

ENERGY CERTIFICATE IN THE ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE: EFFECTIVENESS OF THE APPLICATION ON THE EXISTING HOUSING STOCK IN THE UK

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Summary

In 2003 the European Commission introduced the Energy Performance of Buildings Directive (EPBD) in recognition of the importance of energy savings in housing stock. One of the four key elements described in the Directive is the introduction of energy certificates for the existing building stock. This article discusses the anticipated efficiency and effectiveness of the application of the energy certificate on the existing building stock in the UK. We 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 can mean their effectiveness here will be rather limited. The combination of energy certificates with tax schemes seems promising but will have to be covered in general income taxes or in housing related taxes in order to prevent regressive social effects. If considerable carbon savings are wanted from the residential sector, then the enforcement of the energy certificate needs to be considered as one alternative. Introducing an energy standard by means of the energy certificate in combination with progressive taxes or other economic measures for rewarding better and punishing worse energy performance levels, seems an interesting approach that needs further research.

1. Introduction

New housing production in the EU is 1.9 million units per year, or approximately 1% of the building stock. Dwellings yet to be built will constitute 15% of the total housing stock in 2020 and 5-10% of the total housing stock in the Kyoto period 2008-2012 (NOVEM, 2002). There is a great CO₂ potential in the renovation of the late post-war housing stock (Boon and Sunikka, 2004). The environment, however, continues to play a small part in renewal projects (Bus, 2001). Costs are often seen as a main barrier for the adoption of CO₂ reduction measures in urban renewal, but this concern is related to impressions of costs at face value, rather than any consideration of the actual costs and benefits (Van der Waals *et al.*, 2003).

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 key elements described in the Directive is the introduction of energy certificates in a property transaction. 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 focuses on the potential impact of the energy certificate, the Article 7 of the Directive. The UK, which makes up one of the oldest and least efficient housing stocks in Europe, is taken as a case study. This paper addresses the research questions: What is the anticipated impact of the energy certificate on the existing housing in the UK? How large are the additional savings associated to combining the energy certificate with other policy instruments?

2. Analysis

In this research, the impact of the energy certificate in the UK is assessed with an excel-based model. 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. The analysis is based on probabilities and includes uncertainties like any attempts trying to describe the future. It is not an impact assessment of the complete Energy Performance of Buildings Directive, nor is it directly 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. 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. 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. An optimistic assumption has been made that households and owners accept long payback times. It is also presumed that there are no capacity problems in the industry supply or in energy inspections so that all inspections and improvements can be done, and that the adopted energy efficiency measures are implemented in a right way that enables the planned savings.

The established rate in the installations of cavity wall and loft insulation and double-glazing is assumed to continue at a current rate. This autonomous development is referred to business-as-usual and the carbon savings resulting from the energy certificate are added up to it.

The impact of the energy certificate depends 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 addressed consequently.

1) Annual property transactions

Since an energy certificate has to be issued when a dwelling is constructed, sold or rent, the number of energy certificates depends on the annual property transactions. The number of sale or rental exceeds the annual new construction and large refurbishment in the UK and, therefore, seems to offer an effective interference point for improvements in energy efficiency. Figure 1 shows the annual rates of new construction, refurbishment and property transactions in the UK (The National Centre for Social Research, 2003; Petersdorff et al., 2002; Sak and Raponi, 2002).

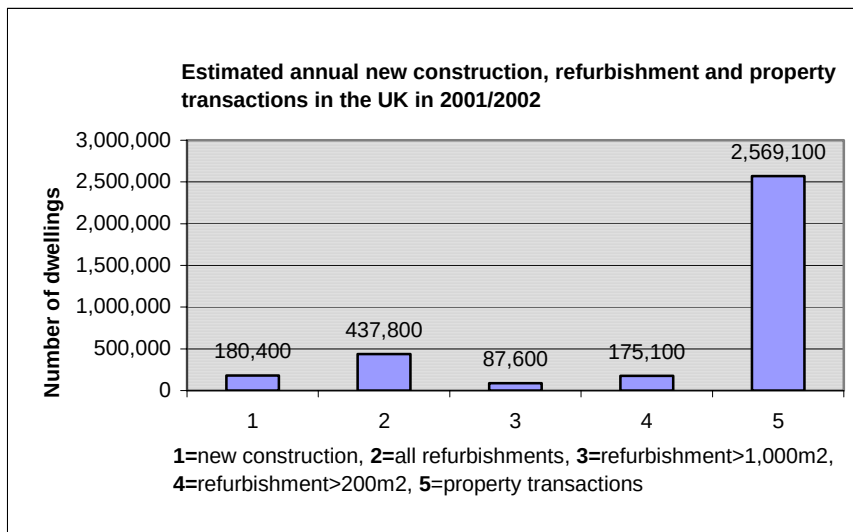


Figure 1 Annual rates of new construction, refurbishment (if the Article 6 is applied in renovations exceeding 1,000m², 200m² or all refurbishments) and property transactions in the UK in 2001/2002.

