

Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries

FINAL REPORT

European Commission (DG Energy)
19 April 2013



Document information

CLIENT	European Commission (DG Energy)
CONTRACT NUMBER	ENER/C3/2010-578
REPORT TITLE	Final report
PROJECT NAME	Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries
PROJECT CODE	SP-0165 / CEENEREPC
PROJECT TEAM	Bio Intelligence Service, Ronan Lyons, IEEP
DATE	19 April 2013
MAIN AUTHORS	Shailendra Mudgal, Lorcan Lyons and François Cohen, Bio Intelligence Service; Ronan Lyons, Oxford University; Doreen Fedrigo-Fazio, IEEP.
KEY CONTACTS	Shailendra Mudgal sm@biois.com Lorcan Lyons lorcan.lyons@biois.com
ACKNOWLEDGEMENTS	The authors wish to thank those who assisted in gathering data, especially Daft.ie, Konstantin Kholodilin (DIW), Notaires de France, the Department of Communities and Local Government, Landmark and Land Registry. We also thank those at the following organisations who agreed to be interviewed for the assessment of EPC schemes: IKM, University of Innsbruck; Technical Chamber of Cyprus (ETEK); VITO (Flanders); Flemish Energy Agency; Bureau de Qualité Technique et Réglementation Technique de la Construction (France); Sustainable Energy Authority of Ireland; ADENE (Portugal); Department of Communities and Local Government (UK), Usable Buildings Trust (UK). Marine Grémont previously of BIO and Pernille Schiellerup previously of IEEP made contributions during the initial phase of this project.
DISCLAIMER	The information and views set out in this study are those of the authors and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

Please cite this publication as: Bio Intelligence Service, Ronan Lyons and IEEP (2013) Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries, Final report prepared for European Commission (DG Energy)

Photo credit: cover @ Per Ola Wiberg

Table of Contents

CHAPTER 1: INTRODUCTION	17
1.1 Study outline	18
CHAPTER 2: LITERATURE REVIEW	21
2.1 Scope	21
2.2 The market transformation policy approach	21
2.3 Market transformation in property markets	23
2.4 The link between energy performance labelling and property values	25
2.5 Barriers to change	27
2.6 Existing energy performance labels for buildings	29
2.7 Existing studies of the effect on transaction prices	29
2.8 Preliminary expectations about the relationship between EPCs and property value	40
CHAPTER 3: ASSESSMENT OF EPC SCHEMES	43
3.1 Introduction	43
3.1.1 Existing studies of implementation across Member States	43
3.2 De minimis elements that need to be in place to ensure a market response	44
3.3 Assessment of EPC schemes	45
3.3.1 Presence of the label	46
3.3.2 Understanding of the label	47
3.3.3 Concern about energy use and environmental impact when selecting a property	47
3.3.4 Trust in the information on the energy label	48
3.3.5 Assessment questions	49
CHAPTER 4: DATA GATHERING AND ECONOMETRIC MODEL	51
4.1 Creating a combined dataset	51
4.1.1 EPC data	51
4.1.2 Data on transactions	52
4.2 Establishment of an econometric model	53
CHAPTER 5: AUSTRIA	55
5.1 Assessment of the EPC scheme	55
5.1.1 Presence of the label	55
5.1.2 Understanding of the label	56

5.1.3	Concern about energy use and environmental impact when selecting a property	57
5.1.4	Trust in the information on the label	57
5.1.5	Anticipated effect of EPCs on transaction prices and rents	58
5.2	Establishment of a dataset	60
5.3	Regression results	60
5.3.1	Results for sales market	61
5.3.2	Results for lettings market	61
5.3.3	Summary	62
CHAPTER 6:	BELGIUM	65
6.1	Assessment of the EPC scheme in Flanders	65
6.1.1	Presence of the label in Flanders	65
6.1.2	Understanding of the label in Flanders	66
6.1.3	Concern about energy use and environmental impact when selecting a property in Flanders	66
6.1.4	Trust in the information on the label in Flanders	67
6.1.5	Anticipated effect of EPCs on transaction prices and rents	69
6.2	Establishment of a dataset	69
6.2.1	EPC data in Flanders	69
6.2.2	Databases on transactions and rents	70
6.3	Regression results	70
6.3.1	Results for Flanders	71
6.3.2	Results for Brussels-Capital	73
6.3.3	Results for Wallonia	73
6.3.4	Summary of regression results for Belgium	75
CHAPTER 7:	FRANCE	77
7.1	Assessment of the EPC scheme	77
7.1.1	Presence of the label	77
7.1.2	Understanding of the label	79
7.1.3	Concern about energy use and environmental impact when selecting a property	79
7.1.4	Trust in the information on the label	81
7.1.5	Anticipated effect of EPCs on transaction prices and rents	83
7.2	Establishment of a dataset	83
7.3	Regression results	84
7.3.1	Results for Marseille	84
7.3.2	Results for Lille	85
7.3.3	Summary	87

CHAPTER 8: IRELAND	89
8.1 Assessment of the EPC scheme	89
8.1.1 Presence of the label	89
8.1.2 Understanding of the label	90
8.1.3 Concern about energy use and environmental impact when selecting a property	91
8.1.4 Trust in the information on the label	91
8.1.5 Anticipated effect of EPCs on transaction prices and rents	92
8.2 Establishment of a dataset	95
8.3 Regression results	96
8.3.1 Sales	97
8.3.2 Rental	98
8.3.3 Effect over time	99
8.3.4 Summary	100
CHAPTER 9: UNITED KINGDOM	101
9.1 Assessment of the EPC scheme	101
9.1.1 Presence of the label	101
9.1.2 Understanding of the label	104
9.1.3 Concern about energy use and environmental impact when selecting a property	105
9.1.4 Trust in the information on the label	106
9.1.5 Anticipated effect of EPCs on transaction prices and rents	107
9.2 Establishment of a dataset	109
9.2.1 EPC data	109
9.2.2 Data on transactions	110
9.3 Regression results	110
9.3.1 Results for Oxford	111
CHAPTER 10: CONCLUSIONS	115
10.1 Summary of regression results	115
10.2 Lessons from the assessment of EPC schemes	118
10.2.1 Presence of the label	118
10.2.2 Understanding of the label	118
10.2.3 Concern about energy use and environmental performance when selecting a property	120
10.2.4 Trust in the information on the label	121
10.2.5 Implications for the effect of EPCs on transaction values	121
10.3 Policy implications	122
10.4 Concluding remarks	124

ANNEX A: WHAT EU-LEVEL LEGISLATION REQUIRES OF MEMBER STATES	126
ANNEX B: CYPRUS – ASSESSMENT OF THE EPC SCHEME	130
ANNEX C: PORTUGAL – ASSESSMENT OF THE EPC SCHEME	136
ANNEX D: FURTHER INFORMATION ON DATASETS NOT USED	143
ANNEX E: NOTE ON AVOIDING SELECTION BIAS	147
ANNEX F: ACRONYMS	149
ANNEX G: REFERENCES	151

List of Tables

Table 1: Overview of past studies and papers	31
Table 2: Overview of papers published by sector and year of publication	34
Table 3: Overview of studies by segment and location	34
Table 4: Overview of total numbers of “units” labelled under different schemes	36
Table 5: Overview by type of impact studied	37
Table 6: Overview coverage of potential cases in multi-country studies	44
Table 7: Introduction of EPCs in Austria	55
Table 8: Attitudes to climate change in Austria and Europe	57
Table 9: Results for Austria, sales and rental	62
Table 10: Introduction of EPCs in Flanders	65
Table 11: Attitudes to climate change in Belgium and Europe	67
Table 12: Sample sizes for energy efficiency listings in the Belgian property market	70
Table 13: Results for Flanders, sales and rental	71
Table 14: Results for Brussels-Capital and Wallonia, sales and rental	74
Table 15: Introduction of EPCs in France	77
Table 16: Attitudes to climate change in France and Europe	81
Table 17: Results for Marseille and Lille (sales transactions)	86
Table 18: Introduction of EPCs in Ireland	89
Table 19: Attitudes to climate change in Ireland and Europe	91
Table 20: Results for Ireland, sales market	97
Table 21: Results for Ireland, rental market	99
Table 22: Introduction of EPCs in England and Wales	101
Table 23: Attitudes to climate change in Europe and the UK	106
Table 24: Results for Oxford, both current and potential performance	112
Table 25: Summary of attitudes to climate change by country	121
Table 26: Introduction of EPCs in Cyprus	130
Table 27: Attitudes to climate change in Cyprus and Europe	131
Table 28: Introduction of EPCs in Portugal	136
Table 29: Attitudes to climate change in Portugal and Europe	139

This page is intentionally left blank.

List of Figures

Figure 1: The vicious circle of blame	27
Figure 2: European buildings at a glance	53
Figure 3: Residential EPC, Austria	59
Figure 4: Effect of a one-letter improvement in energy efficiency on prices and rents (and 95% confidence interval) in the Austrian property market	63
Figure 5: Residential EPC, Flanders	68
Figure 6: Price and rent effects of 100-point improvement in CPEB score (and 95% confidence interval) in the Belgian property market	75
Figure 7: Factors in purchasing decision according to real estate agents in France, June 2010	80
Figure 8: Gap between general public and buyers in attitude to energy performance	80
Figure 9: Residential EPC, France	82
Figure 10: Estimated effect and 95% confidence interval of a one-letter improvement in energy rating for Marseille and Lille house and apartment markets overall	88
Figure 11: Residential EPC, Ireland	93
Figure 12: Non-residential EPC, Ireland	94
Figure 13: Effect of one-letter improvement in energy efficiency on prices and rents in the Irish property market (2009-2012)	100
Figure 14: Effect of one-letter improvement in energy efficiency on prices and rents (and 95% confidence interval) in the Irish property market	100
Figure 15: First page of residential EPC, England and Wales	108
Figure 16: Effect of one-letter or ten-point improvement in current and potential energy efficiency on prices in the Oxford property market	113
Figure 17: Effect of one-letter or equivalent improvement in EPC rating across European property markets (95% confidence interval shown; see also notes in the text)	117
Figure 18: Residential EPC, Cyprus	132
Figure 19: Non-residential EPC, Portugal	141

This page is intentionally left blank.

Executive Summary

The potential for making energy savings in the building sector is widely recognised, especially through the refurbishment of existing buildings. However, as in other areas of energy efficiency, progress has been more difficult to achieve than anticipated. The Energy Performance of Buildings Directive (EPBD) (Directive 2002/91/EC) is the main EU policy instrument to improve the energy performance of buildings. Among other measures, it introduced a framework for energy performance certification, with a deadline for all Member States to bring into force the necessary laws, regulations and administrative provisions by 4 January 2006.

Energy Performance Certificates (EPCs) must include reference values, such as current legal standards, in order to make it possible for consumers to compare and assess energy performance. They must also be accompanied by recommendations for cost-effective improvement options to raise the performance and rating of the building. The recast of the EPBD in 2010 (Directive 2010/31/EU)¹ strengthened the role of EPCs, for example by demanding publication of the energy performance indicator of the EPC at the time of advertising a building for sale or rental rather than only at the time of signing a purchase agreement or rental contract.

Provision of clear and reliable information at affordable cost and at the appropriate time to prospective tenants and buyers is crucial for making energy efficiency investments more attractive. The EPC can thus be expected to provide an incentive for builders and owners to invest in improving energy efficiency, as it can be hypothesised that improving the energy performance of a building should lead to higher sale prices and rents on the market.

This study explores whether there is a link between the energy performance of buildings as expressed by EPCs and their value, whether rented or sold; in other words, whether or not the EPC energy rating of a property has an effect on the purchase or rental price when a property is listed or transacted.

The methodology involved first carrying out a literature review to identify existing evidence on the possible link between energy performance certification and the value of a building. A review was carried out of 22 studies that use the hedonic regression method to examine whether energy performance certification affects property values. This was followed by an assessment of EPC schemes in a selection of EU Member States and regions. The assessment aimed at analysing country-specific information and the differences in certification schemes implemented in order to support the interpretation of the results of the econometric analysis in this study. A poorly designed certification scheme and requirements, insufficient enforcement, low public awareness or acceptance, or the quality of the personnel carrying out audits can all affect the manner and extent to which certificates can influence the market.

The next step was to identify datasets for the various countries and regions that combine EPC ratings and data on sales prices and rents. It is perhaps an important indicator of the level of implementation at Member State level at the time of writing that accessing this data was

¹ Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings (recast). OJ L 153 of 18.6.2010, p.13.

difficult. In particular, several countries' EPC registers cite data protection as an obstacle to providing a sample of data, due to the inclusion of addresses. DG ENER supported the project team in this regard and good data coverage was achieved that allowed analysis of different factors, e.g. rental and sales, urban and rural, warmer and colder climates, houses and apartments. Datasets were obtained for Austria (Vienna and Lower Austria), Belgium (Flanders, Wallonia and Brussels-Capital regions), France (Marseille and Lille), Ireland and the UK (Oxford). The EPC schemes of Cyprus and Portugal were also assessed but datasets combining EPC ratings and transaction prices could not be obtained for these two countries.

An econometric model was established and regression analysis carried out for each dataset, with results for both sales and rental sectors, where possible. A standard hedonic price regression model was used, whereby the price (sales or rental) of an individual property was expressed as a function of a series of attributes, such as size, number of bedrooms/bathrooms, location and energy efficiency. Samples of properties were then used to estimate the price of each attribute.

The analysis of property transactions and listings from residential property markets in Austria, Belgium, France, Ireland and the UK, both sales and lettings, overwhelmingly points to energy efficiency being rewarded by the market. The only market where a positive relationship between energy efficiency and price was not found was Oxford (UK), where a one-letter (e.g. from C to B) improvement in potential energy rating was associated with a 4% lower price, everything else being equal. This imprecise negative relationship may result from either age as an omitted variable or alternatively the size of the sample available for analysis.

In other countries and regions, however, the effects of energy efficiency are clear and positive. In Austria, the property market in Vienna and the surrounding region was analysed. Based on detailed property listings, the effect of a one-letter improvement in energy efficiency is estimated at 8% in the sales market and 4.4% in the lettings market. There is also strong evidence that the price effect is larger in Vienna than in the surrounding (and less urbanised) Lower Austria region.

Similarly, the analysis in Belgium shows a clear relationship between a property's energy efficiency – as measured by its EPC – and its advertised price or rent. The most detailed analysis was of the Flanders market, which showed that a major improvement in energy efficiency (100 CPEB points) is associated with a 4.3% higher price on average. The rental effect was 3.2% - smaller but still statistically and economically significant.

Results for Wallonia and Brussels – based on smaller sample sizes, possibly due to the later introduction of the certificate in those regions – were in line with those for Flanders. A major improvement in energy efficiency is associated with a 5.4% higher price in Wallonia and a 2.9% higher price in Brussels. In the rental market, a similar improvement in energy efficiency is associated with a 1.5% higher rent in Wallonia and a 2.2% higher in Brussels.

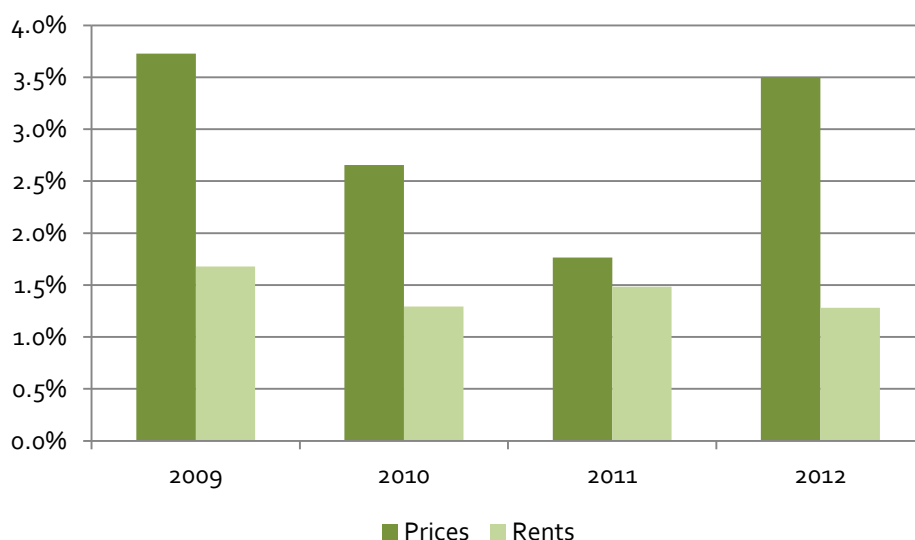
In France, a strong positive relationship between energy efficiency and the price of a dwelling was found for Marseille. Each one-letter improvement in a property's energy label is associated with a 4.3% higher price. This effect is driven by apartments, with no statistically significant effect of energy rating on the price of a house. As with Oxford, however, caution must be exercised when noting this result, as the sample of houses in Marseille is small.

For Lille, there is again a strong positive relationship between a property's energy label and its value, although the effect of a one-letter improvement on value is smaller than for Marseille (3.2% compared to 4.3%). This runs counter to the intuition that energy efficiency would be rewarded more in regions with greater dependence on energy for comfortable conditions of habitation. In the case of Lille, it is houses rather than apartments that drive the relationship between energy efficiency and property values. Each one-letter improvement in label is associated with a 4.7% higher price, while for apartments the effect is 1.5% and only marginally statistically significant.

Finally, with Ireland there are again clear indications from the property market that energy efficiency is rewarded. The effect of a one-letter improvement in energy efficiency is estimated at 2.8% in the sales market and 1.4% in the lettings market. Due to the long-running nature of the Irish dataset, it is possible to examine the relationship over time. The effect in the sales market fell between 2009 and 2011, but was as large in 2012 as it had been in 2009. The introduction of mandatory display of EPC rating in advertisements in early 2013 may have an impact on the relationship between property prices and energy efficiency in Ireland.

A number of segments would benefit from further study with larger datasets to not only enhance the precision of the estimated effects but also allow further robustness checks and analysis by market segment (region, property type or period). As it stands, there are a number of additional points that emerge from the analysis undertaken here.

Effect of one-letter improvement in energy efficiency on prices and rents in the Irish property market (2009-2012)



Firstly, comparing results for sales and lettings segments allows an important distinction to be made between immediate value (the ongoing service offered through energy efficiency of savings on bills, etc.) and the long-run impact (the higher asset value of the property when resold). Renters only enjoy the first of these benefits, and thus help distinguish between the two.

In all three countries for which information on both sales and rental markets was available – Austria, Belgium and Ireland – the estimated rental premium for energy efficiency was smaller than the estimated sales price premium. This suggests that owners reap a benefit that is

additional to the ongoing monthly benefits, i.e. reduced energy bills, which accrue to all occupiers including tenants.

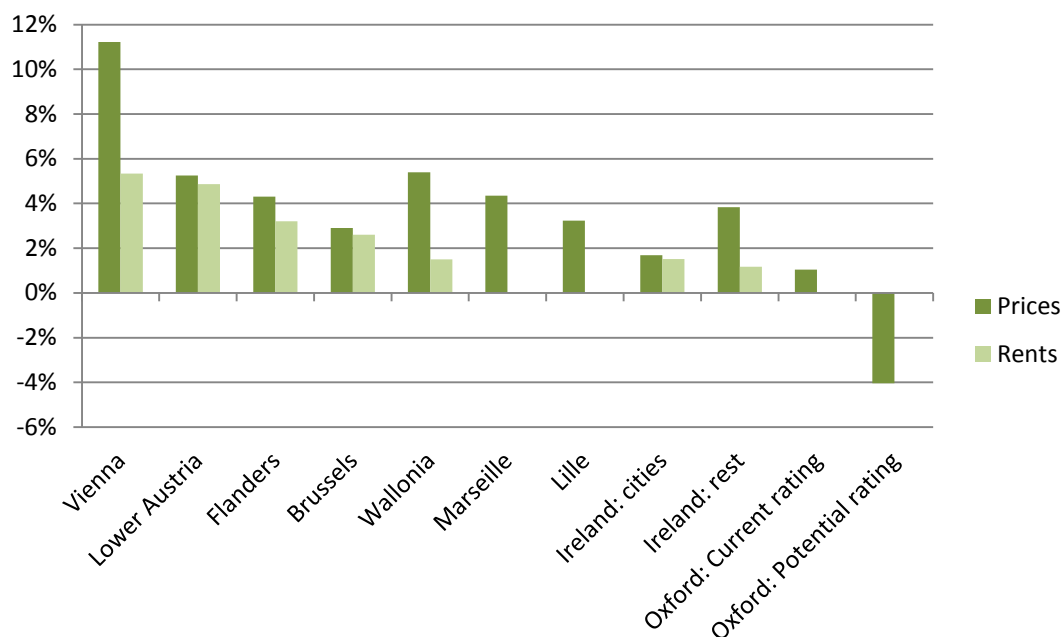
Secondly, comparison across countries and regions potentially allows comparison of the effect of energy efficiency across schemes and climate types. There is contrasting evidence about how the energy efficiency premium varies by location. In Ireland and in Belgium, the effect is smaller – in percentage terms – in cities than in more rural areas. This seems plausible, as potential savings (in €/m² terms) would not vary much by location, while the €/m² cost of a dwelling will be significantly greater in central urban areas.

Nonetheless, in Austria, the evidence is to the contrary: the percentage effect is larger in Vienna than in the surrounding area. An alternative explanation may lie in market conditions. In the falling Irish market, conditions were tougher in rural areas, meaning that energy efficiency is a criterion of differentiation. A similar effect might be at work in Belgium, where the market in 2012 was largely static in real terms (up 2.7% in nominal terms, in mid-2012). In Austria, however, the real estate market was booming in mid-2010 (+10% year-on-year, and even greater in Vienna). Further research on whether market conditions matter to the value market agents place on energy efficiency ratings would be necessary, but comparing across countries, the percentage effect of the EPC appears stronger where selling conditions are easier.

Listings data were used for Austria, Belgium and Ireland. Recent research has highlighted that listings offer a good proxy for transaction prices, even in extreme market conditions, capturing variation both over time and across space. Nonetheless, properties listed for longer without successful sale or lease may be associated with lower transaction prices, everything else being equal. This may understate the effects of energy efficiency on property market outcomes, if energy efficiency is positively correlated with general property quality, and quality in turn is positively correlated with faster sale or lease.

Each country operates its own specific EPC scheme, and for that reason cross-country comparisons must be made with caution. Nonetheless, in each country, a one-letter improvement in EPC is likely to be interpreted by consumers as a significant improvement in energy efficiency, as would a 100-point improvement in the CPEB scale in Belgium. Using that benchmark, an overview of the effect of a significant improvement in energy efficiency across all markets covered in this study is shown in the figure below.

Effect of one-letter or equivalent improvement in EPC rating across a selection of European property markets (see also notes in the main report)



In interpreting the above results, it may be important to bear in mind the nature and state of implementation and uptake for the individual EPC schemes concerned, which has varied a lot until now. For example, the proportion of sales transactions accompanied by an EPC has varied across Member States – from 10% (Cyprus) to 20% (Austria) to around 95% (UK) to virtually 100% (Portugal, France). Take-up is increasing steadily over time as awareness grows and in particular as legislation is implemented. However, although a significant proportion of transactions are accompanied by an EPC, it is sometimes provided only at the moment the contract is signed, i.e. too late in the decision-making process to have an impact. Ongoing implementation of the recast EPBD, in particular the requirement to display the EPC as part of all property advertising, can be expected to have a big impact on awareness of the EPC and its importance as a factor in decision-making.

The full potential of EPCs is not yet being reaped. Member States should be encouraged to continue to focus on quality assurance of the EPC, and improve public trust in and understanding of the label (via communications campaigns). Aside from awareness of the existence of the EPC and its energy rating, it will be important to improve the understanding among buyers and renters of the benefits of a better rating in practice, in particular on their energy bills. As things stand, there is still a certain amount of confusion as to the meaning and derivation of the rating, and the costs and benefits of making improvements.

This page is intentionally left blank.

Chapter 1: Introduction

The EPBD is the main EU legislative instrument to promote energy performance of buildings, taking into account cost-effectiveness and local conditions and requirements (energy consumption in buildings is highly influenced by local climates and cultures). As well as minimum energy performance requirements and inspection of boilers and air conditioning systems, starting in January 2006, energy performance certification has been introduced albeit on a gradual basis and at different speeds depending on the Member State or region. Member States could opt for an additional period of three years (Article 15.2). The final deadline for all Member States to implement a mandatory energy labelling scheme for new and existing buildings or building units (e.g. apartments), along with periodic certification of public buildings, was therefore 4 January 2009.

The recast of the EPBD in 2010 clarified some aspects, strengthened others, extended the scope and promoted the role of the public sector. In particular, it strengthened the role of EPCs in raising awareness of better energy performance of buildings by demanding publication of the energy performance indicator of the EPC at the time of advertising a building for sale or rental rather than only at the time of signing a purchase agreement or rental contract. Quality will also improve with the recast EPBD because Member States will be obliged to implement independent control and random checking.

