of the adopted energy efficiency measures. These factors are consequently addressed.

1) Annual property transactions

Since the energy certificate has to be issued when a dwelling is constructed, sold or rented, the number of energy certificates depends on the annual property transactions. Figure 1 shows the annual rates of new construction, refurbishment and property transactions in the UK.

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



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

The number of sales or rentals exceeds the annual new construction and large refurbishment in the UK and, therefore, seems to offer an effective intervention point for improvements in energy efficiency.

2) Tenure

Table 2 presents an estimation of the annual property transactions in the UK related to tenure.

Table 2 Annual property transactions by tenure in the UK in 2001/2001

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

source: The National Centre for Social Research, 2003.

Property transactions can reach around 14% of the housing stock per year, but this share is not directly representative for the dwellings to be labelled annually because an energy certificate is valid for 10 years and a household is not going to act each time an energy certificate is obtained because an average renovation interval for a building is 25-30 years and in most cases even longer. Some properties may also not change hands for a long time.

3) Compliance

Compliance with the energy certificate is assumed to differ in the owner-occupied, social rental and private rental sectors in the UK. Three compliance scenarios are examined in this research.

Scenario 1 – Current policy

In the UK, the energy certificate is likely to be implemented as a part of the Home Information Pack (HIP) that is going to be mandatory when selling a house and has to be provided by the seller. This accounts for the owner-occupied sector, for the rental sector a supporting policy instrument is still missing. An estimate of compliance and adoption rates resulting from the current policy as percentages of the annual property transactions is presented in Table 3.

Table 3 Estimate of the labelled buildings and households taking action in the current policy in the UK

Tenure	Compliance (% of annual property transactions in the UK)	Adoption of energy efficiency measures (% compliance)
Owner-occupied	50.0	5.0
Social rental	60.0	5.0
Private rental	30.0	2.0

source: author.

The figures address the households and owners that, as a result of the energy certificate, are motivated to take action that they would have not taken otherwise. These rates apply for the UK. Compliance is likely to be better in countries like Germany or Finland where public awareness of energy efficiency and willingness-to-pay is higher than in the UK and there are less problems with compliance with building regulations, even over-compliance. The following points assume low compliance with the energy certificate in the UK:

- There are no consequences for not having the energy certificate. It is unlikely that all dwellings will be labelled because buyers or renters are not likely to set an energy certificate as a condition for a property transaction in the UK housing market. Evidence from a similar energy certificate scheme in Denmark suggests 50% compliance in mandatory labelling, if there are no sanctions (COWI consult, 2001). The EU funded project on the Energy Labelling of Existing Buildings (BELAS) concluded on the basis of the existing labelling systems in Denmark, the Netherlands, Ireland, the UK and Vermont, that pure-market based, non-mandatory systems are little used by individual home-owners and a successful labelling system for existing buildings must be ‘pulled’ by government with regulatory measures (BELAS, 2004).
- There are no direct incentives for the inhabitants to take up the improvement suggestions proposed in the energy certificate. Willingness-to-pay for energy efficient measures is still low in the UK, although public awareness is increasing. According to the 1999/2000 English Housing Survey, 51% of the households were prepared to pay up to £ 50 for energy efficiency improvements, 26% of the households between £ 50-200 and 23% over £ 200, if an annual saving of £ 50 in energy costs was expected (Bates *et al.*, 2001). Developments in energy prices can change the situation in the future but this is not assumed in the analysis.
- The experience from the energy label for household appliances is positive but buildings cannot be compared to household appliances. Improvements in buildings are on a different cost scale than products and often need professional support to be implemented. The technical and economic feasibility of energy efficiency measures needs to be evaluated for each dwelling. Life cycles of buildings are very long and a slow turnover in buildings compared to appliances means also that achieving the savings will take time once the policy is implemented. Moreover, there is a principal agent-problem where the owner who should make the investment does not necessarily benefit from it in the operation phase. In contrast to the need for a new fridge and then opting for an energy labelled one, the inhabitant has to take a conscious purchasing action for insulation and it is easier not to do anything.

Scenario 2 – Energy certificate and incentives

In scenario 2, the energy certificate is not enforced but new fiscal incentives are introduced to shorten payback times and attract more households to take up energy improvements suggested in the certificate. For an estimate of compliance and the adoption rates in the UK, see Table 4.