Tenure

Table 1 presents an estimation of the annual property transactions in the UK related to tenure (The National Centre for Social Research, 2003). The number of transactions is related to all transactions and the total housing stock. Figures show that 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 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, in most cases even longer. Some dwellings may also not change an inhabitant for a long period of time.

Table 1 Annual property transactions related to tenure in the UK in 2001/2001

Tenure	Annual transactions	% 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

Compliance

Compliance with 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 estimation of compliance and adaptation rates resulting from the current policy as percentages of the annual property transactions is presented in Table 2.

Table 2 Estimation of the labelled buildings and households taking action in the current policy in the UK

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

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 and apply for the UK. Compliance is likely to be better in countries like Germany or Finland where public awareness in energy efficiency and willingness-to-pay is higher than in the UK and there are less problems in 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 in existing buildings must be 'pulled' by government accompanying and/or 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 measure is still low in the UK, although the 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 in a different cost scale than in products and often need professional support to be implemented. Technical and economic feasibility of energy efficiency measures should be evaluated per 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. As contrast to a 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 estimation of compliance and the adaptation rates in the UK, see Table 3.

Table 3 Estimation of the labelled buildings and households taking action in scenario 2 in the UK

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

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. Fiscal incentives that could be introduced in order to achieve the compliance and adaptation rates in this scenario are direct subsidies, where energy certification is used as a prerequisite for granting financial incentives for renovation, council tax and stamp duty rebates for a good energy performance verified in the energy certificate or a reduced Value Added Tax (VAT) for the renovation materials. Also preferential, earmarked loans can be linked to the energy efficient improvements, possibly in a direct connection to a mortgage, and 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 estimation of compliance and the adaptation rates in the UK, see Table 4.

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

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

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 adaptation 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.

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 5 presents the energy efficiency measures estimated to be adopted as a result of the energy certificate and the related energy savings (kWh) (Anderson *et al.*, 2002). Energy savings obtained with each measure is a weighted average saving per dwelling type in the English Housing Condition Survey.

Table 5 Comprehensiveness of energy efficiency measures adopted from the energy certificate (kWh)

Measure adopted as a result of the certificate	Saving (kWh)	Measure package adopted (2 measures)	Saving (kWh)
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

The adaptation 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 adaptation 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. After 2016, most housing is expected to have double-glazing and an increasing number of dwellings will have loft and cavity wall insulation. In 2026-2050, a gradual decrease from 90% to 10% in the adaptation of incremental, low-cost insulation measures is expected. New innovations are going to be introduced in the market, but due to high costs it is assumed that they are not going to be adopted in 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.

Energy savings depend also on which insulation measure a household or an owner is going to choose. Table 6 presents estimation of which share of households adopt a certain energy efficiency measure in the renovation. It is presumed that an installation of double-windows and loft insulation are the most popular measures and 40% of the households that take up measures are going to be motivated to install them as a result of the energy certificate in 2006-2016.

Table 6 Choice of low cost energy efficiency measures adopted as a result of the energy certificate (kWh)

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

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 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 per year, including domestic hot water and household appliances and lighting (Building Research Establishment, 2003). According to Department for Environment, Food and Rural Affairs (2004) a 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 the existing housing.

3. Results

Figure 2 presents the annual carbon savings that result from the energy certificate based on modelling the conditions presented in the previous section regarding annual property transactions, tenure, compliance, the labelled 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.

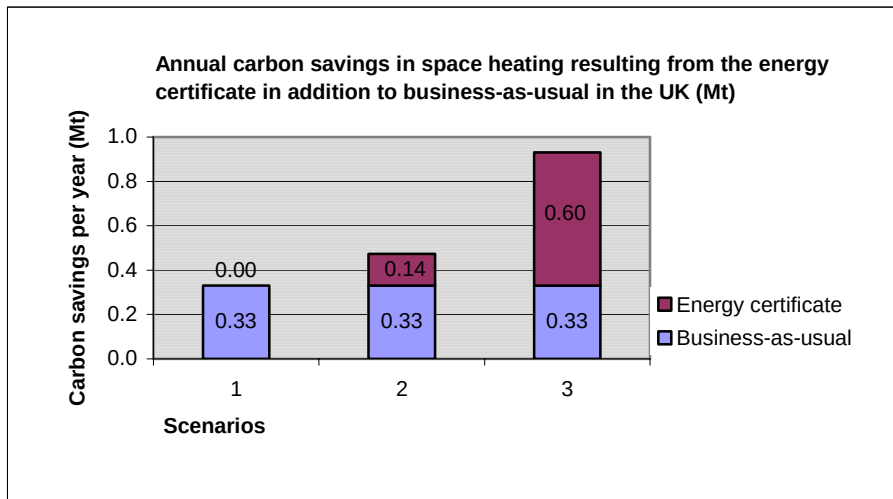


Figure 2 Annual carbon saving (Mt) resulting from the energy certificate in space heating in the existing housing stock in the UK in addition to business-as-usual (0.33 Mt).