Under the EPBD, EPCs must include information on the energy needs/consumption of a building including reference values in order to make it possible to compare and assess the energy performance of the building. EPCs must also include recommendations for cost-effective improvement options to raise the rating of the building. In most countries, ratings are expressed on a letter scale (e.g. A to G, where A is very efficient and G is very inefficient). In others, e.g. Germany, a continuous scale is used. For existing buildings, the potential rating (including possible improvements) is sometimes displayed on the certificate along with the current rating, and/or a benchmark (e.g. for a similar average performing building). The EPBD requires that EPCs be issued by independent assessors using a standard calculation methodology, in such a way that energy performance can be compared to reference values (e.g. buildings of the same type) by prospective buyers, tenants, owners, occupiers, investors, etc.²

As the EPBD is a framework piece of legislation, and given the subsidiary principle in the EU, there is significant room for Member States to detail the mechanisms and manner of implementation. The implementation of energy performance certification in the EU-27 reflects the diversity of Member States and regions. Implementation and effectiveness vary from country to country and region to region depending on a range of factors including the local political and legal context, and the characteristics of the local property market. The existence of related incentives and subsidies at national or regional level needs to be taken into account as well. In

² All of the countries and regions in this study rely on calculations, with the exception of Flanders for public buildings and France, which uses a combination of calculations and measurement.

general, it can be said that low ambition in implementation leads to certification schemes of poor quality, i.e. not providing sufficient and accurate information or the necessary quality control.

The basic idea behind certificates is to create information that such actors can use to make more informed decisions and integrate energy efficiency (and fuel costs) into their decision-making process (or in the case of occupiers of existing buildings, to inform them about possible improvements to reduce energy demand and operating costs). The information stemming from the issuing of an EPC should provide an incentive for builders and owners to invest in energy efficiency, as it can be hypothesised that the improvement of the energy performance of a building should then also lead to higher transaction prices and rents on the market.

Provision of clear and reliable information up-front and at affordable cost to prospective tenants and buyers is crucial for making energy efficiency investments more attractive. EPCs and the EPBD in general have certainly brought the subject of the energy efficiency of buildings onto political agendas, into building codes and to the attention of citizens. However, it is difficult to quantify their full impact at European level because of the highly disaggregated nature of the sector, the complementarity of energy improvements to other policy objectives, uneven transposition and lack of proper monitoring.

1.1 Study outline

The motivation for this study is to demonstrate whether there is a link between the energy performance of buildings (or building units) as expressed by EPCs and their value whether rented or sold; in other words, whether or not the EPC rating of a building has an effect on the sale or rental price. We achieve this by performing detailed econometric analysis on combined datasets of EPC information and data on sales prices and rents. As each EPC scheme and country or region is different, it can be expected that the strength of any such effect will vary. The underlying policy regimes are thus assessed in a harmonised way and overall conclusions for policy makers drawn.

The methodology followed involved first carrying out a literature review into the link between energy performance certification and the market value of a building. Next, the EPC schemes within the scope of this study were assessed because a poorly defined certification scheme and requirements, insufficient enforcement, low public awareness and/or acceptance, low quality personnel carrying out audits, etc. will affect the way the certificate influences the market. In order to be able to properly interpret the results of the econometric analysis, it is therefore important to gather country-specific information and set out the differences in certification schemes.

All things being equal, the more effective the implementation, the more likely it is that a link between energy class and value can be established. Of course, a number of noise factors can obscure this and therefore we have also sought to establish whether there are additional factors outside the issue of implementation that may affect the reception of energy labelling and its capacity to influence the market.

It is important to note that datasets were not readily available – this is an important finding in itself as it hinders policy research, monitoring and evaluation. In particular, several countries' EPC registers cite data protection as an obstacle to providing a sample of data, due to the inclusion of

addresses. We therefore investigated solutions and alternatives in consultation with DG ENER in this regard. In the end we achieved good sectoral coverage, e.g. rental and sales, urban and rural, warm and cold climates, and obtained detailed datasets for France (Marseille and Lille), Ireland, Belgium (Flanders, Wallonia and Brussels-Capital regions) and the UK (Oxford and region), and a smaller dataset for Austria (Vienna).

An econometric model was established and run for each dataset, and useful results for both sales and rental sectors were obtained. In the final chapter, policy implications are discussed and some recommendations provided.

This page is intentionally left blank.

Chapter 2: Literature review

2.1 Scope

This chapter reviews the literature on the link between energy performance certification and property values. It looks at the existing applied economic research and other literature on the link between an EPC of a building and the value that building yields in rent/sale.

The chapter is structured as follows: we start by considering why we should be interested in the relationship between energy performance certification and property value at all. We place energy labelling in the broader context of policy instruments that can be used to transform the market for a given good towards greater energy performance. Next we outline why energy performance certification can be expected to affect property value. We move on to examine the empirical evidence that energy (or broader environmental) performance certification schemes affect property values as reflected in transaction data on sales and rentals. Finally, we provide some concluding remarks on what the literature reviewed suggests about the link between energy performance certificates and the value of property now and in the future.

We are primarily interested in literature that investigates, through empirical analysis of transaction data, whether it is possible to link the presence of an energy performance certificate to a positive effect on the value of a property. More broadly, we are interested in literature concerned with why the energy performance certification of property can be expected to have a positive effect on property value. As the former literature is limited at present, especially insofar as EPC schemes are concerned, and as the latter can provide a useful framework and will be important to inform the conclusions for policy makers, we look at both.

2.2 The market transformation policy approach

The labelling of different product groups is a well-established EU-level policy practice. First attempts probably go back to Directive 79/530/EEC on the indication by labelling of the energy consumption of household appliances. It is an approach that now covers not only lighting and domestic and professional appliances but also cars and buildings (under different Directives). Similar debates took place about whether and how to implement these schemes, with variations depending on the product group and policy community involved.

The rationale for any labelling scheme is as an enabler; it is a policy intervention that facilitates but does not guarantee a certain outcome. In order to fulfil this role it must be well implemented, e.g. labels should be visible to the public and the level of energy performance presented on the label must be accurate. There are opportunities to enhance the effectiveness of a labelling scheme and we return to the issue of implementation later in this study.

Energy and other environmental labelling schemes make visible in the market a dimension of a product that is not easily visible, in this case energy performance. In the absence of information from sellers about the energy performance of properties, the added value of a well-insulated

building would not be reflected in the transaction price or rent, which may in turn dissuade owners from making energy-saving improvements – especially if they are planning to rent their property or sell it in the short term.³

Following Lancaster (1971), any product can be understood as a bundle of characteristics. Some of these characteristics will be more visible than others. Energy and other environmental labelling schemes provide the basic conditions for the buyer to take into account this dimension of a product. In the absence of such labelling schemes it is more difficult to compare products on this basis; it requires much greater determination and technical insight on the part of the consumer.

Information will only produce an effect if energy performance is regarded as a salient attribute by buyers/renters, or if sellers/landlords anticipate that it will become a salient attribute in the future and bet on this market such that the choice facing the buyer becomes structured in this direction.

In order to achieve a sufficient quality of implementation, a number of social practices and practitioners need to be mobilised. This is quite explicit in the framework directive on product labelling (Directive 2010/30/EU) for example, which places specific responsibilities on manufacturers and retailers. The aim is for all relevant actors to take account of and act on the new information: for buyers to integrate it into their purchasing decisions, for intermediaries to integrate it into their advice, and finally for sellers to react to (and anticipate) a shift in buyer preference. There are numerous links in this chain that require careful attention in order for this to happen.

Labelling schemes are best understood in the context of a broader market transformation approach. As the name suggests, the approach aims to transform or shift whole markets. It grew out of product policy and has more recently been applied to the complex area of transforming property markets (Fawcett and Boardman, 2009; Killip, 2011a). Simply put, market transformation integrates policies into a strategy to ensure that the average product sold moves towards greater energy efficiency (Boardman, 2012). There is a normative element to this literature insofar as it proposes ways to better integrate policy instruments at different levels of governance over time to achieve a given level of energy performance. It is also a perspective that can be used to describe and assemble many of the extant public policy instruments. Finally, it is a perspective that can be used diagnostically to examine whether there is sufficient strategic ambition and tactical integration in a given policy area.

Killip (2011a) explains market transformation as an approach to policy making and programme design that aims to improve the energy performance of whole stocks of energy-consuming products in a market economy (Geller and Nadel, 1994). He identifies some of the common themes of the approach as the provision of information to help consumers make informed choices at the point of sale; rewards and incentives for innovation at the best-performing end of the market; and mandatory minimum standards for performance to remove the worst performing products (Hinnells and Boardman, 2011). Killip points out that the detail of individual programmes to improve the stocks of different appliances takes account of the technical design of the appliance and the condition of the market for it before market transformation

³ In this respect, the housing market may be similar to the market for second-hand cars, as described in Akerlof (1970). Not only is there lack of information but the second-hand segment is very large.

intervention. Background research and stakeholder engagement for the market in question are important early steps in the process.

The combination of instruments into a strategic framework maximises the effectiveness of each. As some of these instruments are mainly at EU level and others at Member State level, the challenge of combining them into a coherent whole with sufficient clout is of course not an insignificant challenge. The value of labelling, whether for appliances, equipment, vehicles or buildings, should therefore not be understood in isolation but as an essential (enabling) part of driving innovation for better energy performance in a given market (Hinnells and Boardman, 2008).

2.3 Market transformation in property markets

Building on earlier work by colleagues at the Environmental Change Institute, University of Oxford, Killip (2011a) reflects on the challenges involved in moving from transforming product markets to transforming much more complex property markets. He focuses his discussion on existing residential buildings. Existing buildings are in terms of scale more important and in terms of complexity more difficult to get right than new build. There will be differences with non-residential property, but the overall argument is likely to apply to both.

Killip argues that the EPC creates, for the first time, a link between two separate markets: the market for property transactions (including sales and rentals) and the market for refurbishment (including installation of energy efficiency measures, installation of micro-generation technology, and a general set of services referred to as repair, maintenance and improvement (RMI)). Within the market for refurbishment, the market for RMI is by far the most dominant in value and Killip suggests that significant savings can be made in cost and disruption by seeking to integrate energy-saving refurbishments with the “normal” operation of this market. The link between the two markets is created through what Killip refers to as the “dual rating” of the EPC, which in the UK contains both a *current* rating and a *potential* rating. That is, the current rating of a property and where it could get to if the Article 3 § 2 (Directive 2002/91/EC) recommendations were followed.

It should be noted that although this is the form of the EPC in the UK, Directive 2002/91/EC only required the certificate to be accompanied by recommendations for the cost-effective improvement of energy performance. The text in the recast directive (Directive 2010/31/EU) has been expanded but still does not specify something as concrete as a dual rating.⁴ It might be argued though that the requirement to show recommendations as to the potential for improvement still creates the link identified by Killip, although depending on the format chosen for the certificate in a given Member State this may be more or less transparent.

This principle, of showing the potential for improvement through the recommendations, was an innovation compared with appliance labelling, a recognition that improvements to the energy performance of buildings are not achieved through product replacement but through the

⁴ The recast Directive requires that the EPC shall include recommendations for the cost-optimal or cost-effective improvement of the energy performance of a building or a building unit (Article 11 § 2), unless there is no reasonable potential for such improvement compared to the energy performance requirements in force.

provision of a refurbishment service (Killip, 2011a). In the context of transforming property markets, the refurbishment cycle therefore plays a crucial role.

It is widely recognised that there is huge potential for making emissions reductions in the buildings sector, especially through the refurbishment of existing buildings. But the challenge in accessing this potential should not be underestimated. Killip points to several studies of the UK residential sector and makes the point that modelling studies tend to be based on system components (elemental U-values) without allowing for a margin of error in installation, and thus effectively assume the quality of installation to be perfect. In addition, innovation in buildings may require innovation not only in the construction sector, but also among professionals to implement new professional practices and building users to break out of old routines and learn and establish new ones. Studies such as the Probe studies of “post-occupancy” by the Better Building Trust⁵ for example have shown that low-energy buildings often do not meet their promise, for a variety of reasons. All of this jeopardises the potential savings from buildings, whether based on a purely technical assessment, cost-optimality or cost-effectiveness.

Killip argues that in order for market transformation to be successful in the building sector, it must take account of the conservatism of the construction sector, and the nature of innovation in that sector. This, it is argued, takes place in ways that are hidden from the conventional metrics of innovation such as R&D spending and patent applications. While such indicators relate to innovation of new technology, construction is as much about the process of putting new materials together as it is about the materials themselves. Drawing on the work of Harris and Halkett (2007), three aspects of innovation in the construction sector are identified, with implications for developing market transformation policies for the building stock:

- Innovation in construction is highly non-linear: it derives from evolving working practices, project collaborations and problem-solving;
- Innovation is driven by regulations, client demand and skills supply;
- Innovation takes place between construction companies, consultants and clients, not in the R&D lab.

Policy makers, argues Killip, should engage with this very different way in which the industry innovates: the emphasis is on experimentation, for which the impetus needs to come from regulation (in the absence of significant client demand). On the basis of his analysis, Killip proposes a model of market transformation based on continuous improvement through industry engagement. At the heart of the model is the idea of energy standards being developed in parallel with the necessary vocational standards.

It is worth going into what Killip (2011a) proposes in a little more detail as it sets the EPC not only in the context of a wider set of market transformation policy instruments, but also very firmly at the heart of the interaction of multiple markets and practices that are required to be mobilised to secure the transformation of the building stock.

Mobilising the interest and co-operation of the various actors in such a diffuse sector is a challenge in itself, and one that hinges on the perception among industry members of the future

⁵ See www.usablebuildings.co.uk.

size of the market. Voluntary schemes, demonstration projects and pilots can all inform the process, but they do little to stimulate the mass market. Regulation through a mandatory energy performance standard, announced several years in advance in order to give the industry time to invest in supply chains and training, is a key part of the process of industry engagement.

In order for minimum performance standards to be delivered on the ground, they need to be matched by a vocational standard. These standards will not achieve market transformation on their own, but nor will the other policy tools achieve it without this dual set of minimum standards being in place.

Monitoring, evaluation and dissemination need to underpin the entire process, so that the lessons from one round of innovation are fed all the way through the compliance regime; and the lessons from that round of compliance testing feed back into the next round of innovation. A central co-ordination body is needed because there are multiple sources of information in the system of markets that make up the current delivery mechanism for refurbishment. The EPC, the building industry, product manufacturers, estate agents, finance brokers and compliance checkers all need to be working to the same set of standards in order to minimise the risk of the whole exercise unravelling.

The institutional framework to manage such a programme does not currently exist although different aspects of the knowledge and expertise required can almost certainly be found in various places. The challenge for national administrations is to bring disparate capabilities together by combining several key roles: co-ordination and engagement of multiple groups of stakeholders; development of energy standards based on field trials and technical studies; simultaneous development of occupational standards in collaboration with relevant bodies; liaison with manufacturers and wholesalers of products, including product innovators; co-ordination of the energy standards with the detailed workings of the EPC; better understanding of how occupants behave in real-life refurbished houses and the impact that has on consumption and CO₂ emissions.

Killip's discussion focuses on existing buildings. These are the most significant challenge in securing energy and carbon savings from the building sector. But it is also important to ensure that today's new buildings do not become the problem buildings of the future. A clear roadmap has been set out at EU level as regards new buildings, with these required to be nearly zero energy by 2020 (or 2018 in the case of buildings owned and occupied by public authorities).

2.4 The link between energy performance labelling and property values

There are several ways to think about the value of property (Sayce et al., 2010). In the context of this study, we are most interested in the value of property in exchange, i.e. as value is revealed through transaction, either rental or sales. When looking at the value of property in exchange, it is important to bear in mind that the housing market is subject to complex social processes in which a wide range of actors intervene.

Interest in energy performance of buildings and building values is not new. Brounen and Kok (2011), for example, refer to literature from the United States on the residential sector from the mid-1980s (Laquatra, 1986; Gilmer, 1989; Dinan et al., 1989). The concern then, as now, is whether an investment in improving energy efficiency will be reflected in the value of a building.

There are several reasons to be interested in this. To the extent that a building with better energy performance costs more to build, and this is not necessarily the case, it is of course interesting to know if this additional investment can be recovered and if it leads to any additional return to the investor. A similar argument applies in the context of the renovation of existing buildings. At the more entrepreneurial end, it may also simply be interesting to know if the buyer is willing to pay more (a premium) for buildings with better performance, irrespective of whether or not these cost more to build. Another way of looking at this is in terms of the capacity of buildings with better energy performance to better preserve their value going into the future (future-proofing) e.g. in the face of changing demand and regulatory requirements. Finally, this kind of information can be of interest because it can encourage market actors to invest in the better energy performance of buildings.

Many expect the energy performance of buildings to affect the value of buildings because it saves money and is also in line with changing social norms vis-à-vis the environment. The energy performance of buildings is also expected to affect the monetary value of property because there are numerous other benefits associated with buildings that are more energy efficient, i.e. energy-efficient buildings provide a greater level of services (see Ürge-Vorsatz et al. (2009) for a comprehensive review).

Lancaster (1966) opened the way to relating the features of a consumer good to the services that it provides. For example, a house can be decomposed into various features, such as size, number of rooms, number of bedrooms and bathrooms, presence of a garden, etc. These features are indispensable for consumers to get services from their house (e.g. a good night's sleep, a shower, etc).

For a given amount of services, energy performance affects running cost. If the running costs associated with two homes are different for the provision of identical services, the price of living in those homes (as an owner or a tenant) should take that difference into account. Because the net present value of goods providing the same utility to consumers should equalise, the price of two goods providing the same services but with different energy efficiency levels should not be the same.

Furthermore, buildings account for around 40% of energy demand and savings are more easily achieved than in some other sectors. As energy mixes in most countries remain dominated by fossil fuels, better energy performance in the buildings sector is therefore very important in fighting climate change and improving security of supply. Although there is a very significant way to go before this is integrated in the behaviour of individuals and institutions, it should (in principle) lead to a change in what is valued in society, including how energy efficiency is valued when purchasing or renting a property. Several of the authors reviewed expect this to happen in the real estate market under certain conditions (e.g. McNamara, 2008; Sayce et al., 2010).

2.5 Barriers to change

Perhaps surprisingly then, the transformation of the building stock towards greater efficiency has been slow to happen. Numerous reasons have been identified and studies on barriers to energy efficiency in buildings and other sectors are legion. In this section we briefly review some of the reasons why efficiency performance *should* in principle count and the barriers to making it count.

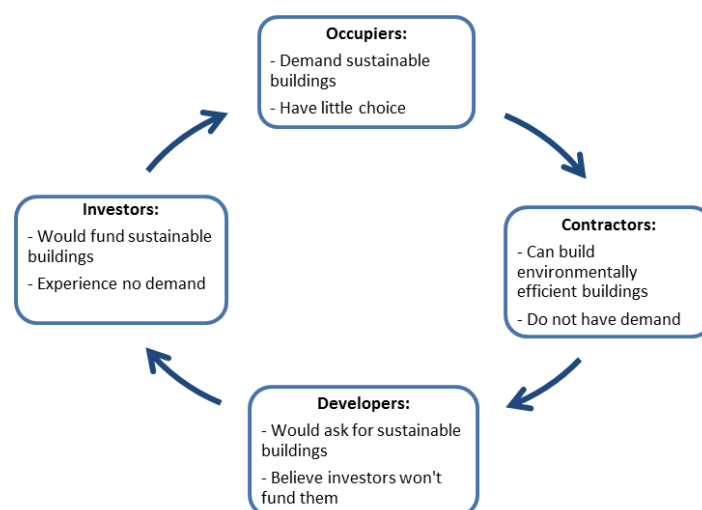
Advocates of energy efficiency have been asking since the 1970s why progress on energy efficiency is not happening more quickly. On one level progress is happening, and analysis undertaken for the European Commission (EC, 2011a) shows that energy efficiency has in fact been the most important energy resource. However, at the same time, we are not succeeding in taming our overall demand for energy, and the environmental concerns about energy have sharpened over time as we have come to recognise the threat of climate change, so more is also expected from energy efficiency.

Numerous reasons why progress on the energy performance of buildings is not happening more quickly have been identified. Bloom et al. (2011) provide a good list in the context of the residential sector including transaction costs, lack of information among buyers/tenants, uncertainty of energy savings, split incentives (principal-agent problem) and initial capital cost.

Fuerst and McAllister (2011b) rehearse a number of the challenges in the context of a broader paper on the uptake of sustainability features in the commercial property sector including split incentives, risk aversion, high discount rates and skills shortages inter alia.⁶

In order to get an overall picture of why change has been slow, it can be helpful to map the dynamics of property through an actor-based model. A number of attempts have been made in recent years, mostly focusing on a limited number of actors (e.g. Guy, 2002; Guy, 2006; Pett and Ramsay, 2003; Schiellerup and Gwiliam, 2009; Killip, 2011b; Nösberger et al., 2011). An example of this is the idea of the “vicious circle of blame” attributed to David Cadman (Keeping, 2000):

Figure 1: The vicious circle of blame



⁶ Many office buildings have already been renovated and image may be important. The shopping and leisure sector is particularly complex because a large part of the market is small shops with diverse activities. Educational buildings meanwhile are mostly owned by local authorities or national administrations.

The idea of the vicious circle of blame is to show how different actors in the (commercial) property market (e.g. occupiers, contractors, developers, investors) are ready to take action but depend on, or say they depend on, other actors to take action before they can respectively demand, build, commission or fund sustainable buildings. The dynamics are likely to be similar in the residential market and indeed Bloom et al. (2011) make a very similar observation about the United States residential property market: “for energy-efficient building practices to become more prevalent, it must be established that homebuyers are willing to pay more for energy-efficient homes”.

Information will play a key role in breaking the vicious circle of blame and in this context the role of intermediary actors such as property agents and especially valuation professionals are often posited as key (e.g. Guertler et al., 2009). Pett and Ramsay (2003) provide a rather extended version of the vicious circle of blame in the context of a discussion of the office sector, with a larger number of actors.

For Lorenz and Lützkendorf (2008a), who write from a valuation perspective, the mainstreaming of sustainable property investment and management is constrained by a “misalignment between suppliers and those demanding property assets for occupation and/or investment”. However they argue that the vicious circle can be broken by providing actors with appropriate feedback on both the environmental and social aspects of building performance as well as on its various interrelations with financial performance and property value. They argue that not only the involvement of the construction industry but also property professionals, banks, assessors and certifiers as well as research and educational institutions “is an absolute necessity”.

According to the authors, the interplay between all these different actors as well as the information flow needs to be organised in such a way that knowledge regarding the benefits of sustainable buildings pervades all areas and is accounted for within the highly influential processes of valuation, investment counselling and risk analysis. If building owners and investors, the authors go on, know nothing or very little about the real performance of the buildings they buy, use and operate, then these buildings cannot be improved systematically in pursuit of both individual and collective well-being. The alternative, they suggest, is for property professionals to begin assessing and reporting the value creation through sustainable design, incentivising change and more sustainable behaviour.

Lorenz and Lützkendorf (2008a) argue that the added value attributable to sustainable design will underwrite a restructured approach and a radical change in how we understand and value our built environment and that the end result will be the emergence of a proactive, self-perpetuating loop driving further change and even more sustainable behaviour – in other words a virtuous circle instead of a vicious circle. In their paper, the authors illustrate this virtuous circle, which contains a larger number of actors than Cadman’s vicious circle and which is notably framed by the actions of policy makers, creating a supportive legal framework.

The authors go on to argue that a precondition for assessing and reporting value creation through sustainable design and for installing appropriate feedback mechanisms within the property sector lies in overcoming existing information asymmetries. They suggest that what is needed is a systematic description of major characteristics and attributes of buildings for various purposes such as valuation, risk assessment and certification. They put forward the idea of “building passports” as an “information container” to support the exchange of information

between actors in the property and construction markets. While Lorenz and Lützkendorf start from a valuation perspective and Killip (2011a, 2011b) starts from a refurbishment perspective, they share the basic insight of the need to link up different markets to enable improvement in energy performance and situate energy performance certification as an important part of this wider context.

2.6 Existing energy performance labels for buildings

Reed et al. (2009) suggest that the current era of rating tools for buildings commenced in 1990 with the introduction of the BREEAM rating tool (UK), a multi-criteria tool. This was followed by numerous other schemes in different jurisdictions, some taking a broader multi-criteria, sustainability approach, and others focusing more narrowly on energy (Sayce et al., 2010). The French HQE scheme (multi-criteria), the Swiss Minergie (energy) label and the Energy Star (energy) in the United States all began in the 1990s and were followed in the 2000s by various multi-criteria schemes such as the US-based LEED, CASBEE in Japan, Green Globe in Canada and Green Star in Australia inter alia. The EU framework for the energy performance labelling of buildings can be seen as a relatively late starter. However, whereas the other schemes are voluntary, requirements under the EPBD are mandatory.