Table 4 Estimate of the labelled buildings and households taking action in scenario 2 in the UK

Tenure	Compliance (% of annual property transactions in the UK)	Adaptation of energy efficiency measures (% compliance)
Owner-occupied	50.0	30.0
Social rental	60.0	30.0
Private rental	30.0	5.0

source: author.

Long payback time is currently one of the main barriers to energy efficient improvements in the domestic sector (Boon and Sunikka, 2004). The costs are dependent on policies. Some fiscal policy measures that could be combined with the energy certificate exist already in the UK for example in a more problematic private rental sector are the Landlord Energy Saving Allowance, lower VAT on some energy saving measures and a Green Landlord Scheme. Fiscal incentives that could be introduced in order to achieve the compliance and adoption rates in this scenario are:

- Direct subsidies, where energy certification is used as a prerequisite for granting financial incentives for renovation, like in the Dutch EPA (see the previous section). Subsidies alone, however, do not make a project cost-effective and there should be clear lines in what can be expected, because some investors might wait for the subsidies to increase. Evidence from the Netherlands the risk of a free-rider effect in subsidising home insulation (Beumer *et al.*, 1993; Kemp, 1995).
- Council tax and stamp duty rebates for good energy performance verified in the energy certificate, reduced Value Added Tax (VAT) for the renovation materials. Tax systems can feel complicated for the inhabitants and need information to be effective. The Regulatory Energy Tax (REB), 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).
- Preferential, earmarked loans linked to the energy efficient improvements, possibly with a direct link to a mortgage. Energy cost savings can be used to repay the loan.

Scenario 3 – Enforced energy certificate

In scenario 3, the energy certificate is strongly enforced and encouraged with incentives like in the previous scenario. For an estimate of compliance and the adoption rates in the UK, see Table 5.

Table 5 Estimate of the labelled buildings and households taking action in scenario 2 in the UK

Tenure	Compliance (% of annual property transactions in the UK)	Adaptation of energy efficiency measures (% compliance)
Owner-occupied	80.0	60.0
Social rental	90.0	70.0
Private rental	70.0	20.0

source: author.

In order to ensure full compliance with the energy certificate in the UK, regulation is needed. In the owner-occupied sector a sale could not be registered without an energy certificate, and in the social housing sector, housing allowances would not be allocated to tenants living in unlabelled dwellings. In order to reach these rates in the adoption of energy efficient improvements, they need to be enforced as well. A dwelling could not be sold or a new rental contract agreed unless its thermal performance was updated to an acceptable minimum level, set by the government for each building type and tenure.

4) Comprehensiveness of the adopted measures

It is assumed that energy efficiency improvements with low payback time will be carried out first, namely cavity wall and loft insulation and double-glazing. The amount of non-cavity wall and floor insulation is considered to be small due to complex construction works and costs. It is assumed that half of the owners or households that take will action as a result of their energy certificate adopt one energy efficiency measure and half of the owners or households adopt a package of two energy efficiency measures. Table 6 presents the energy efficiency measures estimated to be adopted as a result of the energy certificate and the related energy savings (kWh/year) (Anderson *et al.*, 2002). Energy savings obtained from each measure are a weighted average saving per dwelling type in the English Housing Condition Survey.

Table 6 Comprehensiveness of energy efficiency measures that can be adopted as a result of the energy certificate (kWh)

Measure adopted as a result of the certificate	Saving in kWh/yr	Measure package adopted (2 measures)	Saving in kWh/yr
Double-glazing	2049	Double-glazing+cavity wall insulation	7705
Loft insulation	7853	Double-glazing+loft insulation	9902
Cavity wall insulation	5655	Cavity wall insulation+loft insulation	13508
Non-cavity wall insulation	9693	Non-cavity wall insulation+loft insulation	17546
		HR windows+cavity wall insulation	6033

source: Anderson *et al.*, 2002 (weighted average calculated by author).

All energy savings are based on delivered energy and presented as carbon. Table 7 explains the translation of energy savings (kWh) to carbon dioxide and carbon savings (kg) considering the proposition of fuel type delivered to the housing stock in the UK.