Table 7 relates the carbon savings resulting from the energy certificate to the space heating demand of households (25.6 Mt per year) and the total energy demand of the households (41.4 Mt per year) in the UK (Building Research Establishment, 2003).

Table 7 Annual carbon savings (Mt) resulting from the energy certificate in the UK in relation to the households' space heating demand and total energy demand

Scenarios	Carbon savings (Mt) per year			Annual reduction (%)	
	Business-as-usual	Energy certificate	Total saving	Space heating demand (25.6 Mt)	Total energy demand (41.4 Mt)
[1] Current	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

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 rent 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 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 in the UK. A motivation of 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% adaptation of one or two low-cost energy efficiency measures in addition to the autonomous development. Considering the business-as-usual energy savings this approach would ensure a total 0.93 Mt annual carbon reduction in the UK. This would be 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).

Considering the impact of the energy certificate in a 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 3 presents an estimation of cumulative carbon savings in the existing housing stock resulting from the implementation of the energy certificate in the UK in different scenarios in 2050.

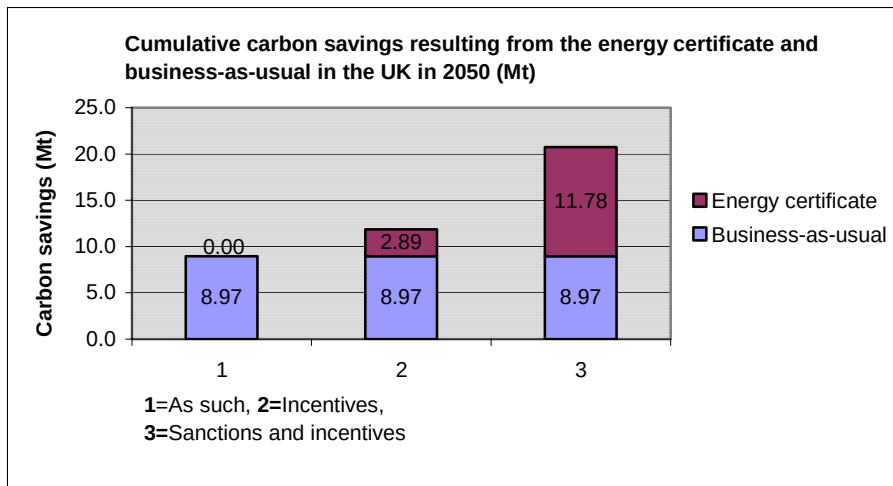


Figure 3 Cumulative carbon savings (Mt) resulting from the energy certificate in space heating of the existing housing stock in the UK in 2050, in addition to business-as-usual (8.97 Mt).

4. Conclusions

This paper has presented an analysis of the anticipated effectiveness of the application of the energy certificate, the Article 7 of the Energy Performance of Buildings Directive (EPBD). The main focus has been modelling how the energy certificate is going to motivate energy efficient improvements in the existing housing stock taking the UK as a case study. Three implementation scenarios have been examined in the model, based on the 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 in energy efficiency. Good energy performance verified in the certificate can make energy investments visible when selling or renting a house and therefore, 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, which that suffers from a housing shortage in the UK. Furthermore, a lack of interaction with other policy instruments is likely to limit compliance with the energy certificate and the adaptation of measures. Consequently, the energy certificate is likely to support energy efficiency trends in the existing housing stock but alone it is not an adequate policy measure to obtain carbon savings in the UK that would distinguish from business-as-usual.

Combining the energy certificate with fiscal incentives, such as subsidies for the improvements suggested in the energy certificate, tax rebates and earmarked, preferential loans could ensure a compliance of 30-60% and 5-30% adaptation of the suggested improvements (dependent on tenure) in the UK. This would result in annual 0.14 Mt carbon in space heating of 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.

A compliance of 70-90% with the energy certificate and 20-70% adaptation 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 business-as-usual is considered. This 2% reduction in would be sufficient to stabilise the increase households' total energy demand in the UK (Defra, 2004). If the energy certificate is enforced like in this scenario, it changes from a communicative policy instrument towards regulations and has cost implications. However, if considerable carbon savings are wanted from the residential sector, then the enforcement of the energy certificate needs to be considered as one alternative. Forcing energy efficiency improvements in the existing housing stock is difficult but not irresolvable. Introducing an energy standard by means of the energy certificate in combination with progressive taxes or other economic measures for rewarding better and punishing worse energy performance levels, seems an interesting approach that needs further research. Property transaction as an interference point seems promising for energy efficient improvements at the building level. Like any transactions, property transactions are not governed entirely by self-interest. There is a string of cultural norms that dictate the rules and tell us what is legitimate pursuit of self-interest and what is not (Edwards, 2002). Public education is essential in increasing the willingness-to-pay and supporting the implementation of new policy instruments like the energy certificate of the Energy Performance of Buildings Directive.

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