Winward et al. (1998) distinguish two types of label: endorsement labels and comparison labels. Endorsement labels essentially divide buildings into two categories: those that meet the specified criteria and those that do not. Only buildings that meet the criteria may be awarded the label. Endorsement labels are normally voluntary: it is expected that buildings good enough to win a label will wish to display that fact.

Comparison labels are multi-category: all buildings are attributed a label that classes them from “better” to “worse”. To be effective, comparison labels have to cover *all* goods on the market, and are therefore normally compulsory. It is clear that endorsement labels may also be multi-category (e.g. BREEAM, LEED or Energy Star), but the essential distinction between endorsed (i.e. those that are rated) and not endorsed (those that are not rated) is retained. The EPC on the other hand is mainly a comparison label showing buildings that are “better” and “worse” from an energy performance point of view, in order to shift the market as a whole towards better energy performance, but also has an element of endorsement and rewarding the best (A-rated) properties.

2.7 Existing studies of the effect on transaction prices

In this section we examine existing evidence on whether energy performance certification affects property values. As Sayce et al. (2010) point out, many surveys show willingness to pay a premium but it is really only in the transaction data (whether rental or sale) that a positive link between energy performance certification of a property and its exchange value⁷ can be shown.

⁷ While Sayce et al., like this study, are concerned with value in exchange (i.e. price), they are careful to point out that market values are only one definition of value and that value in its wider sense can reflect a number of characteristics that can be said to provide value (monetary or psychological) to people. The authors point out (as have others before)

This part of the literature review therefore focuses on studies that link transaction data with data on energy performance certification. Of the studies we identified, Fuerst and McAllister (2011a) is based on appraised value rather than exchange value. Pivo and Fischer (2010) is based on a mixture of transaction and appraised value, at least as far as the sales-related analysis is concerned. Only three studies address the EPC rating specifically.

The standard approach to identifying the contribution of any given characteristic of property to its value, and therefore also the presence of an energy performance certificate, is some form of hedonic regression analysis. Hedonic price regression is a standard tool that has been used in various fields of economics since it was formalised theoretically in the economics literature by Sherwin Rosen in the 1970s. It is used in environmental, regional and urban economics, for example, to assess the value of amenities and disamenities such as proximity to transport facilities or potentially hazardous facilities.⁸

Hedonic regression is commonly used to estimate the value of individual attributes of a property, the prices of which are typically implicit (not observed directly). It is also used by a wide variety of organisations to calculate house price indices, as this method corrects for any shifts in the underlying basket of properties being analysed. Muldavin (2008) provides a reflection on some of the methodological challenges and pitfalls when it comes to assessing the extent to which there is a demonstrable link between environmental performance certification and property value. The quality and clarity of presentation is unquestionably variable but overall the hedonic regression approach is a robust one and widely accepted.

We thus only included studies that were based on this type of methodology (one study, Griffin et al. (2009), was excluded on that basis). The search yielded 22 papers, which were analysed in terms of several characteristics (Table 1):

- Year of publication;
- Location;
- Market segment;
- Scheme;
- Comparison;
- Data sources;
- Sample size;
- Period;
- What impact the study addressed (sales and/or rental value);
- Whether an impact was identified and if so whether it was positive or negative;
- Magnitude of the impact.

that in a perfect market, value in exchange will reflect all these characteristics accurately and reflect that the property market is seldom perfect and that although value may exist for one party, it will not always be fully reflected in transaction data. The purpose of energy labelling is to help correct some of the information failures in the market.

⁸ A 1989 study by the US EPA used this method to estimate the effect of energy efficiency improvements on home values: Dinan and Miranowski, *Journal of Urban Economics*, 1989.

Table 1: Overview of past studies and papers

	Study	Location	Segment	Scheme	Status	Scheme start	Compares	Data	Period	Sample size (labelled)	Sales / Rent	Price increase/decrease (+/o/-)	Magnitude	
													Sales	Rental
1	Miller, Spivey, Florance (2007, 2008)	United States	Office (A rating only)	LEED, Energy Star	Voluntary	2000 (LEED), 1995 (Energy Star)	Labelled to non-labelled	CoStar	2003-2007	643 Energy Star. Unclear how many LEED. Maybe 248 as 927 total observations.	Sales	+	10% (LEED), 5.8% (Energy Star)	n/a
2	Salvi, Horehajova, Müri (2008)	Switzerland, Zurich	Residential	Minergie	Voluntary	1998	Labelled to non-labelled	Unstated	1998-2008	259	Sales	+	7% (single-family homes), 3.5% (flats)	n/a
3	Fuerst, McAllister (2008)	United States	Office	LEED, Energy Star	Voluntary	2000 (LEED), 1995 (Energy Star)	Labelled to non-labelled	CoStar	-	-	Both	+	31.4% (LEED), 10.3% (Energy Star)	9.2% (LEED), 11.6% (Energy Star)
4	Soriano (2008)	Australia, ACT	Residential	ACTHER S (1-10)	Mandatory	1999	Properties with different ratings (1-10)	Land Information Centre transaction data; ACTPLA energy ratings	2005, 2006	2 385 (2005), 2 719 (2006)	Sales	+	3% per star level	n/a
5	Wiley, Benefield, Johnson (2010)	United States	Office (Class A only)	LEED, Energy Star	Voluntary	2000 (LEED), 1995 (Energy Star)	Labelled to non-labelled	CoStar	Unstated but paper online by 30 July 2008	About 12 LEED and 70 Energy Star (sales), about 292 LEED and 438 Energy Star (rental)	Both	+	\$130 / square foot (LEED), \$30 (Energy Star)	15-18% (LEED), 7-9% (Energy Star)
6	Eichholtz, Kok, Quigley (2008, 2009, 2010a)	United States	Office (commercial)	LEED, Energy Star	Voluntary	2000 (LEED), 1995 (Energy Star)	Labelled to non-labelled	CoStar	2004-2007 (sales, unstated (rental)	694 LEED or Energy Star	Both	o (LEED), + (Energy Star)	No statistically significant premium (LEED), 19% (Energy Star)	No significant rent premium (LEED), 3.3% (Energy Star). Effective rent: 9% (LEED), 10% (Energy Star).
7	Salvi, Horehajova, Neeser (2010)	Switzerland	Residential	Minergie	Voluntary	1998	Labelled to non-labelled	New build properties advertised on homegate.ch	2002-2009	1 173	Rental	+	n/a	6% net rent (i.e. minus running costs), 4.9% gross rent

8	Eichholtz, Kok, Quigley (2010, 2011)	United States	Office (commercial)	LEED, Energy Star	Voluntary	2000 (LEED), 1995 (Energy Star)	Labelled to non-labelled	CoStar transaction data. US EPA (LEED), USGBC (Energy Star).	2007 and 2009 for panel analysis, 2009 for snapshot analysis	Panel analysis: 694 Energy Star or LEED first rated in 2007 (rental only). Snapshot analysis of properties rated by 2009: 102 LEED and 293 Energy Star (sales), 209 LEED and 774 Energy Star (rental)	Both	+	11.1% (LEED), 13% (Energy Star)	5.8% (LEED), 2.1% (Energy Star). Effective rent: 6% (LEED), 6.5% (Energy Star).
9	Pivo, Fisher (2010)	United States	Office	Energy Star	Voluntary	1995	Labelled to non-labelled	Quarterly data from National Council of Real Estate Investment Fiduciaries. Transaction data for properties that had not been sold. US EPA data on Energy Star. Unclear whether rental value is all transaction data or also a mix of appraised and transaction value.	1999-2008	Unclear how many properties actually had an Energy Star	Both	+	8.5%	5.2%
10	Brounen, Kok (2010, 2011)	Netherlands	Residential	EPC	Mandatory	2008	Properties with different ratings (A-C compared to D-G)	Sales transaction data from the database of the Dutch Association of Realtors. EPC database by Agentschap NL.	January 2008 – Summer 2009	31 993	Sales	+	3.6%	n/a
11	Fuerst, McAllister (2011a)	UK	Different types of commercial property including offices	EPC	Mandatory	2008	Properties with different ratings (A-G)	Investment Property Databank UK Universe (appraised value, not transactions)	Current values as of April 2011	708 (293 retail, 226 office, 173 industrial)	Both	o	No evidence that EPC had an effect	No evidence that EPC had an effect
12	Fuerst, McAllister (2011b)	United States	Office (commercial)	LEED, Energy Star	Voluntary	2000 (LEED), 1995 (Energy Star)	Labelled to non-labelled	CoStar	1999-2008 (sales), Q4 2008 (rental)	127 LEED and 559 Energy Star (sales), 197 LEED and 834 Energy Star (rental)	Both	+	25% (LEED), 26% (Energy Star)	5% (LEED), 4% (Energy Star)
13	Fuerst, McAllister (2011c)	United States	Office (commercial)	LEED, Energy Star	Voluntary	2000 (LEED), 1995 (Energy Star)	Labelled to non-labelled	CoStar	1999-2009 (sales), Q4 2008 (rental)	87 LEED and 876 Energy Star (sales), 268 LEED and 1 846 Energy Star (rental)	Both	+	25% (LEED), 18% (Energy Star)	4-5% (LEED), 3-4% (Energy Star)
14	Bloom, Nobe, Nobe (2011)	United States	Residential	Energy Star	Voluntary	1995	Labelled to non-labelled	Transaction data from the county assessor's records matched with Energy Star Colorado data	1995-2005	150	Sales	+	\$8.66 per square foot	n/a
15	Addae-Dapaah, Su Jen Chieh (2011)	Singapore	Residential	Green Mark	Voluntary	2005	Labelled to non-labelled	Building and Construction Authority data on rated properties matched with the Urban Redevelopment Authority's Real Estate Information System	July 2005 – June 2009	34 projects (21 000 dwelling units)	Sales	+	9.2-27.8% depending on rating	n/a

16	Jafee, Stanton, Wallace (2011)	United States	Office (commercial)	Energy Star	Voluntary	1995	Labelled to non-labelled	CoStar combined with US EPA Energy Star information	2001-2010	141	Sales	+	13.4%	n/a
17	Yoshida, Sigiura (2011)	Japan, Tokyo	Residential	TGLSC	Mandatory (new or renovated >5 000m ²)	2005	Labelled to non-labelled	Transaction Price Information Service	2002-2009	1 472	Sales	-	-5.5%	n/a
18	Deng, Li, Quigley (2012)	Singapore	Residential	Green Mark	Voluntary	2005	Labelled to non-labelled	Building and Construction Authority data on rated properties matched with the Urban Redevelopment Authority's Real Estate Information System	2000 – June 2010	62 projects (18 296 dwelling unit transactions)	Sales	+	4%	n/a
19	Kok, Jennen (2012)	Netherlands	Office	EPC	Mandatory	2008	Properties with different ratings (A-C compared to D-G)	Leasing transaction data from real estate agents CBRE, DTZ Zadelhoff and Jones Lang LaSalle G4	2005-2010	1 072	Rental	+	n/a	6.5%
20	Reichardt, Fuerst, Rottke, Zietz (in press)	United States	Office	LEED, Energy Star	Voluntary	2000 (LEED), 1995 (Energy Star)	Labelled to non-labelled	CoStar	2000-2010	1 768	Rental	+	n/a	2.9% (LEED), 2.5% (Energy Star)
21	Kok, Kahn (2012)	United States	Residential	LEED, Energy, GreenPoint	Voluntary	2000 (LEED), 1995 (Energy Star)	Labelled to non-labelled	Internal documentation provided by USGBC (LEED), Build It Green (GreenPoint); local Energy Star rating agencies (Energy Star).	2007-2012	4 321 (1.6 million contro)	Sales	+	9% (+/-4%)	n.a.
22	ADEME (in press)	France	Residential	EPC	Mandatory	2008	Properties with different ratings (A-G)	Notaires database	?	?	Sales	?	?	n.a.

2.7.1.1 Year of publication

Table 2 gives an overview of papers published on the basis of the studies by sector and by year. We are not aware of any papers prior to Miller et al. (2007) and it is clear that there was an explosion of publications in 2010, mostly on the United States commercial (office) sector. The vintage of papers, at least as far as the commercial sector is concerned, tallies very well with the findings of Sayce et al. (2010) who conducted a major review of the global literature in this area published by June 2009, and found that three major studies had so far been published (Miller et al., 2007; 2008; Fuerst and McAllister, 2008; and Eichholtz et al., 2008; 2009; 2010a).

Table 2: Overview of papers published by sector and year of publication

	2007	2008	2009	2010	2011	2012	In press	Total
Office	1	3	1	4	5	1	1	16
Residential	0	2	0	2	4	2	0	9
Total	1	5	1	6	9	3	1	25

2.7.1.2 Location, segment and scheme

Table 3 gives an overview of studies reviewed by segment and location. There are more studies for the commercial segment than for residential buildings, and studies come from several locations. The single most important focus has so far been commercial property, and in particular offices, in the United States. As can be seen, only three studies were focused on the EPC scheme of the EU: one on the residential sector (Brounen and Kok, 2010; 2011) and two on the commercial sector (Fuerst and McAllister, 2011a; Kok and Jennen, 2012). A small number of studies have recently appeared on Asian residential property markets (Singapore and Japan).

Table 3: Overview of studies by segment and location

Location	Scheme	Office	Residential	Total
EU	EPC	2	1	3
United States	Energy Star, Green Point and/or LEED	10	2	11
Switzerland	Minergie	0	2	2
Singapore	Green Mark	0	2	2
Japan	Tokyo Green Building Programme	0	1	1
Australia	ACT House Energy Rating Scheme	0	1	1
Total		12	9	20

2.7.1.3 What did the studies compare?

This seems to depend on the type of labelling scheme. For studies based in jurisdictions where the scheme is voluntary (Energy Star, LEED, Green Mark, Green Point, Minergie) the principal focus is on comparing certified buildings to comparable non-certified buildings. For studies based in jurisdictions where the scheme is mandatory (EPC, ACTHERS, TGLSC) the principal focus is to compare value effects within the rating, that is, comparing different classes (Soriano, 2008;

Fuerst and McAllister 2011a), or groups of classes to each other (Brounen and Kok, 2010; 2011; Kok and Jennen 2012). Several of the studies based in jurisdictions where schemes are voluntary also examined the difference that the different levels of rating made.

2.7.1.4 Data sources

Interest in the relationship between energy (or wider environmental) performance and property value predates the present interest in linking the presence of a given certification scheme to value (Laquatra, 1986; Gilmer, 1989; Dinan et al., 1989). In principle of course, the presence of such certification makes life easier for those who want to conduct this type of analysis as certificates stand in for the relevant physical characteristics of buildings and thus render the analysis much simpler in as the researcher does not have to assemble a collection of building characteristics into an indicator of performance (Bloom et al., 2011). This reduces the data collection burden considerably. At the same time it raises the issue of the accuracy with which certificates of different types reflect performance and also whether the positive value effect (if it occurs) should be linked to the label or to the underlying physical characteristics, which are after all what matters. However, significant data collection challenges remain (Sayce et al., 2010; Fuerst et al., 2011; Lorenz and Lützkendorf, 2008a). Even if EPCs were perfectly implemented, this data challenge could hamper the identification of any effect.

Fuerst et al. (2011) set out three types of data that are required: firstly, data on market prices (rents and sales); secondly, data on environmental performance (of which energy consumption is an important part); and thirdly, data on the attributes of buildings (e.g. leases, specification, size, location etc.) – key in order to examine the importance of energy or environmental performance relative to other characteristics of the property that contribute to its value. The authors note that all three types of data may be obtainable from a single data owner or may be distributed among different organisations. A key issue is whether different types of data can be combined and matched in a single dataset.

It is noteworthy that all of the US-focused studies (with the exception of Pivo and Fischer (2010) and Kok and Kahn (2012)) relied on the CoStar database for transaction data, and that most relied on Environmental Protection Agency (EPA) data for the LEED and Energy Star information. The relatively early appearance of labelling schemes in combination with the ready availability of data in the United States has facilitated the study of the relationship between environmental performance labelling and property value in that country. This is in contrast with the UK, where BREEAM has been in operation since 1990 but the data is not widely available. This may help to explain why we did not identify any studies, other than Fuerst and McAllister (2011a), which try to link BREEAM ratings with property value effects.

Fuerst et al. note that “a heavy shroud of secrecy envelopes the data on EPCs” in the UK. They remark that this contrasts markedly with the situation in the Netherlands. It is therefore not surprising that the first two studies examining the price effects of EPCs on the basis of transaction data focused on the Dutch property markets (Brounen and Kok, 2010; 2011; Kok and Jennen, 2010). As noted above, the study by Fuerst and McAllister (2011a) of different commercial property types in the UK was based on appraised value rather than transaction data. It is important to note that the shroud of secrecy has now been lifted in the UK and the country is a leader in making EPC data available for research purposes.

The point here is that it is not only the implementation, but also a set of not inconsiderable data-related conditions that have to be met before the relationship between energy performance certification and property values can be studied with any degree of confidence in a given Member State. Fuerst et al. (2011) outline a number of the dimensions that are required to be fulfilled before the required data can be considered fit for purpose (lineage and provenance, availability, coverage and content). In most Member States, these are unlikely to be uniformly fulfilled across the three types of data required. Importantly in the context of the present study, a dimension of “availability” is how long it may take to make a given data set fit for purpose.

2.7.1.5 Sample size

The overview table at the end of this section shows the range of sample sizes in the studies. The maximum potential sample size is directly related to the total number of rated properties, and the “fitness for purpose” of the data.⁹ Even with a substantial number of properties rated in a given scheme, if the data is not what Fuerst et al. (2011) refer to as fit for purpose, the number of properties that can be examined will be reduced.

It should be noted that for most schemes the total number of rated properties, relative to total stock and transactions, remains very limited (Salvi et al., 2010; Reichart et al., in press). Table 4 below gives an overview of what is known about the number of units labelled within the schemes (other than EPC) covered in the 22 studies identified.¹⁰ The number of labelled properties is given in different “units” as they appear in the sources identified in the table. This is because it is not straightforward to translate them into a single format. Therefore we have kept a degree of heterogeneity. Table 4 does illustrate the point that so far a very small proportion of buildings, however counted, have been labelled. Oddly, in Yoshida and Sigiura (2011) the number of green condominium “observations” exceeds the total number of buildings that have been evaluated under the TGBP and therefore also the total number of possible green condominiums.

Table 4: Overview of total numbers of “units” labelled under different schemes

	New residential buildings	Residential housing estates	Non-residential buildings	Year of launch	Year of data point	Source
Energy Star	1 200 000	-	12 600	1995	2010	EPA, 2011
LEED	-	-	5 384	2000	2010	Reichardt et al., 2012
Green Mark	-	86	164	2005	2010	Deng et al., 2011
Minergie	13 800	-	1 200	1998	2009	Salvi et al., 2010
TGLSC	1 154	-	-	2005	2010	Yoshida and Sugiura, 2011

⁹ Guertler et al. (2009) reflect on the time it will take for the total stock of (office) buildings in the UK to be labelled. The authors remind us that the requirement to provide an EPC is triggered by a decision to sell or to let a property. They estimate based on modelling that by 2010 80% of commercial offices should have a certificate and by 2021 100% of commercial offices would be certified. The figure for 2010 now seems optimistic.

¹⁰ We are not aware of any aggregate data on total number of EPCs across the EU. Some information can be found in BPIE (2010, 2011) and other sources. We report on what is known about this in the various country chapters.

2.7.1.6 *Period*

This is the period covered by the transaction data analysed. This should fall within the timeframe of the operation of the scheme. The exceptions to this are Yoshida and Sugiura (2011) and Kok and Jennen (2012) where transaction data from prior to the operation of the scheme appears to have been included. The earliest sample dates from 1995 (Bloom et al., 2011), while the most recent is from 2012 (Kok and Kahn, 2012).

2.7.1.7 *Type of impacts studied (rental value or sales value)*

Table 5 shows some differences between the nine studies that looked at the residential sector, and the 12 studies that looked, with the exception of Fuerst and McAllister (2011a), exclusively at the office sector. The studies looking at the residential sector are, as we have remarked already, much more geographically diverse. However, they tend only to be concerned with the impact on sales, with the exception of Salvi et al. (2010) which examined the effect of the Minergie label on rental value. Studies looking at the office sector on the other hand mostly examine the impact of environmental/energy performance certification on both sales and rental value.

Table 5: Overview by type of impact studied

		Rental	Sales	Both	Total
Residential	Australia	-	1	-	1
	France	-	1	-	1
	Japan	-	1	-	1
	Netherlands	-	1	-	1
	Singapore	-	2	-	2
	Switzerland	1	1	-	2
	United States	-	2	-	2
Non-residential	Netherlands	1	-	-	1
	UK	-	-	1	1
	United States	1	2	7	10
Total		3	11	8	22

2.7.1.8 *Impacts identified, if any*

As can be seen from Table 1, in 19 of the 22 studies a positive impact on either rental or sales value or both was identified. The exceptions to this were Fuerst and McAllister (2011a), Yoshida and Sugiura (2011) and Eichholtz et al., (2010a).

► Residential property

The nine studies identified that were concerned with the residential sector were geographically diverse, covering six different locations and as many different schemes. Seven covered sales value and one covered rental value (Salvi et al., 2010).

Of the seven studies examining the impact on *sales value*, six found that the presence of energy/environmental labelling had a positive impact on the sales value and one study (Yoshida

and Seguirá, 2011) found that it had a negative impact. The seven studies covered six different schemes. The only studies covering the same scheme were Deng et al. (2012) and Addae-Dapaah and Su Jen Chieh (2011), both focused on the Green Mark Scheme in Singapore introduced in 2005. The effect found by Addae-Dapaah and Su Jen Chieh (9.2-27.8% depending on the rating) seems to have been at least twice that of Deng et al. (4%).

Of the seven studies, two looked at the effect of different levels of ratings within a given scheme, but taking different approaches to this, and the rest compared labelled to non-labelled property, but taking different approaches to reporting the data. It is therefore difficult to aggregate the studies other than to say that all, with one exception, point in the same direction.

Yoshida and Seguirá (2011) attribute a negative effect on sales to low marginal benefits of using costly new technology in a market where energy efficiency levels are already high, as well as to the risk of potentially higher maintenance costs of certified buildings (Fuerst and McAllister, 2011a). Fuerst and McAllister (2011a) suggest another potential explanation might be that higher energy efficiency is used to make up for perceived negative features such as inferior location or low reputation of the developer in a way that is not captured by the pricing model (omitted variable bias).

Only one study (Salvi et al., 2010) addressed the link with *rental value*. This study also found evidence of a positive effect of energy/environmental performance labelling on residential property value.

► Non-residential property

The twelve studies identified that were concerned with the non-residential (office/commercial) sector were geographically a lot more homogeneous, with ten studies focusing on the United States, one study on the Netherlands and one study on the UK.¹¹ Ten studies looked at sales value and ten studies looked at rental value (most looked at both).

Of the ten studies examining the impact on *sales value*, nine found that the presence of energy/environmental labelling had a positive impact on the sales value and one (Fuerst and McAllister, 2011a) found that there was no evidence of an impact, either positive or negative. One study (Eichholtz et al., 2010a) found evidence of a positive link for Energy Star but not for LEED. Fuerst and McAllister (2011a) was the only study identified addressing the link between energy/environmental performance certification and the sales value of commercial property outside the United States, and is the first to examine the impact of EPCs on the sales value of commercial property in the EU.

The United States studies indicate quite a significant range of values both for LEED and for Energy Star. As far as the impact of LEED rating is concerned, this ranges from Eichholtz et al. (2010a) who found no significant relationship, to Fuerst and McAllister (2011b; 2011c) who found 25% in what appears to be two near-identical studies (appearing to differ only by the inclusion of

¹¹ Kok and Jennen (2012) in a recent paper assert that in contrast to the United States, studies of the European (commercial) property market have thus far been hindered by the slow diffusion of heterogeneous labelling schemes and the lack of centralised transaction data.

an additional year of data).¹² As far as the impact of the Energy Star is concerned, the range is a little smaller from 5.8% (Miller et al., 2008) to 26% (Fuerst and McAllister, 2011b).

In their examination (based on appraised values) of whether there is any identifiable impact of EPCs on the sales price of commercial property, Fuerst and McAllister (2011a) did not find evidence that the EPC was “yet” having the effect on sales value “that would be expected if EPC ratings were both indicative of the actual energy consumption in a property and readily available at the outset of a transaction and, subsequently, taken into account by prospective tenants and buyers” (p. 6 614). It is worth remembering that this study was based on appraised values and not transaction values. Appraised values are retrospective and lag behind transacted values. Thus a weak signal from a (so far) weakly implemented EPC would be further weakened by using appraised values.