Table 7 Translation from energy (kWh) to carbon savings (kg) by fuel type in the UK

Fuel type	Proportion delivered to the housing stock (%)	KWh=CO ₂ kg	KWh=carbon kg
Gas	69	0.19	0.052
Electricity	20	0.44	0.120
Oil	6	0.26	0.071
Solid fuel	4	0.30	0.082

source: Shorrock and Utley, 2003; author.

Table 8 presents an estimate which insulation measure a household or an owner is likely to adopt in a renovation. This study does not assume building services that complement insulation measures because for example energy efficient boilers cannot be paid back in a reasonable time with the resulting receipts in energy costs and energy reduction produced by replacing an old boiler varies greatly in the existing housing stock being smaller in a better insulated than in a poorly insulated house.

Table 8 Estimate of the energy efficiency measures adopted in renovations (kWh)

Measure adopted	In % of the renovations		Measure package adopted (2 measures)	In % of the renovations	
	2006-2016	2016-2050		2006-2016	2016-2050
Double-glazing	40.0	-	Double-glazing+cavity wall insulation	30.0	-
Loft insulation	40.0	40.0	Double-glazing+loft insulation	40.0	-
Cavity wall insulation	20.0	20.0	Cavity wall insulation+loft insulation	30.0	40.0
Non-cavity wall insulation	-	40.0	Non-cavity wall insulation+loft insulation	-	20.0
			HR windows+cavity wall insulation	-	40.0

source: author.

The long-term level of energy saving depends on the ownership of measures. In 2001, 93% of houses in Great Britain had loft insulation (56% of them more than 100 cm), 32% cavity wall insulation and 75% double-glazing (52.1% of them had at least 60% of rooms double-glazed) (Shorrock and Utley, 2003). It is assumed that most houses will have cavity wall insulation around 2060 but this can be reached earlier if the annual take-up increases. Solid wall insulation is considered to slowly become more important measure around 2016. Most dwellings are expected have full double-glazing in 2016. Loft insulation has the highest ownership and most of the houses are expected to have it in 2016. In order to keep this level of saving, improvements are expected in the existing loft insulations after 2016, especially in the 44% of the houses that have less than 100 cm of insulation (Shorrock and Utley, 2003). The number of floor insulation is considered to be small due to complex construction works and costs and, therefore, not assumed in here. As the take-up of double-glazing should ensure draught proofing (81.7% of households in Great Britain in 2001) and its impact on energy demand is relatively small, draught proofing has not been considered in the adopted measures.

The impact of the energy certificate is expected to resemble S-shape curve. During the first 10 years of the implementation (2006-2016) a gradual increase in the adoption of the energy certificate suggestions is assumed from 50% to 100% because some households and owners are going to react to the energy certificate with a delay. The impact of the Directive on the existing stock is assumed to peak in 2016-2026. In 2026-2050, a gradual decrease from 90% to 10% in the adoption of low-cost insulation measures is expected.

In order to keep this level of saving feasible, the energy certificate should introduce new measures to improve energy efficiency. At this moment the use of more complex measures like solar energy is still limited by long payback times. Also new innovations are probably going to be introduced in the market, but due to high costs it is assumed that they are not going to be adopted on a large scale in the existing stock in the UK. If energy prices and willingness-to-pay increase faster than expected then a more optimistic scenario is valid.