Of the ten studies examining the impact on *rental value*, nine found that the presence of energy/environmental labelling had a positive impact on the rental value and one (Fuerst and McAllister, 2011a) found that there was no evidence of an impact, either positive or negative. One study (Eichholtz et al., 2010a) found evidence of a positive link for Energy Star but not for LEED. Kok and Jennen (2012) and Fuerst and McAllister (2011a) were the only studies identified addressing the link between energy/environmental performance certification and the rental value of commercial property outside the United States. They are the first to examine the impact of EPCs on the rental value of commercial property in the EU (the Netherlands and the UK respectively).

The United States studies indicate quite a significant range of values both for LEED and for Energy Star, although the range is smaller than for sales values. As far as the impact of LEED rating is concerned, this ranges from Eichholtz et al. (2010a) who found no significant relationship, to Wiley et al. (2010) who found 15-18%. As far as the impact of the Energy Star is concerned the range was 2.1% (Eichholtz et al. 2010b; 2011) to 11.6% (Fuerst and McAllister 2008).

The two studies that looked at rental values in the Netherlands (Kok and Jennen, 2012) and the UK (Fuerst and McAllister; 2011a) reported quite different findings. As for the impact on sales values, Fuerst and McAllister found no evidence that the EPC was yet having the kind of impact that would be expected (see above reporting the results in relation to sales). However, Kok and Jennen find a 6.5% premium of A-C rated properties relative to D-G rated properties. While what is compared is thus not identical in the two studies, we can still see that one identified an effect and the other did not. It should be noted that Kok and Jennen’s study is based on a much larger sample of properties and is based on transacted values and therefore on this basis may be considered as more robust.

Fuerst and McAllister, in addition to the problem with appraised values cited above, suggest that it is possible that the information contained in the EPC is not adequately considered by tenants in rental transactions, either because the EPC is not made available to tenants or because tenants are unaware of the availability of the information or because tenants discount the information as less relevant, possibly because energy costs typically only make up a small fraction of a

¹² While most of the studies report their results in percentages, this is not the case of Wiley et al. (2010) who reported in \$/square foot. We have therefore not integrated their results in the ranges given here.

company's cost base (see also Guertler et al., 2009). They also suggest that a further potential explanation is that the commercial rental market is less responsive to variations in energy efficiency across properties than the residential market due to the prevalence of owner occupation in the residential segment (in the UK). Regardless of potential cost savings, tenants might be less concerned with the structural and energy efficiency features as they merely “use” and do not own the property (principal-agent or in this case landlord-tenant problem) (p. 6 614).

2.8 Preliminary expectations about the relationship between EPCs and property value

Many actors are interested in and expect differences in energy performance to be reflected in the value of property. One of the barriers to this happening has been the lack of visibility of this characteristic of property at the time of sale or rental. Information provision through energy performance labelling can help render the differences between otherwise comparable properties more readable, enabling market actors to act on this information when they perceive it to be salient to them. The provision of information through energy performance labelling is a necessary but not sufficient condition for the market to take account of relative energy performance. Other barriers to improving energy performance will remain, and require addressing. Energy performance labelling is best seen as part of a wider suite of policies deployed together to transform property markets, and will be most effective if integrated into such a strategic market transformation framework.

The relationship between energy performance and property value predates the EPBD. However, systematic rating of properties makes it easier to assess this link provided that certification reflects the fundamentals of energy performance. The longstanding nature of sustainability rating schemes in the United States and the availability of fit-for-purpose data has facilitated a number of studies of the relationship between value and sustainability rating in the United States office market since the late 2000s. Other jurisdictions where studies have been conducted include Australia, Japan and Singapore. In Europe, a small number of studies have been conducted on the Minergie label in Switzerland.

Three studies are currently available that examine the relationship between energy performance rating under the EPBD and property value. Two of these were on the Dutch property market (residential and commercial) and one on the UK property market (a selection of commercial property). Only the Dutch studies were based on actual transaction data. While the overwhelming majority of studies show that there is a positive link between property value and sustainability/energy rating, there are thus to date only really two studies on the European property market that have been based on transaction data. Both of these are based on Dutch transaction data. Both studies identify a positive effect (3.6% on residential sales, controlling for the quality of the dwelling (Brounen and Kok, 2011), and 6.5% on office rental (Kok and Jennen, 2012)).

The overwhelming majority of studies conducted so far are based on a comparison between labelled and non-labelled properties in the context of voluntary schemes. The three studies on the European EPCs and the study on the Australian ACTHERS are exceptions. The dynamics of

value attribution are likely to be different when the entire market is labelled as opposed to those of the top-performing part of the market, which has invested in the rating process on a voluntary basis. There is therefore some reason to be cautious about extrapolating in a very direct way the results of studying schemes such as Energy Star and LEED to what is happening as a result of the introduction of EPCs.

Further studies are in progress in a number of countries. For example, at the time of writing ADEME is carrying out a study on the effect of EPCs on prices in France. Preliminary results have been published (ADEME et al., 2011) with a final report due in 2013.

This page is intentionally left blank.

Chapter 3: Assessment of EPC schemes

3.1 Introduction

The EU framework for energy performance labelling of buildings and the implementation of Member State legislation should be seen as a *potential* which requires change in the normal practices of a substantial number of different actors such that information about the energy performance of buildings is integrated into the practices of market actors. The *quality* of implementation in Member States is therefore of key significance. This is what to a large extent determines how much of the promise of energy performance labelling can be delivered. The way in which implementation is carried out can therefore either diminish or amplify the potential effect of energy performance labelling in the property market.

The purpose of this chapter is to assess the quality of implementation in the case study Member States and regions. A quality checklist with key indicators for EPC schemes and their role for indicating future property values was established to allow differences in national certification schemes in the countries concerned to be described, in particular insofar as they could have an impact on the outcome of the regression analysis later in the study. Examples of the parameters to be compared are the date of entry into force of the certification scheme; quality and quality control; point in time at which the information is revealed to the interested buyer/tenant. An overview of “points for attention for the implementation of the EPC scheme” (BPIE, 2010) by the Buildings Performance Institute Europe was also taken into account.

The challenge is to identify the elements in the implementation of EPC schemes that are necessary, if not sufficient, for there to be a “consumer response”, be it in the residential, non-residential, sales, rental, existing or new construction markets. As such, the purpose here is not to set up a quality checklist that assesses all of the elements in the scheme, but to investigate those factors that at a minimum need to be in place to facilitate a response by the buyer/renter. We are therefore not investigating the presence of supporting schemes that may enhance the impact of the scheme; that could provide an interesting avenue for further research.

3.1.1 Existing studies of implementation across Member States

It is not surprising, given the number of Member States and the complexity of the EPBD, that relatively few comprehensive studies have been made of implementation. The first, as far as we are aware, was the European Energy Network 2008 report based on a survey of national energy agencies in 22 Member States (and Norway) (European Energy Network, 2008).

A recent in-depth and comprehensive report regarding the requirements on energy performance certification is BPIE (2010). This was an attempt to extract lessons from the experience so far and was written with the designer of EPC schemes in mind. Another more recent report from BPIE, the 2011 *Europe's Buildings Under the Microscope – a country by country review of the energy performance of buildings* is more interested in the state of the building stock in the EU and only in policy as a context for this. It does nevertheless contain some interesting information with

bearing on this study. BPIE has also recently launched the website www.buildingsdata.eu, which contains regulatory overviews by country. A similar initiative at international level is the BEEP website of the International Energy Agency (www.sustainablebuildingscentre.org/pages/beep).

A 2010 publication by the Concerted Action - EPBD (CA-EPBD) project was dedicated to reporting on the discussions among Member State implementation practitioners across the EPBD, including energy performance certification. This project also produced country reports on the implementation of the EPBD for all Member States.

The Intelligent Energy Europe project IDEAL EPBD investigated the consumer response to energy labels in residential buildings in five countries, and provided recommendations for improvements in the EPBD and the certification process for all ten participating countries. The most comprehensive report (BPIE 2010) only contained country reports on ten Member States, and while BPIE (2011) covers all Member States, there is little detailed information about energy performance certification as such. Backhaus et al. (undated) conducted a study of the effectiveness of energy performance certificates focusing on the consumer response in ten case study countries. Table 6 below shows the extent to which the Member States and regions in this study were included in those studies.

Table 6: Overview coverage of potential cases in multi-country studies

	Austria	Cyprus	Flanders	France	Ireland	Portugal	UK
BPIE (2010)	X		X	X	X	X	
BPIE (2011)	X	X	X	X	X	X	X
CA (2010)	-	-	-	-	-	-	-
IDEAL EPBD (2011) – recommendations	-	-	-	-	-	X	X (England)
IDEAL EPBD (2011) – interviews	-	-	-	-	-	X	X (England)

The rest of this chapter is structured as follows: Section 3.2 identifies the de minimis elements that need to be in place to ensure a market response. Section 3.3 translates these into a set of questions that form the assessment of EPC schemes. Finally, Section 3.4 offers some concluding remarks. Annex A gives an overview of what the EU level legislation (Directives 2002/91/EC and 2010/31/EU) requires of Member States.

3.2 De minimis elements that need to be in place to ensure a market response

In Chapter 2, we outlined how the purpose of labelling schemes is to address information market failure, and how labels are best thought of as part of a broader set of policy measures. We also noted that energy performance labelling is a well-established policy instrument that is applied to a range of “products”, not only buildings but also energy-related equipment and appliances. In their 1998 review of the first three years of the European energy label for appliances, Winward et al. made some observations that are also of interest in the context of the present study. Noting that “the issue of real interest is the proportion of consumers who actually change their buying

behaviour as a result of the Labels” and that “it is only by changing their purchasing patterns that consumers demonstrate that the Energy Label policy is working and that energy is being saved” they observed that “the link between the Label and actual purchasing behaviour depends upon a complex interaction between:

- the proportion of appliances fully labelled in the shop;
- consumer understanding of the Label;
- consumer concern about appliance energy use;
- consumer concern about the environment;
- trust in the information on the Energy Label.”

If we replace “appliances” with “buildings” this would also seem to describe the preconditions for potential buyers and renters to take account of the energy label.¹³ It is beyond the scope of the present study to conduct the consumer surveys and interviews with manufacturers and retailers across Member States, as well as testing of the presence of the label in the shops and the accuracy of the label, that were involved in the evaluation of the first three years of the appliance label. But we use the bullet points above to orient our own selection of key indicators, modifying some of the points to take into account the process for buying or renting property and the way in which this differs from the purchase of appliances.

In essence the proposition is that for the buyer/renter to be able to react, the information on the label needs to be made available at an appropriate moment in the purchasing decision. For the buyer/renter to take account of this information, they must be able to understand it. In order to act on this information they must care about the energy consumption of buildings (for whatever reason), and this is more likely to be the case if they care about the environment. Finally, although the information on the label may be available at the most appropriate moment in the purchasing decision, and although the consumer understands and finds energy consumption salient in their purchasing/rental decision, if they do not trust the information, they will still not act on it. On this basis we set up a list of questions about the way in which the EPC scheme has been implemented in each Member State or region.

3.3 Assessment of EPC schemes

In this section we reinterpret the questions asked of the appliance labelling scheme after its first three years of operation by Winward et al. (1998) in light of the buildings sector. We place this in dialogue with Table 1 “Points of attention for the implementation of the EPC scheme” in BPIE (2010) so as to organise this according to the logic of a market response, as opposed to a to-do list for those designing EPC schemes. IEA (2010) contains a similar list. The focus of the present study of building energy performance certification is somewhat narrower than the Winward et al. study. The former covered the EU-15 and included two consumer surveys, in-depth interviews

¹³ This is not very far from the observation made by Tigchelaar et al. (2011) that to be successful some preconditions with regard to the EPCs should be fulfilled. Homeowners should: be aware of its existence; understand the information on it; trust the information on it; find the information useful; be motivated to implement recommendations for energy efficiency improvements on it.

with manufacturers and with retailers, as well as independent testing of the accuracy of the label, and the presence of the label in the shops. While it did have an explicit theory of how the label was supposed to affect the market, and that this would lead to a positive impact on the price of appliances with a higher rating, there was no analysis of sales data in the way that forms the central purpose of the present study. Thus we will have to be less ambitious about the data collected in support of the different areas of enquiry that we have borrowed from Winward et al.

3.3.1 Presence of the label

Clearly the first question of importance will be the extent to which an EPC is available (and indeed even promoted) to the interested buyer (or tenant) at an appropriate moment in time for the prospective buyer/tenant to be able to integrate the information on the EPC into his or her decision-making process. This will depend on when the relevant national legislation was brought into force for what building types; the rate at which property is transacted and of course compliance with the requirements to provide a certificate when property is transacted; what the regulations say about when in the buying or rental process the EPC should be made available to the interested buyer or renter;¹⁴ who is responsible for making it available; and finally, how this turns out in practice.

The process of buying or renting property is different from the process of buying energy-using products. Moreover, there will be variations along the following dimensions:

- Residential / non-residential;
- Public sector / private sector;
- Within the commercial sector, different types of commercial space;
- Rental / purchase;
- New built / existing.

In addition there will be the particularities of national practices. This clearly gives rise to a number of different possible permutations.

We can define a set of questions that together give an indication of the extent to which the EPC is presented to the potential buyer/renter at all, and if so, whether this is at an appropriate moment in time:

- ▶ Questions for the assessment
 - When did the scheme come into force for which segments of the property market?
 - What is known about the proportion of properties, as a proportion of total rental or sales transactions, that were actually certified?

¹⁴ The point in time at which the information given on the EPC is revealed to the interested buyer/tenant is particularly important because it is only if the information is given up front that potential buyer/renters will be able to filter potential properties on the basis of energy performance, and conversely that potential sellers/letters of property will be able to distinguish their properties in the market on these grounds. Tigchelaar et al. (2011) note that “often an EPC is not available or not shown before buyers make an offer”.

- What is the legal obligation as to when the information in the EPC should be made available?
- What information is available about what actually happens in practice (regarding timing)?

3.3.2 Understanding of the label

Even if the (full) EPC is made available at an appropriate point in the sales or rental process, it will be necessary that the interested purchaser or renter can understand the information. Many, but not all, Member States have gone for a format that closely resembles appliance labels. CA-EPBD (2010) obtained information about the layout and content of building certificates in different Member States. There are generally two types of labels: stepped labels (e.g. Ireland, Denmark, Sweden) or continuous coloured band strips (e.g. Germany, Italy).¹⁵

According to CA-EPBD, the units used in different Member States to identify energy performance also differ. At a minimum, primary energy in kWh/m² is required under the recast Directive. However, labels in some Member States also provide CO₂ emissions in kg/m² per year or delivered (final) energy. Member States also vary as to whether calculated energy performance or measurements are used.

Given the multiplicity of approaches under the 2002 and now recast Directives, information on whether EPCs and the recommendations for improvements are understood either in general or in specific Member States, and indeed in market subsections would therefore be valuable.

▶ Question for the assessment

- What information is available about buyer/tenant understanding of the EPC?

3.3.3 Concern about energy use and environmental impact when selecting a property

The relative importance of energy use compared to other features of an appliance was one of the topics investigated by surveys of consumers in the EU-15 in Winward et al. (1998). Consumers who had bought a cold appliance in the last 12 months were asked to rank the importance of different features in a cold appliance when making a purchase decision. It should be noted that this is quite different from the many willingness-to-buy type surveys that investigate future intentions (Sayce et al., 2010). We are only aware of one study that has sought to identify post hoc the relative importance of different property features in the decision to rent or buy in a similar way to the interviews with consumers who had bought an appliance in the last 12 months (Lainé, 2011b). That study focused on UK residential buyers/renters. However, even if case-study specific information may turn out to be limited, we can still paint a high-level picture that broadly

¹⁵ Tigchelaar et al. (undated) found evidence that homeowners may have more trouble understanding the continuous scale than the stepped label. This was based on a comparison between the number of homeowners reporting having trouble understanding energy efficiency provided by their EPCs compared to homeowners in other countries.

and briefly distinguishes between the relative importance of energy outlays for the residential sector versus the non-residential sector, and in particular the office sector.

Concern about energy consumption and concern about the environment can both affect buying decisions. And indeed the two concerns can be related in the consumer's mind (Winward et al. 1998, p. 47). As with concern about building energy use, we may assume a positive link between concern about the environment and the propensity to take account of information about energy performance of property when making a purchasing or rental decision. Again, we are not aware of any studies that examine, post hoc, concern about the environment or environmental features in completed transactions by asking buyers/renters about the role that environmental aspects played in the selection of a particular property. Instead we use the results of the latest Eurobarometer (EC, 2011b) survey of the attitudes of European citizens to the environment as an indicator.¹⁶

► Question for the assessment

- Is there information available about the role of energy use or environmental impact as dimensions of the purchasing decision?

3.3.4 Trust in the information on the energy label

Information has to be available at the right moment in the decision-making process, understandable, salient and trustworthy, in order to be taken into account in decision making. Therefore, our final assessment area concerns the issue of trust in the EPCs in the case study countries and regions. This, together with the question about “understanding”, helps to unlock some of the issues around market reception of the label.

In this way, we gauge something of the public debate and the debate among the relevant professionals to understand whether the climate is on the whole one of trust or not. In other words, whether there has been a debate about the trustworthiness of the label and if so what are some of the main themes this has evoked and is it possible to say something about the prevailing climate vis-à-vis EPCs in a given Member State (that may have a bearing with respect to renters/buyers acting on the information). We also examine whether the building blocks for trust are in place especially in terms of the provisions for quality assurance of certification.

CA-EPBD (2010) provides, on the basis of data collected during 2008 and 2009, an early overview of Member State practices in this respect. By the end of 2008, 15 of the Member States surveyed already had a quality assurance scheme in place or were planning to have one. Most of these were mandatory, with only three Member States planning to introduce a voluntary scheme. It is a little unclear from CA-EPBD whether these schemes necessarily applied to both new and existing buildings on the one hand, and both residential and non-residential on the other. CA-EPBD makes the observation that as the schemes mainly depend on national frameworks, the approaches and infrastructure vary greatly (e.g. in terms of structure, funding, parties involved and building survey systems).

¹⁶ See http://ec.europa.eu/environment/working_en.htm.

► Questions for the assessment

- Has trust been an issue in public debate about the introduction of EPCs?
- If so, what themes have been evoked?
- Are the building blocks of trust in place, in particular in terms of provisions for quality assurance of certification?

3.3.5 Assessment questions

Box 1 below brings together the questions developed above, to be applied to the case study Member States and regions.

Box 1: EPC scheme assessment questions

Presence of the label

- When did the scheme come into force and for which segments of the property market?
- What is known about the proportion of certified properties as a proportion of total rental or sales transactions?
- What do the regulations say about when the information in the EPCs should be made available to potential buyers or renters?
- What actually happens in practice (regarding timing)?

Understanding of the label

- What information is available about buyer/renter understanding of the EPC?

Concern about energy use when selecting a property

- What is the role of energy as a dimension of the purchasing decision based on purchases made?

Concern about environmental impact when selecting a property

- What is the role of environment as a dimension of the purchasing decision based on purchases made?

Trust in the information on the label

- Has trust been an issue in the public debate about the introduction of EPCs?
- If so, what themes have been evoked?
- Are the building blocks of trust in place, in particular in terms of provisions for quality assurance of certification?

Hypothesis regarding likely impact of EPC on property value

- In light of the above, what should we anticipate about the influence of EPCs on the value of property so far?

This information is not readily available in all case study countries and regions and so has been complemented by information from interviews with officials and experts, carried out in June/July 2012, together with additional sources revealed in the interviews. Each interview ran through a core set of questions designed to enable a preliminary hypothesis of the extent to which we are likely to be able to identify a value effect relating to EPCs. The information gathered is presented in later chapters of this report.

The challenge of getting “fit-for-purpose” data (Fuerst et al., 2011) for hedonic regression analysis has proven significant (see next chapter). Similarly, the availability of information on the quality of implementation also varies. The approach we have taken is to gather as much information as possible on each of the case study countries and regions, and to seek to cover as many of the segments of interest to the Commission as possible. While the information available on the quality of implementation often differentiates between the residential and non-residential segments, it less often differentiates between the rental and sales segments or the new and existing segments. Where the information is not disaggregated by segment it is because the information was not available in a disaggregated fashion.

Chapter 4: Data gathering and econometric model

Note: This chapter provides an overview of our approach to assembling a database combining EPC data with transaction price/rent data and large enough to allow robust conclusions to be drawn from the econometric analysis. More information on the final datasets used is provided in the relevant country/region chapters, while further sources that were examined but not retained are described in Annex D.

4.1 Creating a combined dataset

The central issue for each country and region is the extent to which energy certification information is readily available and includes an address. Once both key conditions are met, a sample of properties can be built up that should be large enough to econometrically test for the effect of a better energy rating.

For Ireland for example, energy certification information is already included in the database of transaction data (from the website Daft.ie), as listings include EPC codes when provided by the advertiser. This gives a sample of around 10-12 000 properties each in sales and rentals for the years until 2012. For France, the energy rating is incorporated in the data provided by the *Notaires*. For the UK on the other hand, transaction data from Land Registry had to be matched to data from the official EPC register to create a combined dataset.

In general, the bridge between the EPC databases (energy ratings) and the transaction databases (size/type, location at minimum) is the property's address as a unique common identifier (in future it may be possible to avail of services that allocate a unique identifier to every building¹⁷).

4.1.1 EPC data

Two reports mentioned earlier in this report were useful in beginning to identify data sources. First, the CA-EPBD project's overviews of the implementation status in different countries as of November 2010;¹⁸ second, the December 2010 BPIE study on the implementation status of EPC schemes in 12 EU countries (Austria, Belgium, France, Ireland and Portugal and others). The studies reveal, and this report has confirmed, that there is a lot of variation in the implementation of EPCs in different EU countries and regions. Database management also varies from country to country. A central database is considered best practice but often these have not yet been set up.

¹⁷ For example, for Ireland see www.geodirectory.ie.

¹⁸ See www.epbd-ca.org.

The primary source of the EPC data needed should have been these national and regional databases and registers, where they exist. However, data availability in practice is very poor. For example, even when ostensibly public, EPC registers can sometimes only be accessed for a fee or one record at a time. Data protection legislation is most often cited as the reason (a logic that is not very coherent with the requirement to include the EPC in all marketing of properties for sale or rent).

Greater data transparency should be encouraged. EPCs can provide valuable information to all stakeholders in the building sector and property market, not least policy makers. Data gathered through EPCs can serve as an input into the calculation of potential energy savings, building stock projections, compliance, policy design and – in the case of this study – evidence for (or against) a link between the energy rating of a building and its value on the market.

4.1.2 Data on transactions

Sales and rental data are held by a variety of public and private stakeholders: associations of real estate agents, at national and international levels, chambers of commerce, private websites, national registries, etc. Note that gifts and exchanges are not recorded anywhere and so not included in this study.

Several commercial property advertising websites were contacted. For Ireland, the project team obtained data directly from Daft.ie. However as such websites generally cannot provide their data in a convenient format, data can also be automatically extracted or “scraped”. Technically, this requires some programming, e.g. using Python or R.

Dr Konstantin Kholodilin of the German Institute for Economic Research (DIW Berlin) had done this for a recent paper in which he constructed a dataset of Internet offer prices for flats in 48 large European cities in 24 countries.¹⁹ Data were collected from websites where advertisements for flats for sale are placed. The codes for data downloading are written using an open-source statistical software called R. The data were downloaded at monthly frequency in the period from January to April 2012. Kholodilin extracted data on EPCs from the advertising websites he used in that previous work for use within the framework of this study. To do so, he some further work in R was required to include EPCs in the database. The countries for which this was possible are Austria and Belgium. Data collection was run until the end of November in order to have a larger sample.

Note that property advertising websites provide listed selling prices rather than final transaction prices. Properties listed for longer without successful sale or lease may be associated with lower transaction prices, everything else being equal. This may understate the effect of energy efficiency on property market outcomes if energy efficiency is positively correlated with general property quality and quality in turn is positively correlated with faster sale or lease.

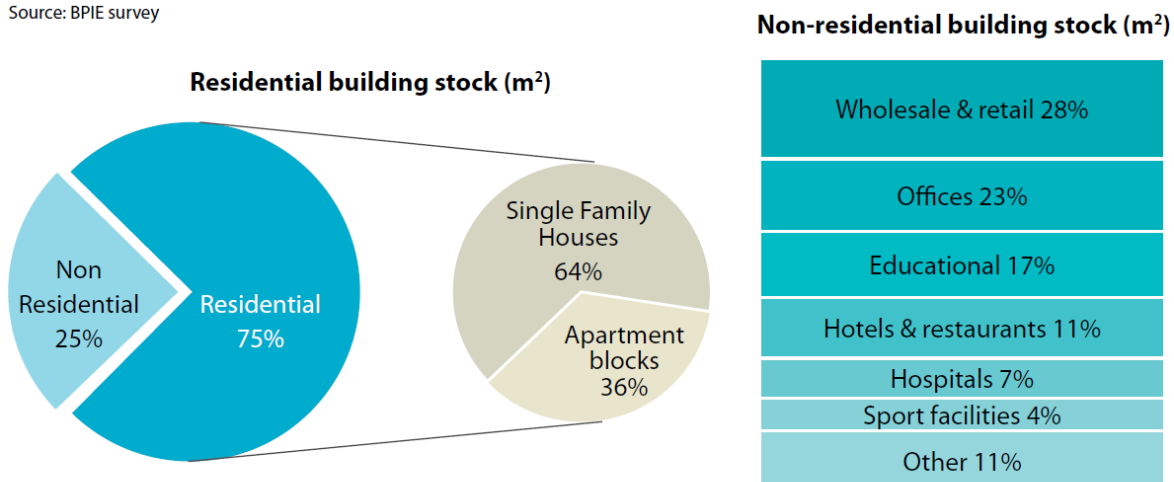
Bearing in mind the lack of availability of data on EPCs and transaction prices, we tried to analyse as many countries/regions/cities, segments (new/old, sales/rental, etc.) and drivers (urban/rural,

¹⁹ *Internet Offer Prices for Flats and Their Determinants*, www.diw.de/documents/publikationen/73/diw_01.c.401712.de/dp1212.pdf.

climate, label/rating etc.) as possible. We focus on residential properties both because we found that this is where the greatest gap in the literature is, and for the practical reason that the number of EPCs issued for non-residential buildings is still very low. Residential housing accounts for around 75% of the European building stock (BPIE, 2011) (Figure 2), while compliance rates for offices and other non-residential buildings (schools, hospitals, etc.) tend to be significantly lower (one reason may be that such buildings are usually more complex).

Figure 2: European buildings at a glance²⁰

Source: BPIE survey



The final set of analyses covers rental and sales markets, urban and rural segments, warmer and colder climates, and the following locations: Austria (Vienna and Lower Austria), Belgium (Flanders, Wallonia and Brussels-Capital regions), France (Marseille and Lille urban areas), Ireland (comprehensive coverage) and the UK (Oxford and surrounding region). We also assessed the EPC schemes of Cyprus (Annex B) and Portugal (Annex C) but did not make a quantitative analysis for those countries.

4.2 Establishment of an econometric model

The core model used in this study is a standard hedonic price regression, where the price (sales or rental) of an individual property is explained as a function of a series of attributes, such as size, number of bedrooms/bathrooms, location, etc. This regression technique breaks down each property into constituent services (embodied in its attributes) and then uses samples of properties to consistently estimate the price of each attribute.

In the hedonic regression, whose general functional form is shown below, the size of the coefficient on each variable represents the value each characteristic contributes to overall value:

$$p=f(h,l,c)+\epsilon$$

In the formula above, p refers to the price of the property, h is a vector of house/apartment characteristics, l is a vector of location characteristics, c is the EPC energy rating and ϵ is the error

²⁰ BPIE, 2011.

term. The coefficient on the c vector should give an estimate of the implicit value of a more energy efficient home.

For each country or region in the chapters that follow, regressions are run that explain a property price (sales or rental) as a function of:

- **location fixed effects**, as granular as possible, to account for location-specific and population-specific attributes affecting the price;
- **date/period the property was listed/transacted**, typically done quarterly, to account for changing market conditions over time – an important consideration given the history of some EU property markets over the past decade;
- **house size and type attributes**, and other quality-related attributes other than energy performance, including surface area (where recorded, or bedroom/bathroom numbers elsewhere), whether it is an apartment, detached home or other type of property, and the age of the property (where available);
- **energy efficiency attributes of the property**, including whether it had a rating at all (used in the first stage of the Heckman), what that rating was (categorical scale), the date of the rating relative to the market transaction or listing (if available), and whether the rating was known to the purchaser (if relevant).

The first three sets of variables effectively ensure no conflation of the effect of energy efficiency with the effect of variables potentially correlated with it, such as size or age. The final set of variables captures the effects of interest in this study: the effect of improved energy efficiency on a property's value, whether this is affected by the age of the rating and whether purchasers who do not know the exact rating factor in energy efficiency into their price.

Where datasets predate the introduction of energy ratings, if the sample size of repeat sales had permitted, it would also have been possible to examine the extent to which energy efficiency is incorporated with and without the rating.

Chapter 5: Austria

5.1 Assessment of the EPC scheme

5.1.1 Presence of the label

- a) *When did the scheme come into force for which segments of the property market?*

Table 7: Introduction of EPCs in Austria

Property type	Date of entry into force
All buildings except public buildings	May 2008
Public buildings	January 2009

- b) *What is known about the proportion of properties (as a proportion of total rental or sales transactions) that were actually certified?*

According to BPIE (2010), EPCs (*Energieausweis*) are not systematically issued at the moment of transaction as there is no enforcement of the obligations. The interview did not yield data on this, only anecdotal information on the residential sector confirming that a low proportion of transactions in Austria was accompanied by an EPC: as long as buyer/renter and prospective seller/landlord could agree that there was no need for the EPC, then the transaction did not in fact have to be accompanied by an EPC. For new construction (and major renovations), the EPC needs to be submitted to the public authority as part of the permitting process, and provincial energy agencies verify that the buildings comply with the certificate level, thereby implying an EPC is delivered for each building.²¹

This suggests that only for a small proportion of property transactions could the information on the EPC have been part of the decision-making process, thus limiting the impact of the scheme on property values overall. It should be noted that as part of the implementation of the recast EPBD, the requirements of the Austrian legislation have been amended and an update of the requirement to provide an EPC came into force as of 1 December 2012. However, the legislation still states that an EPC shall be provided to the buyer (therefore only for sales transactions) within 14 days *after* signing the contract – too late to affect the decision. Implementation at regional level²² will have taken some additional time.

²¹ This is to demonstrate compliance with minimum building performance standards and where a subsidy is sought to demonstrate performance in excess of legally mandated minimum performance standards.

²² In Austria, regions (*Länder*) have responsibility for implementation of the EPBD.

- c) *What do the regulations say about when the information in the EPCs should be made available?*

According to CA-EPBD (2010) the owner must “present a valid certificate to the building authority or to the buyer when the selling or renting contract is established.” For new construction and major renovations, there is a description of how first a temporary and then a final certificate is produced and finally uploaded to the central database of the province or of Statistics Austria. The regulations simply require the EPC to be presented at the time of establishing the contract. This interpretation was confirmed by interview.

- d) *Is there any information available about what actually happens in practice (regarding timing)?*

The interview suggests that in a minority of cases where an EPC does accompany a transaction, this enters into the process close to or at the time of establishing the contract. The combination of the very low proportion of transactions that are accompanied by an EPC and the late stage at which the EPC is made available to the prospective buyer/renter severely limits the impact of the EPC on the market as a whole.

The proportion of transactions accompanied by an EPC has been changing in the regions and in Austria as a whole with the new requirements under the recast EPBD. However, there is a need to understand how the EPC will interact with different procurement processes. Prospective residential (and small business) clients do not “shop” for property in the same way that e.g. large corporations do. The challenge is to ensure that the information made available through the EPC is integrated as much as possible into market practices. This means understanding what the procurement process is in different market segments and fitting the EPC into the process to gain most effectiveness.

5.1.2 Understanding of the label

- a) *What information is available about buyer/renter understanding of the EPC?*

In Austria, implementation of the EPBD involved harmonisation of nine different provincial building codes and various pre-existing energy certificates. The energy rating of the current Austrian certificate still shows heat demand. As part of the implementation of the recast EPBD, the first page will also show primary energy and CO₂ emissions.

In some Austrian *Länder*, more than 50% of residential buildings benefit from support that provides energy consulting including a comprehensive explanation of the role and function of EPCs. This has a very positive effect on public awareness.

Nevertheless, according to BPIE (2010), the Austrian EPC is “not transparent” and does not give building owners very useful information, despite being very detailed and complicated. Recommendations to improve energy efficiency are not always given and are not always clear. BPIE observes that the limited transparency and limited practical usability of the EPC for the building owner creates a barrier to its use and affects public acceptance. This suggests that buyer/renter understanding of the EPC in Austria is likely to be limited.

5.1.3 Concern about energy use and environmental impact when selecting a property

- a) *Is there information available about the role of energy use or environmental impact as dimensions of property selection?*

Tigchelaar et al. (2011) did not include Austria, nor did the interview for Austria shed light though there was some anecdotal evidence that in the office segment, operating costs are becoming more important. The most recent Eurobarometer survey relating to the attitude of Europeans to climate change (EC, 2011b) is shown in Table 8 as part of the broader societal context to the property market in Austria.

Table 8: Attitudes to climate change in Austria and Europe²³

Question	Austria	EU-27
% of respondents placing climate change as the most important problem facing the world	19%	20%
Seriousness of climate change on a scale of 1-10 (average ranking)	7.7	7.4
% of respondents having insulated their home to reduce energy consumption	13%	18%
% of respondents having bought a low-energy home	1%	3%

5.1.4 Trust in the information on the label

- a) *Has trust been an issue in the public debate about the introduction of EPCs? If so, what themes have been evoked?*

The interview for Austria suggests that trust has not been an issue in the public debate around the introduction of the EPC, nor among the estate agent profession, but that the replicability of the EPC is being discussed by a smaller number of building scientists and technical experts. Apparently, different assessors may get different results when they assess the same buildings, in part because the price charged for an EPC does not enable a sufficiently thorough assessment to be undertaken. On the basis of limited information (see question *b*) below), there appears to be a risk that trust could be an issue in future if the replicability of EPCs is not addressed through e.g. training of assessors.

- b) *Are the building blocks of trust in place, in particular in terms of provisions for quality assurance of certification?*

The regional databases perform a basic quality check when a certificate is issued and stored in the database (BPIE, 2010). The system provides a warning when the data seems to be incorrect or incomplete. According to CA-EPBD (2010) some 40 000 such detailed quality assurance processes have been undertaken. As a result many experts have had to revise the EPCs at their own expense and in a few cases legal action has been taken.

²³ EC, 2011b. No explanation of the term “low-energy home” was provided to respondents.

BPIE (2011) noted that there is a need to improve EPC quality and to ensure proper qualification of energy consultants. The interview for Austria suggested that the quality assurance system across regions may vary and that databases of EPCs either do not exist or are not consistently populated. This would be problematic as they are a central part of quality assurance.

While EPCs should be issued by an authorised expert in, for instance, construction, engineering or energy, there is no obligation for these experts to take a training course or pass an exam for energy inspections. The interview for Austria suggested that the list may be too inclusive. However, it was also suggested that significant effort is currently going into training assessors to improve replicability and that there was cause for optimism in this respect. In conclusion, the building blocks that should serve to prevent the erosion of trust in the information on the EPC in future are only partially in place.

5.1.5 Anticipated effect of EPCs on transaction prices and rents

A low proportion of transactions for existing buildings are accompanied by an EPC as the Austrian legislation essentially provides for the possibility of opting out of the requirement by mutual agreement between the contracting parties. When present, the EPC usually arrives too late in the decision-making process to affect the choice of the buyer/renter. This is changing with the implementation of the recast EPBD and the legal requirements in some regions have already changed. However, this is unlikely to have happened in time to affect the transaction data analysed for the purposes of the present study. Thus we can anticipate on the basis of these two parameters that the impact of the EPC itself on property values in Austria is likely to have been very limited so far.

In future, understanding of the EPC may act as a dampener on the extent to which prospective buyers/renters take into account the information in their decision process and so this is an area that could do with more attention. No studies were identified that look into understanding of the EPC by different market actors in Austria. Nor did we find information about the extent to which energy performance counts in existing transactions. While trust in the information on the label does not at present appear to be an issue, it seems clear that it will be important to ensure that adequate quality assurance is in place for the future, so that existing trust is not eroded.

Figure 3: Residential EPC, Austria

Energieausweis für Wohngebäude

gemäß ÖNORM H 5055 und Richtlinie 2002/91/EG

GEBÄUDE

Gebäudeart	<input type="text"/>	Erbaut	<input type="text"/>
Gebäudezone	<input type="text"/>	Katastralgemeinde	<input type="text"/>
Straße	<input type="text"/>	KG-Nummer	<input type="text"/>
PLZ/Ort	<input type="text"/>	Einlagezahl	<input type="text"/>
Eigentümer	<input type="text"/>	Grundstücksnummer	<input type="text"/>

HEIZWÄRMEBEDARF BEI 3400 HEIZGRADTAGEN (REFERENZKLIMA)

HWB-ref = 57,09 kWh/m²a

ERSTELLT

Ersteller	<input type="text"/>	Ausstellungsdatum	<input type="text"/>
Organisation	<input type="text"/>	Gültigkeitsdatum	<input type="text"/>
Geschäftszahl	<input type="text"/>	Unterschrift	<input type="text"/>

Die Energiekennzahlen dieses Energieausweises dienen ausschließlich der Information. Aufgrund der idealisierten Eingangsparameter können bei tatsächlicher Nutzung erhebliche Abweichungen auftreten. Insbesondere Nutzungseinheiten unterschiedlicher Lage können aus Gründen der Geometrie und der Lage hinsichtlich ihrer Energiekennzahlen von den hier angegebenen abweichen.

EA-01-2006-SW-a
EA-WG
08. 10. 2006

5.2 Establishment of a dataset

A comprehensive national EPC database is planned but it is not expected to be ready until the end of 2012. In the meantime, a voluntary national database called ZEUS that collates data from three regions (Salzburg, Carinthia, Styria²⁴) exists and has been used by the Austrian Energy Agency for analysis purposes. It contains mostly non-residential buildings. The regions have their own databases, which contain mostly new properties (several thousand entries) because new or refurbished properties need an EPC in order to qualify for certain grants or subsidies. Responsibility for sold or rented buildings remains at federal level (the Federal Ministry of Justice has overall responsibility for EPCs while in practice they are organised at regional level).

There is extremely limited access to these regional databases for research purposes only. However, the samples available would have contained new properties only, with a focus on row-houses and other developer-built buildings because houses built by owner-occupiers are generally not put on the market after construction. Meanwhile, the transaction datasets identified for Austria do not contain EPC ratings. For this reason, the project team investigated property commercial websites instead (see general description in Chapter 4 and below for Austria).

5.3 Regression results

The results presented for Austria are based on property listings on the widely used immobiliennet.net website. Almost 54 000 listings in total were recorded over a six-month period from July to December 2012. Of these, just over 3 000 contained information on the property's *Energieklasse*, or EPC rating (by letter, from A to G).

Of these 3 000 property listings, the vast majority were either in Vienna (1 800) or the province surrounding it, Lower Austria (*Niederoesterreich*, 800). Thus, observations from other provinces were excluded, as it would not be possible to consistently distinguish between variation due to price levels in different parts of the country and other factors including EPC rating. For the same reason, listings classified as property types other than houses or apartments were excluded. This, in addition to exclusions based on extreme values for either size or price/rent, left a valid sample for analysis of 2 323 listings, of which 1 077 were rental listings and the remainder sales.

In addition to EPC rating and whether a property is for sale or to rent (and its price or rent accordingly), information is available for each property across four additional dimensions. The first is in relation to property type, i.e. house or apartment, and if rental apartment whether the lease is longer or shorter than usual. The second is in relation to the property's size, measured in square metres. The third relates to a property's condition (*Zustand*). Indicator variables were included for properties listed for the first time after being built (*erstbezug*), and for the property being in what the advertiser called very good or good condition. The final dimension relates to location: in Vienna, this is done by PLZ (zipcode), while in Lower Austria, this is done by region (of which there are six).

²⁴ The data is collected by www.energie.steiermark.at.

In addition to size in square metres, an interactive term is included, allowing the marginal effect of size to differ in Lower Austria compared to Vienna. Two principal strategies are used to capture the effect of energy efficiency on prices and rents. As with other countries and regions, the main one is the conversion of the A-G energy rating scale to a numeric scale from 1 to 7 (in one specification, an interaction is also included allowing the effect of a one-letter improvement in Lower Austria.) The second strategy is to include indicator variables for each of the ratings on the scale, using the C rating (the most common) as the control.

As with other countries and regions in this study, the empirical specification includes a filter for outliers. The process uses a calculation called Cook's Distance to exclude those observations with a disproportionate effect on the estimation of the coefficients of the model (a statistical test for outlier status). In the case of Austria, this resulted in the exclusion typically of 5% of observations.

5.3.1 Results for sales market

The models for the sales market in Vienna and the surrounding area explain just under 85% of the variation observed in house prices, a proportion that compares well with similar models in the housing literature. Location-specific effects are typically statistically significant, while an additional square metre is associated with a 1.2% higher price in Vienna and 0.8% in Lower Austria.

There are strong price effects of energy efficiency on list prices. In the core model, which includes both Vienna and Lower Austria and treats EPC rating as a continuous variable, a one-letter improvement in energy efficiency is associated with an 8% higher price. Allowing the effect of energy efficiency to vary between Vienna and Lower Austria, this 8% turns out to be effectively an average of an even higher premium in Vienna (of between 10% and 11%) and a slightly lower one in Lower Austria (between 5% and 6%). These results are outlined in Table 9, where Model (2) tests whether the effect of energy rating differs between Vienna and Lower Austria.

5.3.2 Results for lettings market

The rental model explains an even higher proportion of the variation observed in rents – 92% for the main specifications. Again, variables usually have the signs expected and are statistically significant, while location-fixed effects are also statistically significant. An additional square metre of floor-space is associated with a 0.9% higher rent, an effect that is only marginally smaller outside Vienna than in the capital.

The rent effect of energy efficiency on advertised rent is large, statistically significant but smaller than for prices. For the main specification, a one-letter improvement in energy rating is associated with a 4.4% higher rent. It is possible that the effect is slightly greater in Vienna than in Lower Austria, although when this is tested for directly, while there is a gap between the two regions, it is not statistically significant. These results are outlined in Table 9, alongside the sales results.

Table 9: Results for Austria, sales and rental

Dependent variable: price (or rent)	Sales		Rental	
	(1)	(2)	(1)	(2)
Increase in EPC (A-G scale)	-0.08030***	-0.10191***	-0.04406***	-0.04865***
additional EPC effect in Lower Austria	0.00723	0.01041	0.00493	0.00575
Size (m ²)	0.01182***	0.01168***	0.00943***	0.00944***
additional m ² effect in Lower Austria	0.00026	0.00026	0.00015	0.00015
<i>Type and condition:</i>				
House	0.04742	0.04827	0.12634**	0.13111***
Apartment on short lease	0.02994	0.03007	0.03952	0.03941
Apartment on long lease			0.01442	0.01146
Very good condition			0.01799	0.01797
Good condition			-0.05166**	-0.05041**
First occupancy			0.0182	0.01812
Constant	0.12813***	0.12782***	-0.04811***	-0.04939***
	0.02524	0.02522	0.01164	0.01161
	-0.21034***	-0.21892***	-0.06842**	-0.07127**
	0.03784	0.03795	0.02285	0.02278
	0.14852***	0.15276***	0.17036***	0.17318***
	0.0254	0.02532	0.02999	0.02989
	12.01937***	12.09702***	6.64525***	6.66170***
	0.05008	0.05577	0.02885	0.0305
R-squared	84%	83%	92%	92%
N	1 189	1 187	1 026	1 024

Models (1) and (2) differ in the treatment of energy rating (Model (2) includes a test for whether the effect is different in Lower Austria). Regional fixed effects not shown. Standard deviations are reported in parentheses. ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively. N refers to number of observations included in second-stage regression, which excludes outliers.

5.3.3 Summary

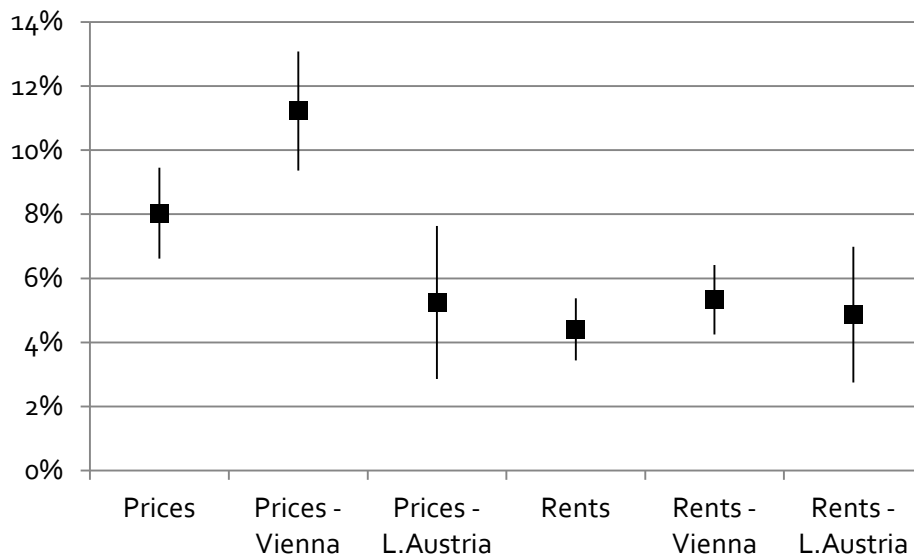
Overall, there are clear signs from the property market in Vienna and the surrounding region that energy efficiency is rewarded. The effect of a one-letter improvement in energy efficiency is estimated at 8% in the sales market and 4.4% in the lettings market. This attenuated rental

effect is in line with results for Belgium and Ireland, and suggests that owners benefit above the ongoing monthly benefits that accrue to occupiers.²⁵

There is also strong evidence that the price effect is larger in Vienna than in Lower Austria. This is in contrast to both Belgium and Ireland, where the price effect is smaller in the cities than in the non-city areas. It is worth noting, in light of the stylised fact from the Irish market that the premium for energy efficiency was related to market conditions, that as of late 2012, the Austrian market was booming (+10% year-on-year, and even greater in Vienna), while the Belgian market was largely static in real terms (price up 2.7% year-on-year by mid-2012) and the Irish market was still falling.

As with other countries for which listed prices and rents (rather than transaction outcomes) are given, it is important to note this caveat. Properties listed for longer without successful sale or lease may be associated with lower transaction prices, everything else being equal. This may understate the effect of energy efficiency on property market outcomes if energy efficiency is positively correlated with general property quality and quality in turn is positively correlated with faster sale or lease. An overview of the results in graphical form, including a 95% confidence interval, is shown in Figure 4.

Figure 4: Effect of a one-letter improvement in energy efficiency on prices and rents (and 95% confidence interval) in the Austrian property market



²⁵ An alternative explanation is given by Lyons (2012), who finds that location-specific amenities have systematically smaller rent effects than price effects and suggests this may be due to greater relative search costs in the rental market compared to the sales market.

This page is intentionally left blank.

Chapter 6: Belgium

Note: The first part of this chapter focuses primarily on the Flanders region but we carry out regression analysis for Wallonia and Brussels Capital regions as well. Although we were able to obtain datasets for all three regions, the dataset obtained for Flanders is by far the largest.

6.1 Assessment of the EPC scheme in Flanders

6.1.1 Presence of the label in Flanders

a) *When did the scheme come into force for which segments of the property market?*

Table 10: Introduction of EPCs in Flanders²⁶

Property type	Date of entry into force
All new buildings ²⁷	January 2006
Existing residential buildings – sale	November 2008
Existing residential buildings – rent	January 2009
Public buildings	January 2009
Existing non-residential	Expected 2013

While the legislation concerning the certification of existing non-residential buildings is already in place, there have been delays in the development of the accompanying software tools and implementation is expected in 2013 (Concerted Action, 2010).

b) *What is known about the proportion of properties (as a proportion of total rental or sales transactions) that were actually certified?*

An interview suggested that compliance with the law is high for sales transactions because a notary is involved and because of their official status. For rental, it was suggested that it is likely that compliance is lower. It appears that no central public body holds figures on both sales/rentals of assets and EPCs produced. It is estimated that Flanders has issued 5 100 non-domestic EPCs (BPIE, 2010).

²⁶ Concerted Action EPBD (2010).

²⁷ New buildings and major renovations have to have an EPB declaration (*Energie Prestatie en Binnenklimaat* (Energy Performance and Indoor Climate)), which has separate software and a separate database.

- c) *What do the regulations say about when the information in the EPCs should be made available?*

According to Concerted Action (2010), a certificate must be available from the moment the building is put up for sale or rent. The owner must give a valid certificate to the buyer when the deed is established. In case of rent, the renter must get a copy. From 1 January 2012 the EPC rating is required in all advertisements when putting a dwelling on the market for rental or sale, at risk of a penalty of 500-5 000 EUR.

- d) *Is there any information available about what actually happens in practice (regarding timing)?*

According to BPIE (2010), EPCs are almost always issued at the moment of transaction (for residential buildings). This was also confirmed in the interview (for the Flemish property market in general and not specifically for the residential market). According to a written response, market surveillance has shown mixed results. Advertisements including EPCs were available for 68% of dwellings (of those checked) in 2010 and this rose to 80% in 2011. Another check in February 2012 showed that only 62% included EPCs. In light of the new Flemish legislation ahead of the recast EPBD, mentioned above, this situation is likely to have improved during 2012.