Business-as-usual

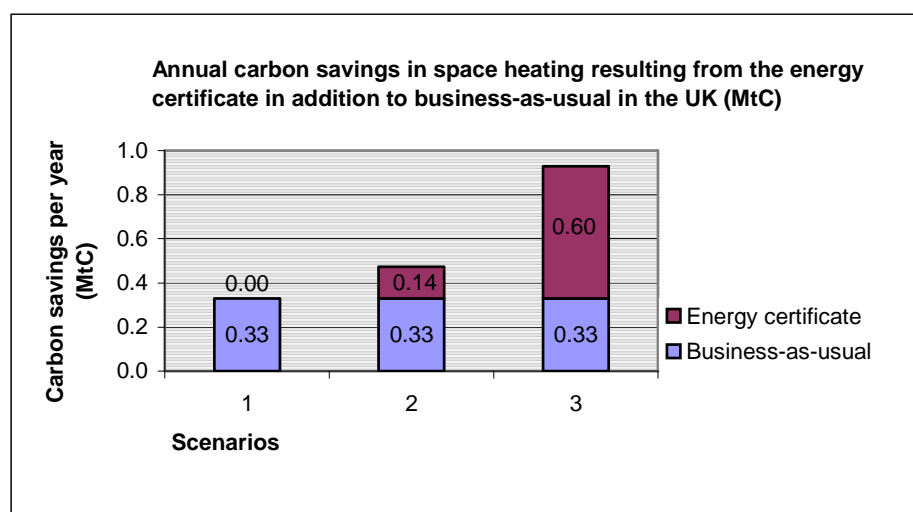
In addition to the savings motivated by the energy certificate, it is assumed that business-as-usual will result anyway in energy savings in space heating in the UK. In this research, an established installation rate of cavity wall insulation (280,000 installations per year), full double-glazing (1,200,000 installations per year) and loft insulation (110,000 installations per year) are considered in addition to the improvements initiated by the energy certificate. This autonomous development will lead to an annual saving of 3.3 Mt carbon in space heating in the existing housing in the UK. As the annual property transactions account for around 10% of the housing stock in the UK, it is assumed that in the business-as-usual scenario, this group of dwellings should contribute an annual saving of 0.33 Mt carbon at the very least. In order to distinguish the carbon savings resulting from the energy certificate from the business-as-usual development, an annual saving of 0.33 Mt carbon has first to be reduced from the carbon saving in each scenario.

The total carbon emissions from households' energy consumption in the UK account for 41.4 Mt carbon per year, including domestic hot water, household appliances and lighting (Shorrock and Utley, 2003). According to the Department for Environment, Food and Rural Affairs (2004) demand for energy services such as comfort and home entertainment have increased at over 2% a year in the UK, more than offsetting energy efficiency improvements, so that energy consumption has kept rising. There is no indication that the service demand trend will fall much below the current rate of around 2% per year. Whether energy consumption rises or falls in the next 20 years depends on the energy efficiency rate, around 1.5% per year in 2000, and if it can stay above the service demand trend (Defra, 2004). In this research, a stabilisation of the 2% growth is taken as a reference in the reduction of space heating demand in existing housing in the UK.

Thesis for discussion

Figure 2 presents an estimate of the annual carbon savings that result from the energy certificate, modelled on the basis of the conditions presented in the previous section (considering annual property transactions, tenure, compliance, the households taking action and comprehensiveness of the adopted energy efficiency measures). Scenario 1 is the current policy, in scenario 2 the energy certificate is combined with incentives and in scenario 3 the energy certificate is enforced.

Figure 2 Estimate of the annual carbon saving (MtC) resulting from the energy certificate in space heating in the existing housing stock in the UK in addition to the business-as-usual development (0.33 MtC)



source: author.

Table 9 relates the carbon savings to the space heating demand of households (25.6 MtC per year) and the total energy demand of the households (41.4 MtC per year) in the UK (Shorrock and Utley, 2003).

Table 9 Estimate of the annual carbon savings (MtC) resulting from the energy certificate in the UK in relation to the households' space heating demand and total energy demand

Scenarios	Carbon savings (MtC) per year			Annual reduction (%)	
	Business-as-usual	Energy certificate	Total saving	Space heating demand in the UK (25.6 MtC)	Total energy demand in the UK (41.4 MtC)
[1] Current policy	0.33	0	0.33	1.29	0.8
[2] Incentives	0.33	0.14	0.47	1.85	1.14
[3] Enforced	0.33	0.60	0.93	3.63	2.25

source: Shorrock and Utley, 2003; author.

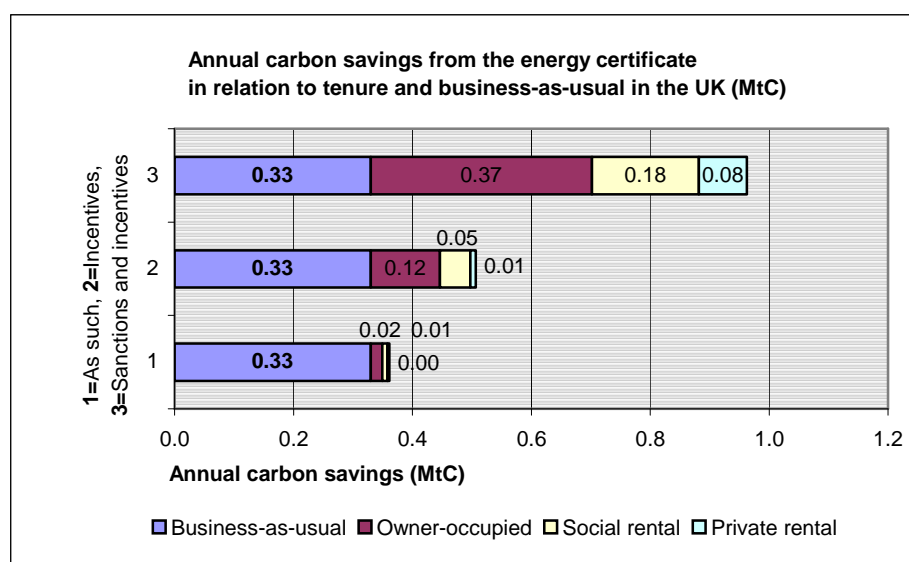
The results show that the implementation of the energy certificate in the UK, as it is planned now, will support the current policy but is not adequate to obtain additional savings that could distinguish from the business-as-usual development.

If the introduction of the energy certificate is to motivate an annual 0.14 Mt carbon reduction, it requires that 30-60% of dwellings, depending on the tenure, will get an energy certificate when sold or rented and in 5-30% of these dwellings one or two low-cost energy efficiency measures, that would not have been taken otherwise, are adopted. This calls for combining the energy certificate with incentives. With savings from the business-as-usual this would ensure a total 0.47 Mt carbon reduction per year in the UK. This accounts for a nearly 2% reduction in households' space heating demand and around 1% reduction in households' total energy demand in the UK (Defra, 2004).

Considerable savings from the energy certificate calls for a more regulatory approach. An annual 0.60 Mt carbon saving in the UK requires 70-90% compliance with the energy certificate, depending on the tenure, and 20-70% adoption of one or two low-cost energy efficiency measures in addition to the autonomous development. Combined with the business-as-usual energy savings this approach would ensure a total 0.93 Mt annual carbon reduction in the UK. This would lead to around 3.6% reduction in households' space heating demand and a 2% reduction in households' total energy demand in the UK and, therefore, could stabilize the annual 2% increase in households' energy consumption (Defra, 2004).

In the UK, most savings can be expected from the owner-occupied sector. The rental sector, however, has a great capacity to contribute to the savings if compliance is ensured and the adoption of measures made more attractive in terms of fiscal incentives like in scenarios 2 and 3. Figure 3 presents the annual carbon savings in space heating in the UK housing stock by tenure, in addition to the reference saving (0.33 MtC), in different compliance scenarios

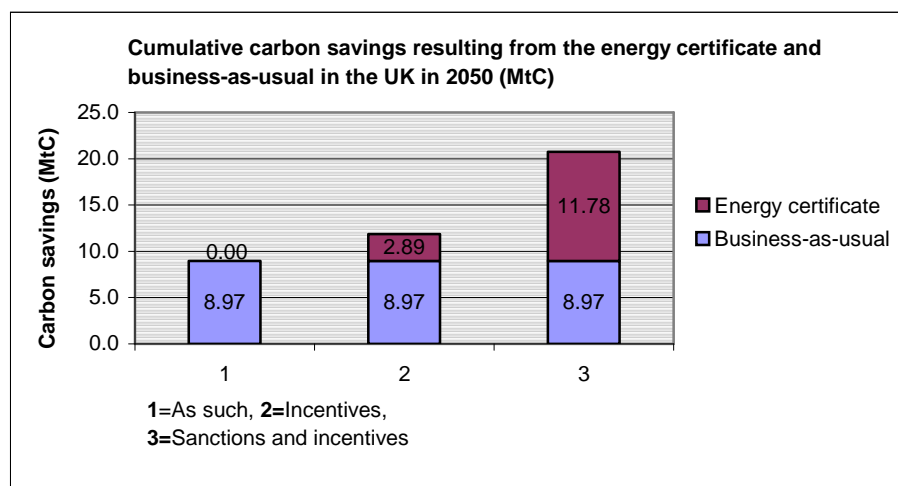
Figure 3 Annual carbon savings (MtC) in the space heating of the UK housing stock by tenure, in addition to the reference saving (0.33 MtC), in different compliance scenarios



source: author.