6.1.2 Understanding of the label in Flanders

- a) *What information is available about buyer/renter understanding of the EPC?*

We were not able to identify any studies on the public understanding of EPCs in Belgium, nor does data appear to be gathered by public bodies. Anecdotal information from the interview suggested that members of the public do not understand that asset rating is based on standardised assumptions about user behaviour and thus not a prediction of what exactly they would consume if they bought/rented the asset but rather an indication of energy performance relative to other assets, making abstraction from user influence. In Flanders the EPC is not based on the A-G rating. The design does reflect the colour coding but it is a continuous scale.

6.1.3 Concern about energy use and environmental impact when selecting a property in Flanders

- a) *Is there information available about the role of energy or environmental impact as dimensions of property selection?*

We were not able to identify any research on the role of energy as a dimension of transactions concluded. Anecdotal information from the interview suggests that this is becoming increasingly important in the purchase of property. A Belgian (i.e. not just for Flanders) study by a network of real estate agencies identified that EPCs are having an increased effect as buyers become more aware of energy costs and consumption levels, particularly for mid-priced assets (ERA, 2012).

The most recent Eurobarometer survey relating to the attitude of Europeans to climate change (EC, 2011b) is shown in Table 11 as part of the broader societal context to the property market in Flanders.

Table 11: Attitudes to climate change in Belgium and Europe²⁸

Question	Belgium	EU-27
% of respondents placing climate change as the most important problem facing the world	24%	20%
Seriousness of climate change on a scale of 1-10 (average ranking)	7.1	7.4
% of respondents having insulated their home to reduce energy consumption	32%	18%
% of respondents having bought a low-energy home	6%	3%

6.1.4 Trust in the information on the label in Flanders

- a) *Has trust been an issue in the public debate about the introduction of EPCs? If so, what themes have been evoked?*

We did not detect any issues about trust in the EPCs in the literature examined. BPIE (2010) states that public acceptance is high. The interview suggested that apart from confusion about the difference between the asset rating and actual consumption, the extent to which the information on the EPC can be trusted has not been a topic of discussion in Flanders. It appears that the introduction of the EPC has been characterised by a degree of indifference, as opposed to any debate about whether the information can be trusted. The EPC has been treated as simply part of the paperwork that must be handed over on contract completion.


- b) *Are the building blocks of trust in place, in particular in terms of provisions for quality assurance of certification?*

Flanders has a mandatory quality assurance scheme. It is run by the Flemish Energy Agency (VEA) and involves the accreditation of assessors and quality control of certificates using the EPC database (Concerted Action, 2010). The interview suggested that over the past year the focus of the VEA has shifted from putting the EPC scheme in place to checking the quality of the work of those who produce the EPCs. They have also been stepping up communication on this. Examples include penalties for inaccurate EPCs and bans for experts who make an unacceptably high number of mistakes. Thus the building blocks for maintaining trust in the information on the EPC are in the process of being put in place.

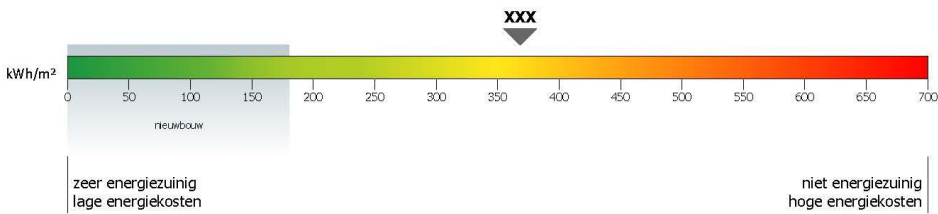
²⁸ EC, 2011b. No explanation of the term “low-energy home” was provided to respondents.

Figure 5: Residential EPC, Flanders

energieprestatiecertificaat bestaand gebouw met woonfunctie

certificaatnummer: 20080101-0000000245-00000015-1		
straat	<input type="text"/>	
nummer	<input type="text"/> bus <input type="text"/>	
postnummer	<input type="text"/> gemeente <input type="text"/>	
bestemming	eengezinswoning	
type	halfopen bebouwing	
softwareversie 13.1		
berekend energieverbruik (kWh/m²):		
XXX		

Het berekende energieverbruik is een inschatting van de energiezuinigheid van de woning. Op de schaal wordt het energieverbruik van de woning vergeleken met het energieverbruik van alle bestaande gebouwen met woonfunctie.



kWh/m²

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700

nieuwbouw


zeer energiezuinig
lage energiekosten

niet energiezuinig
hoge energiekosten

energiesdeskundige		KBO-nr: 0999.999.999
rechtsvorm	<input type="text"/> firma	erkenningscode: EPO1234
voornaam	<input type="text"/> achternaam	nummer
straat	<input type="text"/>	bus
postnummer	<input type="text"/> gemeente	
land	<input type="text"/>	

Ik verklaar dat alle gegevens op dit certificaat overeenstemmen met de werkelijkheid.

datum: **1-1-2008**
handtekening:



Dit certificaat is geldig tot en met **1 januari 2018**

pagina 1 van 5 pagina's

6.1.5 Anticipated effect of EPCs on transaction prices and rents

A high degree of presence could indicate that we should expect some impact. However it seems that at least until recently the certificate has been presented late in the transaction process. This on its own suggests that we should expect little impact on property value up to 2012. We did not find any information on whether the information is understood, other than anecdotal interview information to the effect that calculated energy demand and actual energy consumption are confused in peoples' minds, but the Belgian real estate network has identified increased interest in energy ratings, likely to continue given projected energy price rises. The fact that the introduction of the EPC appears to have been met with indifference would also mean that it is unlikely that we should see a strong effect in transaction data analysed for the purposes of this study that can be directly linked to the EPC.

There appears to be some way to go before the EPC is fully integrated into market practices. Despite the changes introduced with respect to property advertising, it may be that more needs to be done to engage intermediary actors such as property agents both in the commercial and residential sectors such that they are enabled to play a more proactive role. Once this is the case, it seems likely that we should see a clear effect on the value of property in Flanders. This is provided that trust is maintained through appropriate quality assurance systems, the building blocks of which appear to be in the process of being put into place.

6.2 Establishment of a dataset

6.2.1 EPC data in Flanders

Belgium's law of 8 December 1992 on Privacy Protection in relation to the Processing of Personal Data²⁹ is intended to protect citizens against the abusive use of personal data. Implemented by a commission for the protection of privacy, this law states that public organisations are only allowed to make aggregated data public. This is a significant barrier to accessing data.

The Flemish Energy Agency manages an EPC database for the region.³⁰ However, they are not able to provide a data sample due to privacy legislation and there are currently no legislative proposals to make data more publically available.

The databases of real estate agents or notaries, e.g. www.notarimmob.be, should in principle contain information on energy performance certification, as it is now obligatory to provide the energy rating in commercial publications when selling a house. However, these sources are also unable to share data.

²⁹ *Loi relative à la protection de la vie privée à l'égard des traitements de données à caractère personnel*: www.privacycommission.be/sites/privacycommission/files/documents/02.01.01.04-comites-sectorielsart31bis-loi-vie-privee_o.pdf.

³⁰ See www.vea.be.

6.2.2 Databases on transactions and rents

The Belgian *notaires* (notaries) hold databases of property transactions, including by region. However, because of the confidentiality issues, the Royal Federation of Belgium Notaries is only allowed to make aggregated data public. Similarly, a dataset of transaction prices based on real estate transactions is recorded by the *Cadastre du SPF Finances*.³¹ They were willing to share data for this study but again the provision of price/address variables would have run up against the data protection laws.

Therefore the project team again pursued the option of using listings from commercial websites, which include both price and EPC information (see general description in Chapter 4 and for Belgium in next section). This also allowed us to obtain data for Wallonia and Brussels Capital regions as well as Flanders, and thus for Belgium as a whole. Possibly due to the later introduction of certificates in Wallonia and Brussels, sample sizes for those regions are significantly smaller than for Flanders, but of sufficient size to enable hedonic regression analysis.

6.3 Regression results

Analysis of the effect of energy efficiency on property market outcomes in Belgium was conducted using a sample of just over 100 000 property listings, covering sales and lettings segments in Flanders, Wallonia and Brussels, from the second half of 2012. The source of the listings is the widely used immoweb.be website. Information on the measure of energy efficiency (CPEB score) is available for just over one quarter of these listings, the vast majority of which are in Flanders. Extreme values of CPEB (below 25 and above 800) are excluded. Together with filters for unusual property types, sizes and values, this leaves a valid sample of just over 26 000 listings for analysis. The breakdown by region and market is shown in Table 12 below.

Table 12: Sample sizes for energy efficiency listings in the Belgian property market

	Sale	Rental
Brussels-Capital	1 222	660
Flanders	15 935	7 140
Wallonia	1 043	276

Information is available on each property across four main headings: its size in square metres, its location, its property type, and the dwelling's energy performance. Energy performance is given by the CPEB metric, kWh/m², the ratio between the characteristic annual primary energy consumption and the useable floor area.

As with other countries and regions, the empirical specification includes a filter for outliers. The process uses a calculation called Cook's Distance to exclude those observations with a disproportionate effect on the estimation of the coefficients of the model (a statistical test for outlier status). In the case of Belgium, this resulted in the exclusion of on average 5% of observations.

³¹ See http://statbel.fgov.be/fr/statistiques/chiffres/economie/construction_industrie/immo/.

6.3.1 Results for Flanders

The analysis for the Flanders region of Belgium is based on just under 16 000 sales listings and just over 7 100 rental listings, covering properties available in the second half of 2012, noting the filters described above. The model allows for diminishing marginal utility associated with size: additional size variables were included for properties that were small (less than 100 m²) or large (more than 200 m²).³²

To capture location-specific effects, size in square metres is treated as market-specific, where two-digit postal codes were used for micro-markets. For the sales segment, there is one modification: due to small sample sizes, the postal code 82 was combined with its neighbour, postal code 80. Four-digit postal codes were included as additional geographic controls, where sample sizes permitted. Property type indicator variables were included for apartments, and within apartments for penthouses, duplexes and triplexes, and also for bungalows and villas. For the rental segment, the treatment and specification were analogous, with adjustments only to the location-specific fixed effects, to reflect the smaller sample size.

The results are shown in the table below. Model (1) includes CPEB score as a continuous variable. Model (2) exploits the large sample size and continuous nature of the CPEB score to investigate whether the effect of an incremental improvement in energy efficiency may be different if the existing level of efficiency is high or low, in much the same way that the effect of an additional square metre may vary between small and large properties. This is done by interacting the CPEB score with indicator variables that take a value of 1 if the CPEB score is very low (less than 150), low (between 150 and 250), high (between 450 and 600) and very high (above 600).

Table 13: Results for Flanders, sales and rental

Dependent variable: price (or rent)	Sales (1)	Sales (2)	Rental (1)	Rental (2)
Increase in CPEB score	-0.00043***	-0.00049***	-0.00032***	-0.00043***
	0.00001	0.00004	0.00002	0.00004
<i>Additional effect</i>				
at very low CPEB scores		0.00033***		0.0001
		0.00009		0.00008
at low CPEB scores		0.00004		-0.00005
		0.00004		0.00003
at high CPEB scores		0.00004*		0.00008***
		0.00002		0.00002
at very high CPEB scores		0.00008***		0.00016***
		0.00002		0.00003

³² Note that a modelling choice was made not to use polynomials. A second-order polynomial is more standard in the literature but is quite restrictive in imposing a relationship that extends across high, intermediate and low values of a variable. By treating high and low separately, relative to the intermediate band, this allows the relationship to differ. The cost is that cut-off points between high, low and intermediate have to be chosen. Amenity valuation more generally seems to be switching away from polynomials towards more flexible functional forms such as this.

<i>Type and size</i>				
Size (m ²)	0.00473*** 0.00009	0.00476*** 0.00009	0.00594*** 0.00012	0.00591*** 0.00012
Where m ² is low	-0.00154*** 0.00008	-0.00152*** 0.00008	-0.00006 0.00007	-0.00007 0.00007
Where m ² is high	-0.00057*** 0.00004	-0.00056*** 0.00004	-0.00078*** 0.00005	-0.00076*** 0.00005
Apartment	-0.01801** 0.00688	-0.02778*** 0.00695	-0.05593*** 0.00726	-0.06366*** 0.00726
Duplex	0.01113 0.01176	-0.00325 0.01176	-0.04672*** 0.009	-0.05315*** 0.00899
Penthouse	0.23969*** 0.01797	0.22756*** 0.01794	0.05881*** 0.01679	0.05109** 0.01667
Bungalow	0.23488*** 0.02158	0.22952*** 0.02139	0.09403*** 0.02457	0.07490** 0.02429
Villa	0.30248*** 0.00716	0.30200*** 0.00713	0.16604*** 0.01089	0.16454*** 0.01089
Maison de Maitre	0.14382*** 0.0162	0.14257*** 0.01614	0.03081 0.03285	0.03777 0.03275
Rez-de-chaussée	0.04575** 0.01448	0.04537** 0.01441	-0.01836 0.01224	-0.01823 0.0122
Maison bel étage	-0.03792** 0.0146	-0.03597* 0.01453	-0.08470*** 0.02146	-0.08003*** 0.02139
Constant	12.01697*** 0.01256	12.01983*** 0.01757	6.22061*** 0.0151	6.25236*** 0.01947
R-squared	76.8%	77.1%	79.3%	79.5%
N	15 011	15 016	6 931	6 931

Models (1) and (2) differ in the treatment of energy rating, with Model (2) allowing the effect of an improved CPEB score to vary at different levels. Standard deviations are reported in parentheses. ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively. N refers to number of observations included in second-stage regression, which excludes outliers.

Overall, the models have a good level of fit, explaining between 75% and 80% of the variation observed in listed prices and rents. In the sales market, according to Model (1), an improvement of 100 points in the CPEB metric is associated with a 4.3% higher price. Model (2) refines this finding somewhat. It suggests that the premium associated with an improvement of 100 points on the CPEB is significantly smaller for already very energy efficient homes (of the order of 1.6%). The effect is strongest in the middle of the distribution (4.9%) before weakening slightly at high and very high CPEB scores (4.1-4.5%). This may reflect income or information constraints among lower-income households that limit somewhat their reward for energy efficiency.

In the rental market, Model (1) suggests that an improvement of 100 points in the CPEB metric is associated with a 3.2% higher rent, an attenuated effect when compared with the 4.3% price effect. Both effects are precisely estimated in the data. Model (2), however, again adds some nuance to this. The attenuated rental effect is driven by a smaller reward to energy efficiency among energy inefficient homes (those with CPEB scores of 450 or higher). At intermediate levels of energy efficiency, the rent effect of a 100-point improvement (4.3%) is comparable to the price effect. This effect does not diminish where CPEB scores are low.

6.3.2 Results for Brussels-Capital

A smaller sample was available from the same data source for the Brussels-Capital region of Belgium (postcodes 10-12), covering 1 220 sales listings and 660 rental listings, once filters were run for properties with extreme or missing values of variables required. The empirical specification was as for Flanders, but with modifications where necessary. Due to the smaller geographic scale of the Brussels-Capital region, four-digit rather than two-digit postcodes were used to build zones of suitable sample size. Typically, this involved amalgamating contiguous municipalities, using where possible population densities as guides, and left 14 zones in the sales market and 11 in the rental market.

Results for the Brussels-Capital region are shown in Table 14. Again, the overall fit of the Brussels models is high, explaining 86% of the variation in prices and 81% of the variation in rents.

Once again, improved energy efficiency is associated, in a statistically significant way, with higher property prices and rents. According to Model (1), an improvement of 100 points in the CPEB metric is associated with a 2.9% higher price. An equivalent improvement in the rental market is associated with a 2.6% higher rent.

6.3.3 Results for Wallonia

Similarly, a smaller sample was available from the same data source for the Wallonia region of Belgium, covering 1 000 sales listings and 270 rental listings, after filters for properties with missing or extreme values of key variables. Due to significantly smaller samples for the Wallonia region, two-digit postal codes were amalgamated into contiguous zones with a sufficient number of observations. There were 11 such zones in the sales segment and six in the rental segment, all of which were interacted with size (square metres) to reflect market-specific factors.

Despite the significantly smaller sample sizes, the overall fit of the Wallonia models is good, accounting for 76% of the variation in prices, and 85% of the variation in rents. As with Flanders and Brussels-Capital, improved energy efficiency is associated in a statistically significant way with higher property prices and rents. According to Wallonia Model (1), an improvement of 100 points in the CPEB metric is associated with a 5.4% higher price. In the rental market, the effect for an equivalent improvement on rents is significantly smaller at 1.5%.

Table 14: Results for Brussels-Capital and Wallonia, sales and rental

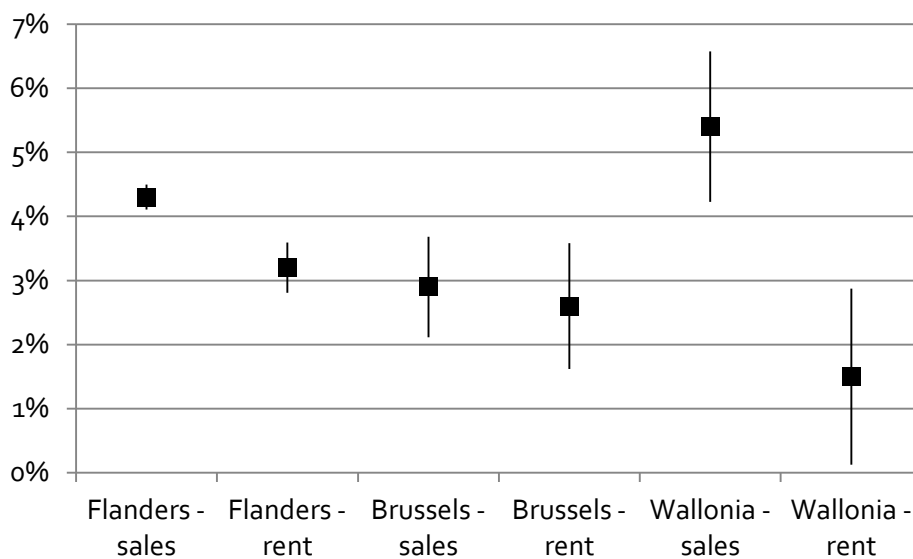
Dependent variable: price (or rent)	Brussels-Capital		Wallonia	
	Sales (1)	Rental (1)	Sales (1)	Rental (1)
Increase in CPEB score	-0.00029*** 0.00004	-0.00026*** 0.00005	-0.00054*** 0.00006	-0.00015* 0.00007
<i>Type and size</i>				
Size (m ²)	0.00772*** 0.00031	0.00728*** 0.00033	0.00651*** 0.00032	0.00736*** 0.00037
Where m ² is low	-0.00078*** 0.00021	-0.00005 0.0002	-0.00120** 0.00036	0.00053* 0.00026
Where m ² is high	-0.00127*** 0.00013	-0.00104*** 0.00023	-0.00087*** 0.00017	-0.00212*** 0.00026
Apartment	-0.03785 0.02021	-0.03664 0.03157	-0.00972 0.02982	-0.052 0.02731
Duplex	0.04487 0.03787	0.02659 0.03929	0.07371 0.06321	-0.11040** 0.03855
Penthouse	0.16965*** 0.03978	0.04669 0.05282		
Bungalow			0.26405*** 0.07454	0.13594 0.08976
Villa	0.14735** 0.04973	0.30246*** 0.07879	0.27268*** 0.02439	0.0795 0.04515
Maison de Maitre	-0.0289 0.05614	0.32825** 0.12451	0.18388 0.15489	
Rez-de-chaussée	0.07514 0.04184	-0.02561 0.04411	0.14302 0.08005	0.28188*** 0.06809
Maison bel étage	0.13882*** 0.04042	-0.15395* 0.0716	-0.01767 0.07454	-0.15112* 0.06597
Constant	11.77292*** 0.04213	6.28693*** 0.05347	11.72858*** 0.05197	6.06350*** 0.05826
R-squared	86.1%	80.6%	76.4%	84.5%
N	1 145	620	986	250

Model (1) is as per the Flanders model, subject to the modifications noted in the text and omitted categories (denoted by blank cells). Regional square meters effects not shown. Standard deviations are reported in parentheses. ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively.

6.3.4 Summary of regression results for Belgium

This analysis of 26 000 property listings has shown a clear relationship between a property's energy efficiency – as measured by its CPEB performance – and its advertised price or rent. The bulk of the listings are for Flanders, and analysis of that market showed that an improvement of 100 points in the CPEB metric (termed here a “major improvement” in energy efficiency) is associated with a 4.3% higher price, on average. The rent effect was smaller but still statistically and economically significant: an improvement of 100 points in the CPEB metric is associated with a 3.2% higher rent.

Figure 6: Price and rent effects of 100-point improvement in CPEB score (and 95% confidence interval) in the Belgian property market



Results for Wallonia and Brussels – based on significantly smaller sample sizes – were in line with those for Flanders. A major improvement in energy efficiency is associated with a 5.4% higher price in Wallonia and a 2.9% higher price in Brussels. In the rental market, a similar improvement in energy efficiency is associated with a 1.5% higher rent in Wallonia and a 2.2% higher rent in Brussels.

The overall finding – that energy efficiency is rewarded in the property market – can be supplemented with two additional findings. Firstly, while the price effect in Wallonia is larger than that for Flanders, it is also less precisely estimated. Instead, of the price effects, it is Brussels-Capital that appears systematically different. This may reflect the higher price levels that prevail in the capital city: if the energy savings associated with a dwelling of 150 m² for example are a certain euro amount, this will be a smaller proportion of the price in Brussels, where such dwellings command a higher value.

Secondly, in all three regions analysed, the effect on rents was attenuated, albeit marginally in the case of Brussels-Capital. This may indicate the internalisation by owner-occupiers of the capital benefits associated with energy efficiency, compared to tenants, who enjoy only an improved accommodation service.

The large sample size for Flanders allowed an investigation of whether effects on prices and rents varied by the level of energy efficiency (similar to diminishing marginal utility of additional space). This analysis suggested that the price effect is significantly smaller at low CPEB scores, i.e. for highly efficient homes, further improvements in energy efficiency were associated with a smaller premium than improvements for less energy efficient homes.

This analysis, however, also suggested that at intermediate levels of energy efficiency (CPEB scores of 250-450), the attenuated rental effect disappears and the rent effect of energy efficiency is of a similar scale to the price effect. Instead, the attenuation occurs at poor levels of energy efficiency, which – if associated with poorer quality accommodation and lower income households – may reflect a lack of willingness to pay for energy efficiency or more likely a lack of awareness of its financial benefits.

Chapter 7: France

7.1 Assessment of the EPC scheme

7.1.1 Presence of the label

- a) *When did the scheme come into force for which segments of the property market?*

Table 15: Introduction of EPCs in France³³

Property type	Date of entry into force
Residential and non-residential buildings – sale	September 2006
Residential and non-residential buildings – rent	July 2007
New buildings	July 2007
Public buildings	January 2008
Display of the certificate in all property advertising	1 January 2011

- b) *What is known about the proportion of properties (as a proportion of total rental or sales transactions) that were actually certified?*

Notaries are obliged to verify that all the legal documents are present including the EPC (known as *diagnostique de performance énergétique* (DPE)). This suggests that since 2007 the compliance level has been almost 100% at the time of sale. The notary does not have the same role when it comes to rental contracts but the interview suggested that estate agents are well informed about the EPC and are also obliged to make sure that all relevant documents accompany rental contracts.

What may fall outside of this picture are rental transactions concluded between individuals. No information was available about the proportion of rental transactions that are concluded directly between individuals as opposed to via an estate agent.

Thus interview data suggests that the proportion of transactions in France accompanied by an EPC is near complete. However, no studies appear to have been undertaken to verify this. BPIE (2010) estimated that in France 90% of social housing and 14% of private houses have certificates but these shares will have been rising over time. It is estimated that France has issued at least 4 000 non-domestic EPCs (public buildings) (BPIE, 2010).

- c) *What do the regulations say about when the information in the EPCs should be made available?*

According to Concerted Action (2010) in relation to all existing property, the owner is obligated to provide a valid certificate to the buyer when the sale or rental is being established. This

³³ Concerted Action, 2010 and BPIE, 2010.

suggests that it is unlikely the certificate has been well integrated into the marketing and purchasing/letting process. However, in January 2011 display of the energy label and class became mandatory in all advertising for sale or rent (newspaper, websites, real estate agent agencies, etc.). This would suggest that potential buyers/renters are more likely to be exposed to the EPC early in the transaction process and this was also confirmed through interview.

d) Is there any information available about what actually happens in practice (regarding timing)?

The January 2011 requirements mean that the EPC should be displayed in all advertising and marketing of properties. However, it is one thing for the rating to be available and another thing for it to be presented and explained to the prospective buyer/renter, and for it to be integrated into market decisions.

ADEME and TNS (2012a) specifically asked heads of households about the extent to which the energy performance class attributed by the EPC would be an important criterion in the context of a home purchase or a decision to rent. In both cases the total percentage of respondents who considered this either “quite important” or “very important” had not shifted a great deal since a 2007 study, hovering somewhere between 80% and 85%. There has however been a shift towards more respondents saying that it would be a “very important” criterion as opposed to “quite important”. While this suggests that a significant proportion of French households would consider the EPC important in a decision to rent or buy, these results relate to a hypothetical purchase or rental situation. However, the results do suggest that the level of awareness of EPCs amongst the French public is significant, and that there is at least potentially significant market interest. Also, since the survey was carried out before the display of EPCs became mandatory in all advertisements, it can be expected that equivalent figures today would be even higher.

Additional questions were asked of those who had recently sold or bought a home. The number of respondents to this part of the study was very low and so the results should therefore be treated with caution. Interestingly 37% of sellers report that the EPC rating had either a weak influence (25%) or a great influence (12%). For 58% of respondents it had no influence at all. Of those who had recently bought a home, 44% reported that the EPC rating either had a weak influence (27%) or a great influence (17%). It had no influence on 55% of respondents.

ADEME and TNS (2012b) also examined the influence of the EPC rating on sales transactions in the residential sector through a survey of property professionals (estate agents and solicitors). If a property has a good EPC rating, 66% of estate agents and 84% of solicitors say that they “often” or “always” include a good energy rating in their “sales pitch” for that property. On the other hand, when the property has a bad EPC rating, 49% of estate agents and 37% of solicitors say that the buyer will mention this. This suggests that property professionals are wiser to the use of the EPC in the process of negotiation than prospective residential buyers. According to 32% of estate agents and 29% of solicitors, a good EPC rating increases the price of a property by “a little” or “a lot”. Conversely, 53% of estate agents and 46% of solicitors say that a bad EPC rating reduces the price of a property “a little” or “a lot”. In both cases, the largest proportion of professionals say that the impact on the transaction price is to reduce/increase it by “a little”.

Property professionals were also asked whether a good or bad EPC rating influenced buyers’ decisions. According to 72% of estate agents and 66% of solicitors, a good EPC rating influenced

buyers' decisions "a little" or "a lot". For a bad EPC rating the equivalent figures are 63% of estate agents and 58% of solicitors. Again, the overwhelming majority of these responses referred to a small influence. Nevertheless, the survey of professionals suggests that the EPC is entering the professional practices of estate agents and solicitors, that buyers are to a certain extent wise to it, and that it is mobilised both as an argument to increase the price of a property, and to reduce the price in the final stages of negotiation (a practice known as "chipping"³⁴).

This suggests that the EPC is integrated relatively early in the purchasing process of the buyer in the residential sales market. According to the national policy maker interviewed, this is also the case for non-residential buildings and for rentals.

7.1.2 Understanding of the label

a) *What information is available about buyer/renter understanding of the EPC?*

ADEME has conducted three studies so far of the reception of the EPC by the general public and by property professionals (estate agents and solicitors). The first study was in August 2007, another followed in May 2010 and the most recent was conducted in January 2012. Although the survey of professionals asked about understanding of the label, the survey of heads of households did not. Nor was there a survey of commercial investors/occupiers. The survey of the understanding of the EPC by property professionals will therefore have to serve as an indicator of what the understanding of prospective clients (whether for residential or office space) might be.

Some 63% of estate agents and 72% of solicitors agree with the statement that the EPC is "simple to understand and explain", while 56% of estate agents and 32% of solicitors agree with the statement that it is "easy to apply and implement". These results suggest that key property market professionals understand, or at least believe they understand, the EPC. However, there is some room for improvement both in terms of the capacity to understand and explain the EPC, and in terms of its application in particular professional contexts. Interestingly, the survey addressed to households did not ask questions about the understanding of the EPCs.

As in many other countries, there is a national communication campaign, a network of 500 experts providing advice to households on all aspects of energy via the *Espaces Infos Energies* created by ADEME.

7.1.3 Concern about energy use and environmental impact when selecting a property

a) *Is there any information available about the role of energy use or environmental impact as dimensions of property selection?*

An Ifop survey in March 2010 found that 90% of the French public consider energy performance to be an important factor. However, a survey of French real estate agents in June of the same

³⁴ See www.fridaysmove.com/property-law-blog/conveyancing-insider/13/01/2011/epc-used-selling-price-negotiation.

year showed that when it comes to the crunch the share of actual purchasers that consider good energy performance as an important factor in their decision is only 45% (Figures 7, 8).

Figure 7: Factors in purchasing decision according to real estate agents in France, June 2010

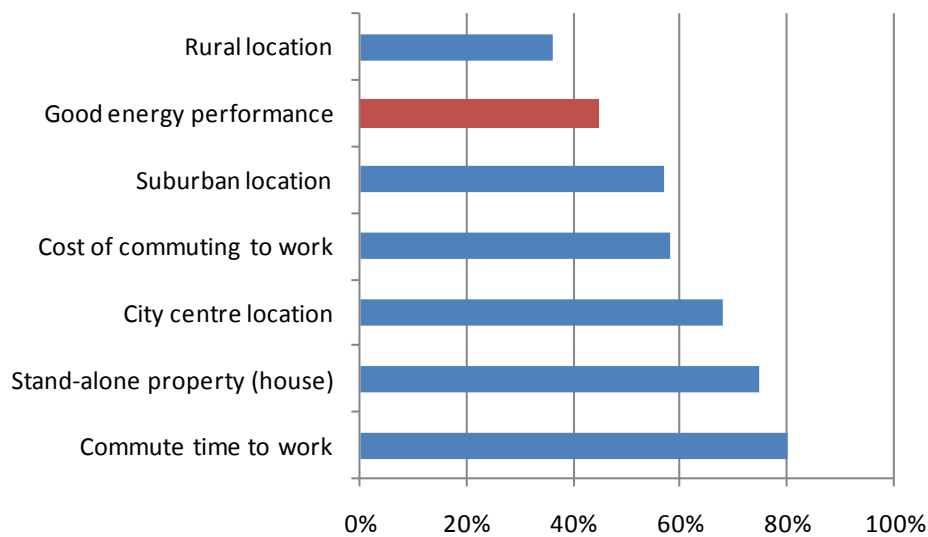
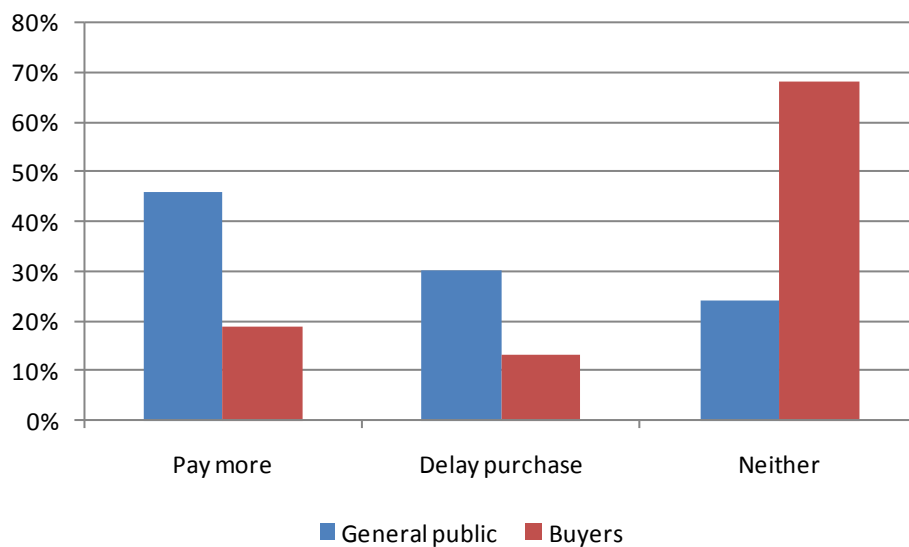


Figure 8: Gap between general public and buyers in attitude to energy performance



Source: Ifop (2010)

- Pay more: Prepared to invest more in order to benefit from a property with good energy performance (or to pay for renovation to improve it)
- Delay purchase: Not prepared to invest more in order to benefit from a property with good energy performance but willing to delay purchase in order to find a property that meets this condition
- Neither: Not willing to delay purchase nor to invest more

More broadly, some of the questions in the most recent Eurobarometer (EC, 2011b) survey relating to Europeans' attitude to climate change can serve as useful context, helping to assess the likelihood of French buyers/renters taking into account energy performance (as a dimension of environmental impact) when selecting a property.

Table 16: Attitudes to climate change in France and Europe³⁵

Question	France	EU-27
% of respondents placing climate change as the most important problem facing the world	20%	20%
Seriousness of climate change on a scale of 1-10 (average ranking)	7.4	7.4
% of respondents having insulated their home to reduce energy consumption	26%	18%
% of respondents having bought a low-energy home	4%	3%

7.1.4 Trust in the information on the label

- a) *Has trust been an issue in the public debate about the introduction of EPCs? If so, what themes have been evoked?*

According to BPIE (2010), the accuracy of EPCs in France has been questioned. This seems to relate to the choice of assessment method and the quality of assessments by assessors. Nevertheless Concerted Action (2010) claims that the creation of EPCs “brought a step change to the market and created improved awareness of energy efficiency in the population.”

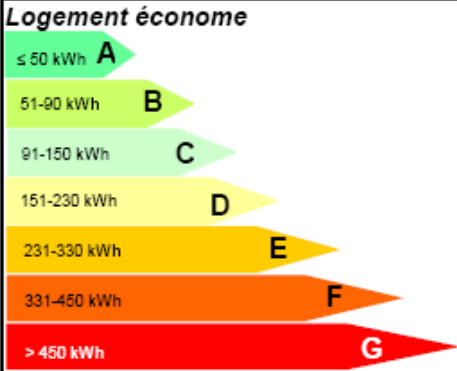
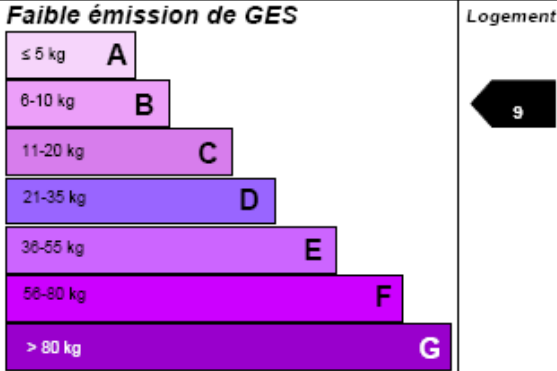
Studies commissioned by ADEME and carried out by TNS contain some questions that can throw light on the question of trust in relation to the residential sector. In a survey of the general public (ADEME and TNS, 2012a), those who had recently sold a home generally had not had any problems getting an EPC done and generally had a good impression of the assessors who determine the EPC for a given property. In particular, 82% said that they “rather agreed” or “agreed completely” with the statement that the assessor seemed “competent and reliable.” However if we look at the results from the survey of professionals, the picture that emerges is a little less reassuring. Only 33% of estate agents thought that the assessment of energy consumption and CO₂ emissions by assessors was reliable, while 43% thought that their work often was not as good as it should be. This suggests that the issue of trust in the EPC may undermine the integration of the EPC in market practices so far achieved and hamper any additional integration.

- b) *Are the building blocks of trust in place, in particular in terms of provisions for quality assurance of certification?*

It is not clear if there is any systematic testing of the quality of EPCs in France yet. In 2010, CA-EPBD reported that a central archive for EPCs was under development and that this would help certification bodies “check the proficiency of experts by reviewing the reports provided online and collecting complaints”. In September 2011, the French government announced a series of measures to increase confidence in the EPC. This included greater transparency in the information given to private households, improvements in the calculation methodology, the use of software validated by the ministry, an online database of EPCs, improved competency of assessors and more effective quality control.

³⁵ EC, 2011b. No explanation of the term “low-energy home” was provided to respondents.

Figure 9: Residential EPC, France³⁶

DIAGNOSTIC DE PERFORMANCE ENERGETIQUE – logement (6.A)				
<p>Directive 2002/91/CE du Parlement européen et du Conseil en date du 16 décembre 2002 sur la performance énergétique des bâtiments. Directive 98/34/CE du Parlement européen et du Conseil en date du 22 juin 1998 prévoyant une procédure d'information dans le domaine des normes et réglementations techniques, modifiée par la directive 98/48/CE du 20 juillet 1998. Le code de la construction et de l'habitation, notamment ses articles R. 134-1 à R. 134-5, le code de l'urbanisme, notamment son article R.112-2. Le décret 1114 du 5 septembre 2006 relatif aux diagnostics immobiliers et modifiant le code de la construction et de l'habitation et le code de la santé publique. Le décret 1147 du 14 septembre 2006 relatif au diagnostic de performance énergétique et à l'état de l'installation intérieure de gaz pour certains bâtiments. Arrêté du 15 septembre 2006 relatif au diagnostic de performance énergétique pour les bâtiments existants proposés à la vente en France métropolitaine. Arrêté du 15 septembre 2006 relatif aux méthodes et procédures applicables au diagnostic de performance énergétique pour les bâtiments existants proposés à la vente en France métropolitaine. Arrêté du 3 mai 2007 relatif au diagnostic de performance énergétique pour les bâtiments existants à usage principal d'habitation proposés à la location en France métropolitaine. En application de la loi de simplification du droit 2004-1343 du 9/12/2004, ce diagnostic a été élaboré par un expert indépendant et assuré pour cette mission.</p>				
1. IDENTIFICATION DU BIEN ET DE L'ORGANISME CHARGE DE LA MISSION				
N°:	DPE 09.071	Adresse :		
Valable jusqu'au :	14/10/2019	Cadastrale :	Lot :	
Type de bâtiment :	Immeuble collectif	Date visite :	13/10/2009	
Année de construction :	1974	Accompagnateur :	Locataire	
Surface habitable :	35.00 m²	Organisme chargé de la mission :	A+ Etats des Lieux RCS BORDEAUX 501 613 400	
Attestation d'assurance, RC professionnelle : AXA Nom du technicien : PIERRE LABERTIT		Propriétaire :		
Propriétaire des installations communes (s'il y a lieu) : Néant		33000 BORDEAUX		
2. CONSOMMATIONS ANNUELLES PAR ENERGIE				
Les consommations énergétiques, les émissions de gaz à effet de serre et les coûts indiqués ci-dessous sont obtenus à partir d'un calcul conventionnel méthode 3CL-DPE version 15c, estimé à l'immeuble / au logement, prix moyens des énergies indexés au 15 août 2006.				
	Consommations en énergie finales (kWh PCI)	Energie	Consommations en énergie primaire (kWh)	Frais annuels d'énergie
Chauffage	1 534.26 kWh	électrique	3 958.39 kWh	139.00 €
ECS	1 320.63 kWh	électrique	3 407.21 kWh	119.65 €
Refroidissement	0.00 kWh	pas de système	0.00 kWh	0.00 €
Total	2 854.89 kWh	-	7 365.60 kWh	258.65 €
Abo. électrique	105.87 €	Abo. gaz naturel	0.00 €	364.52 €
CONSOMMATIONS ENERGETIQUES (EN ENERGIE PRIMAIRE) POUR LE CHAUFFAGE, LA PRODUCTION D'EAU CHAUDE SANITAIRE ET LE REFROIDISSEMENT		ÉMISSIONS DE GAZ A EFFET DE SERRE (GES) POUR LE CHAUFFAGE, LA PRODUCTION D'EAU CHAUDE SANITAIRE ET LE REFROIDISSEMENT		
Estimation du montant annuel des frais inhérents à la consommation : 364.52 €		Estimation des émissions : 9 kg eqCO ₂ /m ² .an		
Consommation conventionnelle : 210 kWhEP/m ² .an		Logement		
Logement économe 		Faible émission de GES 		
Logement énergivore 210		Forte émission de GES 9		

³⁶ Source: www.aplus-expertises.com/images/dpe.png.

7.1.5 Anticipated effect of EPCs on transaction prices and rents

The proportion of transactions that are accompanied by an EPC is high, especially as regards sales transactions. Amongst the general public there appears to be a high degree of awareness of the EPC and of (hypothetical) willingness to integrate it into the choice of a home. There is also evidence that property professionals are integrating the EPC into their practices, suggesting that prospective buyers may have some opportunity to integrate the EPC rating into their purchasing decisions. There is also some indication that this is having at least some influence on the sale price, either upwards or downwards depending on the EPC rating. However, there are clearly some issues of trust in the EPC. Overall therefore, it seems that we might expect a limited positive effect of the EPC on residential sales transactions in France. If we assume that the office sales and rental markets are likely to be more sophisticated than the residential market and integration of the EPC therefore to be further advanced, then all things being equal, we may hypothesise that this effect should also be in evidence in the office markets.

7.2 Establishment of a dataset

The *Notaires*³⁷ hold two databases, one for the Paris region (BIEN) and one for the rest of France (Perval). The two databases are based on the same source: official sales documents signed in notaries' offices. Therefore, they deal only with residential property sales.

BIEN and Perval contain both transaction (sales) data and EPC information. However, EPC information is only available for transactions where the documents are transmitted electronically to the *Bureau des hypothèques* (mortgage registry). In BIEN for example there are 175 000 transactions between August 2010 and July 2011, of which 13% contain EPC information. The Perval database contains EPC information from 2011 onwards, with a similar level of data completeness.

Data is constantly updated and is available for all types of property on the market, listing precise information on location, key features, technical details and transaction prices. The variables include:

- Transaction price
- Address
- Dwelling type i.e. apartment (studio, room, duplex, loft, etc.) or house (detached house, villa, farm, chalet, etc.)
- Number of rooms, bathrooms, parking spaces, etc.
- Surface of the dwelling
- Floor
- Construction period

³⁷ See www.notaires.fr.

- EPC: Energy consumption (A-G) and greenhouse-gas emissions (A-G)
- Total number of variables: 105

The Perval database was used as the source for this study for a number of reasons: first, the Paris market is very tight, which we expected would make the effect of EPCs difficult to distinguish and not easily comparable to other markets; second, within the Paris region there is huge variation in prices over very small distances, which could affect the robustness of results; third, the Perval database would allow us to compare more than one region from the same database. Thus, we obtained datasets of the latest available transactions from the Perval database for both Lille and Marseille to allow comparison of northern and southern climates, and two different sizes of city or urban area.

7.3 Regression results

The analysis for France is based on the Perval database and comprises just under 3 400 sale transactions in the metropolitan areas of Lille (in the north) and Marseille (in the south) between January 2011 and October 2012.³⁸

Information on property type is available for each transaction across seven main dimensions. The first three are the price of the transaction, its date and the INSEE Commune the property is located in. Market conditions are controlled for using quarterly fixed effects. Location-specific fixed effects are described separately for Lille and Marseille below.

The fourth dimension of information refers to property type, of which there are six: standard house, *pavillon*, villa, standard apartment, duplex and studio. The fifth is the property's age (by era: pre-WW1, interwar, post-war, 1970s-1980s, and 1990s-2010s). The sixth dimension refers to property-specific features, such as whether there is a terrace, cellar, balcony, pool, parking spaces, a noticeably good or bad internal condition, or a view that adds to the property's value. The final dimension is the property's energy rating, using an ordinal alphabet ranking from A (most energy efficient) to G (least).

As with other countries and regions, the empirical specification includes a filter for outliers. The process uses a calculation called Cook's Distance to exclude those observations with a disproportionate effect on the estimation of the coefficients of the model (a statistical test for outlier status). In the case of France, this resulted in the exclusion of on average 3% of observations.

7.3.1 Results for Marseille

For Marseille, there were almost 1 350 transactions analysed, comprised of 1 200 apartments and 147 houses. With a median number of observations per zone of 70, each of the 16 different INSEE

³⁸ The original dataset contained just under 3 900 observations. Exclusions were made for missing price, date or size information, and also for unusually large or small properties, and for non-standard property types (anything other than *maison*, *pavillon* or villa for houses, and anything other than *appartement standard*, duplex or studio for apartments).

communes had a sufficient number of observations to be treated separately in the regression analysis.

Capturing location-specific fixed effects was done through use of area in square metres interacted with an indicator variable for each commune. The inclusion of an additional 15 variables (Marseille commune was used as the control) enables not just for one area to have a differential relative to another (as with fixed effects) but for that differential to vary by the size of the property.

Overall, the model explains 86% of the variation observed in property prices, as shown in Table 17. Most variables have statistically significant effects with the sign as expected, with a higher price associated with newer properties, houses (relative to apartments), properties with a terrace, pool or parking space and larger properties.

There is a strong positive relationship between energy efficiency and the price of the house: each one-letter improvement in a property's energy label is associated with a 4.3% higher price. Regressions run separately for apartments and houses suggest that the energy efficiency effect is driven by apartments – with no statistically significant effect of energy rating on the price of a house. Caution must be exercised when noting this result, however, as the sample of houses in Marseille is small.

7.3.2 Results for Lille

For Lille, there were almost 2 000 transactions analysed, comprised of 1 200 apartments and 746 houses. These were in 62 different INSEE communes but only 16 of these contained 30 observations or more, so contiguous communes were grouped together to form 18 zones of sufficient sample size. The median number of observations per zone was 71.

As shown in Table 17, the model explains more than three-quarters of the observed variation in property values. The difference in prices between houses and apartments is significantly smaller in Lille than in Marseille (this may be due to relative supply differences, which would also explain the smaller sample of Marseille).

Aside from this, results are largely similar in sign and statistical significance to those from Marseille. In relation to energy efficiency, there is a strong positive relationship between a property's energy label and its value, although the effect of a one-letter improvement on value is smaller than for Marseille (3.2% compared to 4.3%). This runs counter to the intuition that energy efficiency would be rewarded more in regions with a greater dependence on energy for comfortable conditions of habitation.

However, separate regressions for house and apartment subsamples throw up an additional result. As with Marseille, one of the two segments appears to be driving the relationship between energy efficiency and property value. In the case of Lille however, it is houses, not apartments: each one-letter improvement in label is associated with a 4.7% higher price, while for apartments the effect is 1.5% and only marginally statistically significant.

Table 17: Results for Marseille and Lille (sales transactions)

Dependent variable: Price	Marseille	Lille
Energy label (A=1, G=7)	-0.04347***	-0.03236***
House:	0.88850***	0.23309***
of which <i>pavillon</i>	0.07192	0.0425
of which villa	0.11161	0.10313***
of which two floors or more	0.06372	0.02704
<i>Apartment:</i>	0.10790*	0.18485
of which studio	0.04359	0.17049
of which duplex	-0.02184	-0.03733
on 2nd floor	0.04096	0.02391
on 3rd floor	-0.21423***	-0.03593
on 4th floor	0.02306	0.02842
on 5th or higher floor	0.21839***	0.09824
<i>Property features:</i>	0.03819	0.0591
Terrace	-0.03685*	0.0253
Cellar	0.01711	0.02337
Balcony	-0.02346	0.01358
Pool	0.01787	0.0276
1st parking space	0.02159	-0.06084
	0.02188	0.03351
	-0.04750**	-0.09272***
	0.01809	0.02633
	0.14949***	0.05911**
	0.01794	0.01986
	0.02645	-0.02517*
	0.01358	0.01229
	0.01073	0.03888
	0.01363	0.02698
	0.14045**	
	0.04994	
	0.10297***	0.13474***
	0.01595	0.01335

2nd parking space	0.11281**	-0.01132
	0.03518	0.02515
Good condition	0.03787**	0.03132*
	0.01441	0.01275
Needs renovation	-0.14001**	-0.13668***
	0.0456	0.03991
Views add value	0.01384	0.01795
	0.01969	0.01439
<i>Property age:</i>		
Pre-WW1	0.02324	-0.08502
	0.03288	0.04476
Interwar	0.05047**	-0.04226**
	0.0176	0.01452
1970s-80s	0.08103***	0.05271**
	0.01624	0.01616
1990s-2010s	0.16054***	0.15565***
	0.02236	0.02092
Size (m ²)	0.01587***	0.01311***
	0.00036	0.00042
Additional effect of m ² , if house	-0.00735***	-0.00345***
	0.00072	0.00045
Constant	11.16535***	11.14448***
	0.04685	0.04647
R-squared	86%	77%
N	1 263	1 915

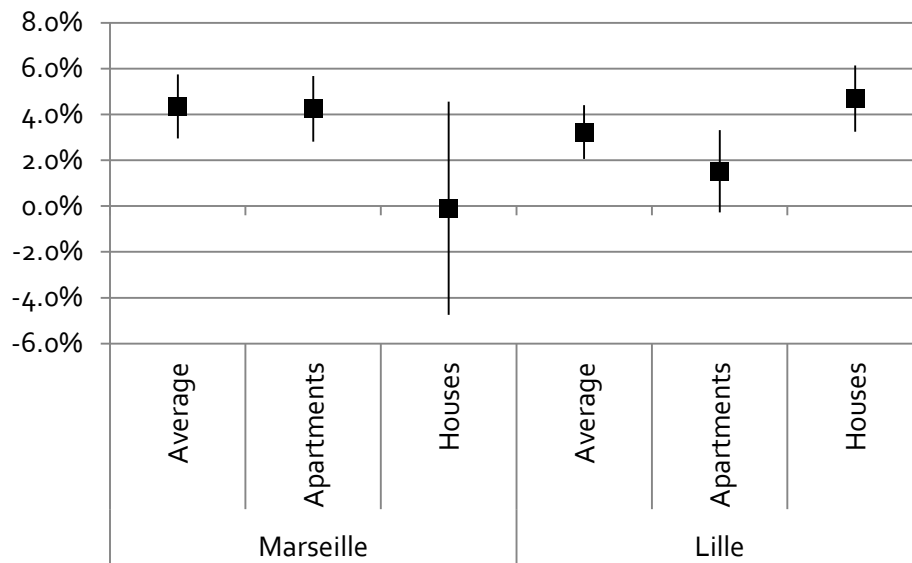
Models as described in the text. Regional square meters effects not shown. Standard deviations are reported in parentheses. ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively.