Considering the impact of the energy certificate in the longer run carries obvious risks and uncertainties but some assumptions can be made on the basis of the factors described in the previous section. Figure 4 presents an estimate of cumulative carbon savings resulting from the energy certificate in existing housing in the UK in 2050.

Figure 4 Cumulative carbon savings (MtC) resulting from the energy certificate in space heating of the existing housing stock in the UK in 2050, in addition to the business-as-usual development (8.97 MtC)



source: author.

Conclusions

This paper has discussed the anticipated effectiveness of the application of the energy certificate, Article 7 of the Energy Performance of Buildings Directive (EPBD), on existing housing in the UK. After 2006, the energy certificate will provide energy saving advice at sales or rentals, but are households are going to act on it? Three implementation scenarios were assumed, based on the estimates of annual property transactions, tenure, compliance and the labelled households taking action (depending on the supporting policy instruments) and comprehensiveness of the adopted energy efficiency measures.

The energy certificate is likely to increase public awareness of energy efficiency in the UK. The recommendations for cost-effective improvements suggested in the certificate can give a signal about the benefits resulting from the better energy standards provided. Good energy performance verified in the certificate can make energy investments visible when selling or renting a house and help an owner or a landlord to distinguish the property in the market. However, information on the energy performance alone at the point of renting or selling is not likely to make energy a purchasing or renting factor in the current housing market, given the housing shortage in the UK. Furthermore, a lack of interaction with other policy instruments is assumed to limit compliance with the energy certificate and the adoption of measures. The energy certificate in the owner-occupied sector is included in the Home Information Pack provided by the seller, but a similar policy instrument is still missing in the rental sector. Consequently, the impact of the energy certificate in the UK is assumed to be modest. Alone it is not considered as an adequate policy measure to obtain carbon savings that would distinguish from the energy efficiency trends in existing housing. If the housing market improves to allow a potential buyer to 'shop around' more, energy efficiency can become a selection factor for a home and a more optimistic scenario is valid.

Combining the energy certificate with fiscal incentives, such as subsidies for the improvements suggested in the energy certificate, tax rebates and earmarked, preferential loans is assumed to ensure a compliance of 30-60% and 5-30% adoption of the suggested improvements (dependent on tenure) in the UK. This scenario would result in an annual saving of 0.14 Mt carbon in space heating in the existing housing stock. Including the savings from business-as-usual, an annual 0.47 Mt carbon saving could be obtained, accounting for around 1% reduction in households' total energy demand in the UK. It should be considered, however, that although energy taxes are necessary for shortening the payback times of energy investments, energy prices would have to at least double before they would be effective. High energy prices would put an unbearable burden on some households resulting in increased fuel poverty. This would be contradictory with the UK government policy that has focused on reliable energy supply and ensuring low energy prices. Furthermore, professional landlords are more likely to understand the value of energy efficient investments but for owner-occupiers shortening payback time from 14 to even 10 years is unlikely to change their investment behaviour, because immediate payoffs are 'overvalued' relative to the more distant ones (Brocas *et al.*, 2004). This tendency to postpone indefinitely costly actions with delayed rewards limits the impact of price signals to change behaviour. People are more likely to act if there is a time constraint and if external commitment mechanisms exist.

A more regulatory approach is needed. An estimate of the compliance rate of 70-90% with the energy certificate and 20-70% adoption of the suggested improvements (dependent on tenure) would lead to an annual saving of 0.60 Mt carbon in space heating in the existing housing stock in the UK, and 0.93 Mt if the business-as-usual development is

considered. This 2% reduction would be sufficient to stabilise the increase households' total energy demand in the UK (Defra, 2004). If the energy certificate was enforced as in this scenario, it changes from a communicative policy instrument towards regulations and has cost implications. However, in housing market failure where housing demand exceeds the supply an introduction of new criteria from the consumer side is very difficult without government support. If energy efficiency is left to the households that make a renovation decision at very long intervals, compared to institutions, they may not be well informed enough to make a change. If considerable carbon savings are wanted from the residential sector, then the enforcement of the energy certificate needs to be considered as one alternative.

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