7.3.3 Summary

Figure 10 shows the estimated effect – and 95% confidence interval – of a one-letter improvement in energy efficiency, across Marseille and Lille. Separate results are shown for the house and apartment segments of each urban area. As discussed above, energy efficiency is not rewarded in the Marseille house market but is in the more temperate Lille market, where a one-letter improvement is associated with a 4.7% higher price.

In the apartment segment, energy efficiency is strongly associated with higher values in Marseille but the relationship is only marginally statistically significant in Lille. This is a result that would benefit from further study, taking in to account the particulars of the market in each city.

Figure 10: Estimated effect and 95% confidence interval of a one-letter improvement in energy rating for Marseille and Lille house and apartment markets overall



Using a pooled regression, it is possible to test whether the difference in effect across cities and segments is statistically significant, or whether it may be due to chance, as a result of small sample size. The pooled regression combines all observations for both urban areas, interacting property attributes with an indicator variable for Lille to allow differentials to vary by city. This analysis suggests that the overall estimated effect of a one-letter improvement in energy efficiency is 3% but that in Lille the effect is smaller, of the order of 1.2%. There is no strong evidence from this model that the effect differs between houses and apartments in either city (this can effectively be seen in the graph above as a horizontal line at 3% would cut through all six confidence intervals).

In summary, there is strong evidence from Marseille and Lille that energy efficiency is rewarded in the French sales market, in particular apartments in Marseille and houses in Lille. The estimated effect of a one-letter improvement in energy efficiency 3.2% for Lille and 4.3% for Marseille. Results would suggest that in the market for houses at least, energy efficiency enjoys a greater premium in the city more dependent on energy for heating, although larger sample sizes are needed for this to be established definitively.

Chapter 8: Ireland

8.1 Assessment of the EPC scheme

8.1.1 Presence of the label

- a) *When did the scheme come into force for which segments of the property market?*

Table 18: Introduction of EPCs in Ireland³⁹

Property type	Date of entry into force
New residential	January 2007
New non-residential	July 2008
Existing buildings offered for sale or rent	January 2009

- b) *What is known about the proportion of properties (as a proportion of total rental or sales transactions) that were actually certified?*

BPIE (2010) estimates Ireland to have issued around 149 000 domestic and 5 000 non-domestic certificates. The written response from the policy maker shed further light, saying that by 16 July 2012 the number of dwellings with a valid EPC was 302 212, and the number of buildings other than dwellings with a valid EPC was 9 261. There were 1 462 296 private households in permanent housing units, according to the most recent census carried out in April 2006. This gives a rough estimate of about 20% of dwellings having an EPC, notwithstanding the difference in time between the census and the EPC figures. This is much lower than the *assumed* proportion of properties certified from the written response, where 2011 Sustainable Energy Authority of Ireland (SEAI) market research identified that, of 200 individuals surveyed, for 40% of transactions an EPC was not requested/provided.

Looking at transactions, according to a recent study (Hyland et al., 2012), 5% of properties for sale and 2.3% of properties to rent listed on Ireland's largest property website Daft.ie (which lists 90% of properties for sale or rent in Ireland) provided details of the EPC (known as the Building Energy Rating (BER) in Ireland). However, the study covered the period January 2008 to early 2012, i.e. before an EPC was required for existing buildings offered for sale or rent.

- c) *What do the regulations say about when the information in the EPCs should be made available?*

The legislation (S.I. No. 666 of 2006) requires that a person (and any agent acting on behalf of such person in connection with such offering) who offers for sale or letting (whether in writing or otherwise) a building shall produce a printed copy of the EPC and advisory report in relation to the building to any person expressing an interest in purchasing or taking a letting of the building

³⁹ Concerted Action, 2010.

and, on demand, to the building control authority in whose functional area the building is situated. In relation to new construction, there are provisions for a provisional EPC to be provided to “any person expressing an interest in purchasing or taking a letting” and a final EPC shall be provided to any purchaser or tenant, before completion of such sale or letting.

Under the 2006 legislation, the onus seemed not to be on the “person offering for sale or letting” or indeed their agents, to be offering the EPC as a matter of course when providing the particulars of buildings, such as for example in the windows of estate agents, on their websites or when spontaneously providing a prospective client with a selection of properties that might be of interest to them. What we can say with certainty is that the EPC had to be provided before contract completion, as according to the written response from the national policy expert, “the EPC requirement is on the conveyance checklist used by solicitors who are responsible for the legal documents”. Thus there is a clear final stop (which is not of use in terms of influencing the purchasing decision) but insufficient clarity in terms of the practices of market actors and who does what, of when the EPCs have to be shown to the potential buyer/renter.

As of 9 January 2013, the EPC must be displayed in all online and print adverts, brochures and “for sale/rent” signs outside properties. As compliance increases, these new regulations should ensure that the EPC is taken into account in decision making.⁴⁰

d) Is there any information available about what actually happens in practice (regarding timing)?

According to the written response from the national policy maker, “the property market is weak at present and activity is relatively low when compared to previous years. Hyland et al. (2012) indicates that 4% of sale properties and 2% of letting properties listed on Daft.ie had an EPC. The EPC is produced in many cases before the sale or lease is complete. The rental market remains a challenge and the SEAI intends to focus awareness campaigns on this sector. S.I. 243 of 2012 (the national legislation transposing the recast EPBD) has required the inclusion of the EPC in advertisements since 9 January 2013.

8.1.2 Understanding of the label

a) What information is available about buyer/renter understanding of the EPC?

According to the IEA (2010), “the frequency of certification of different types of buildings has been studied and consumer awareness and attitude surveys have shown a high level of recognition of the concept of energy certification for buildings among the general public”. Indeed, the SEAI has commissioned market research on the EPC annually since 2008. From a presentation provided by the national policy maker interviewed, 2011 results show that awareness of the term “BER” (i.e. EPC) for homes or buildings amongst a sample of residential buyers or renters has remained high in the past three years. The figure was 21% in 2008, and this increased substantially to 54% (2009), 59% (2010) and finally to 69% (2011). In relation specifically to *homes*, the awareness level is even higher. Whether in relation to homes for sale or rent, as a

⁴⁰ Guidelines on the advertising of EPCs have been published at www.seai.ie/Your_Building/BER/Advertising_of_BER/.

seller/landlord or buyer/renter, awareness levels hover between 83 and 87%. The highest proportion of people polled correctly identified the BER as the Building Energy Rating (47%), although more than one-quarter (27%) responded “don’t know”. Similarly, the number of people who felt that “a certificate showing how energy efficient your home/building is” was an accurate description of the BER responded overwhelmingly (83%) that the BER was “very accurate” (58%) or “fairly accurate” (25%). This is consistent with results from 2009 (86%) and 2010 (84%). A sample of 213 people was interviewed, roughly a quarter each for home sellers, home buyers, renters and landlords.

8.1.3 Concern about energy use and environmental impact when selecting a property

- a) *Is there information available about the role of energy use or environmental impact as dimensions of property selection?*

The national policy maker’s response stated that general results from SEAI market research show that buyers and tenants are willing to pay for increased energy efficiency, with buyers valuing energy efficiency more than renters. This confirms the findings of our literature review.

The most recent Eurobarometer survey relating to Europeans’ attitude to climate change (EC, 2011b) is shown in Table 19 as part of the broader societal context to the property market in Ireland.

Table 19: Attitudes to climate change in Ireland and Europe⁴¹

Question	Ireland	EU-27
% of respondents placing climate change as the most important problem facing the world	13%	20%
Seriousness of climate change on a scale of 1-10 (average ranking)	7.0	7.4
% of respondents having insulated their home to reduce energy consumption	28%	18%
% of respondents having bought a low-energy home	3%	3%

8.1.4 Trust in the information on the label

- a) *Has trust been an issue in the public debate about the introduction of EPCs? If so, what themes have been evoked?*

According to the national policy maker’s written response: “Trust in the information on the label has not featured strongly as an issue. The independence of BER/EPC assessors is a matter of ongoing consideration at SEAI.” However, it is interesting to note from the 2011 SEAI market research that 35% of respondents (i.e. 200 people) did not know who is authorised to carry out a BER assessment.

⁴¹ Eurobarometer, 2011.

- b) *Are the building blocks of trust in place, in particular in terms of provisions for quality assurance of certification?*

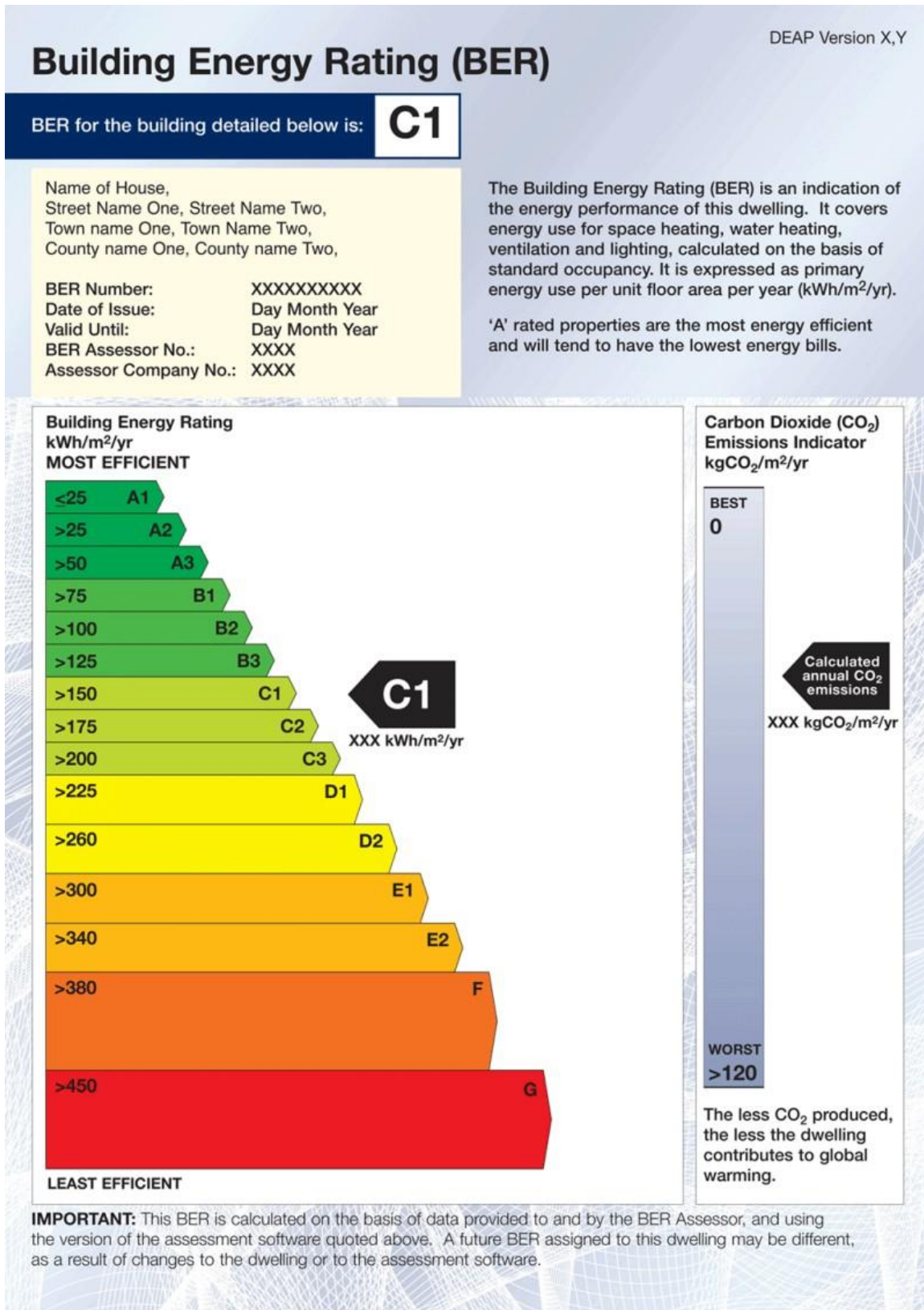
According to BPIE (2010), EPCs are issued by specially trained BER assessors, who are building professionals with relevant backgrounds, registered with the SEAI, which sets requirements for assessors. They have to follow initial accreditation training with examination and periodic follow-up training courses and pay a fee to be re-registered annually (see also IEA, 2010). Assessors have to sign a Code of Practice that includes requirements to act in a professional and independent manner, to comply with the scheme rules and ensure confidentiality. The national database is used for practical quality control of issued certificates. Audits are taken both on a random basis and as a result of any unusual or suspect data. Every active assessor is on average assessed at least once a year. It is the responsibility of the “Issuing Authority” (SEAI) to check the work of the energy assessors, and “reasonable sanctions” can be imposed. The Building Control Authority is responsible for enforcing compliance by building owners.

8.1.5 Anticipated effect of EPCs on transaction prices and rents

The low level of dwellings for sale or rent with EPC ratings provided could indicate a low level of enforcement of the legal requirement to provide this information. This situation is likely to be greatly helped by the changes to this legislation in implementing the recast EPBD, requiring that the energy rating be listed when an asset is advertised. Unfortunately, it is not possible to identify the level of public trust in the label although understanding of what the label represents appears high. According to the national policy maker’s response, trust in the label has not been an issue; therefore we can presume that availability of the EPC early in the asset selection process will only increase its potential role in the decision-making process. Similarly, one or two studies have shown that the energy efficiency rating of dwellings is of interest to prospective buyers/renters, so we can presume that such interest will continue to grow or at least be maintained given generally anticipated energy price increases. Too few data or responses were provided for non-residential assets, so it is not possible to draw conclusions.

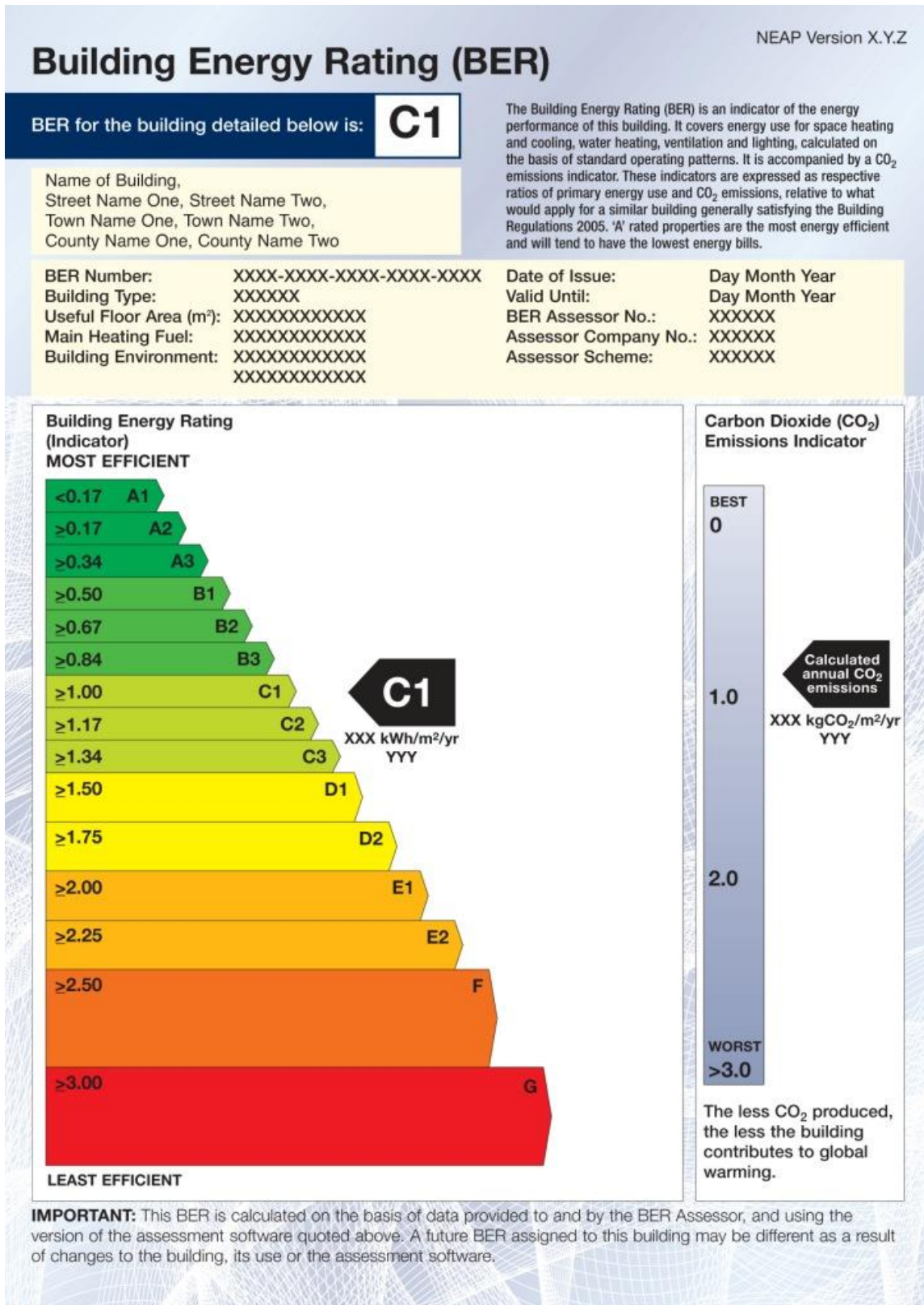
Another policy development that could help strengthen the role of EPCs in purchasing/renting decisions (for both residential and non-residential assets) is the Irish government’s financial support to energy efficiency building retrofits. Through the Better Energy Homes scheme, financial assistance is provided to homeowners to reduce energy use, costs and greenhouse-gas emissions and improve the comfort levels within their home. The EPC is a mandatory element of this scheme. Also, the Better Energy: National Upgrade Programme aims to support the improvement of energy efficiency of one million homes, businesses and public buildings by 2020 (DCENR, 2011). Actions supported include improving insulation, upgrading boilers or installing better heating controls. This could offer owners/landlords the opportunity to better understand the link between improved energy efficiency and the (potential) value of the asset, whether for rental or sale.

Figure 11: Residential EPC, Ireland



Source: Sustainable Energy Authority of Ireland, BER Helpdesk.

Figure 12: Non-residential EPC, Ireland



Source: Sustainable Energy Authority of Ireland, BER Helpdesk.

8.2 Establishment of a dataset

The central register of EPCs is maintained by the SEAI.⁴² The register contains, for both domestic and non-domestic properties:

- Address of the dwelling;
- Rating achieved;
- Validity period of the certificate;
- Floor area;
- Wall and window type;
- Number of storeys;
- Space and water heating systems;
- Assessor's contact details.

The Irish register distinguishes three types of property:

- New dwelling (Provisional) - This is for properties that are not yet completed. A final assessment cannot be performed as the building may change during construction.
- New dwelling (Final) - This is for newly constructed properties. The definition of 'new' is a property which has never been occupied or sold.
- Existing dwelling - Any property which has previously been sold or occupied.

In July 2012 SEAI launched a National BER Research Tool to give researchers access to statistical data from the BER scheme.⁴³ This tool provides access to information on all aspects of construction that affect the energy performance of dwellings. Results can be viewed on screen or downloaded in the form of an Excel spreadsheet. In order to comply with data protection legislation, the full address (the crucial variable needed in this study for matching with transaction prices) has been removed from the BER records available. Nevertheless, Ireland is a front-runner among Member States in this respect and the tool would be useful for other types of research project.

As EPC data with addresses could not be obtained from SEAI, we use the self-reported energy ratings contained in the Daft.ie property dataset, described in the next section. An official register of transaction prices in Ireland has only recently been established and does not provide very detailed information.

⁴² See <https://ndber.seai.ie/pass/ber/search.aspx..>

⁴³ See www.seai.ie/Your_Building/BER/National_BER_Research_Tool/.

8.3 Regression results

The results presented for Ireland are based on property listings on the widely used Daft.ie website. Listings were available for the entire period from a year prior to adoption of mandatory EPCs for transactions (although advertising the EPC rating was not mandatory), for the entire country, for both sales and lettings markets.

An academic paper by Hyland, Lyons and Lyons (2012) describes in detail a two-stage model, including selection effects (i.e. which properties were more likely to have an EPC) as well as price effects (see Annex E for a description). The focus here is on the effect on price (or rent), meaning the dataset comprises 20 000 sales listings and 28 000 rental listings over the period 2008-2012 with valid EPC ratings.

In addition to EPC rating and whether a property is for sale or to rent (and its price or rent accordingly), information is available for each property across four further dimensions. The first is in relation to property type, i.e. house or apartment for lettings, and for sales further detail on the type of house. The second is in relation to the property's size. Unlike most countries, size in square metres is not a widely used metric by Irish consumers, and indeed this information is not available at all for the lettings segment. A dual approach was adopted. For both sales and lettings, information on the number of bedrooms and bathrooms (relative to bedrooms) is used as a proxy for size. For a subsample (of roughly 11 000 sales listings), information on square metres was also available.

The third relates to when a property was listed. Indicator variables were included for each quarter from Q12008 to Q42012. The final dimension relates to location: this is captured using postcodes within Dublin city and broader city/county fixed effects for the rest of the country.

As with other countries, interactive size terms are included, both for larger and smaller properties (above 200 m² and below 100 m², respectively), allowing the premium for an extra square metre to change between from small to large properties, and also for rural properties, to allow differentials to vary between urban and rural markets.

There are three empirical strategies adopted to estimate the effect of energy efficiency on prices and rents. The first treats the EPC rating as a 15-point scale from A₁ to G, while the second treats it as a seven-point scale from A to G, to allow comparability of results with other countries. The third includes an interactive term for rural listings, to examine whether the premium for energy efficiency varies between urban and rural markets.

As with other countries and regions, the empirical specification includes a filter for outliers. The process uses a calculation called Cook's Distance to exclude those observations with a disproportionate effect on the estimation of the coefficients of the model (a statistical test for outlier status). In the case of Ireland, this resulted in the exclusion of 5% of observations, on average.

8.3.1 Sales

The model for the sales market in Ireland explains roughly three-quarters of the variation observed in house prices, a proportion that rises to 80% when the model uses square metres rather than number of bedrooms and bathrooms to measure size. The premium associated with an additional square metre is 0.6% in the cities and 0.4% elsewhere, which is lower than in the other European regions in this study.

There are precisely measured effects of improved energy efficiency on price. In the model including square metres, Model (3), a one-letter improvement in EPC is associated with a 2.8% increase in list price. Model (4) breaks this down between city and non-city areas and, as per Hyland, Lyons and Lyons (2012), the effect on price is stronger in rural markets (3.8% on average, compared to 1.7% in the cities). This may reflect weaker market conditions outside the cities or, as discussed in the case of Brussels-Capital, it may reflect a trade-off between fixed euro savings per square metre and high property values in the cities.

These results are outlined in Table 20, where Models (1) and (2) use the 15-point EPC scale but differ in their treatment of size, while Models (3) and (4) use a 7-point scale (from A to G), comparable with other European Member States and regions.

Table 20: Results for Ireland, sales market

Dependent variable: Advertised price	Model (1)	Model (2)	Model (3)	Model (4)
Increase in EPC (15-point A1-G scale)	-0.01464***	-0.01192***		
Increase in EPC (7-point A-G scale)			-0.02834***	-0.01691***
Additional EPC effect Outside five major cities			0.00186	0.00274
<i>Property size:</i>				-0.02144***
Size (m ²)		0.00559***	0.00561***	0.00365
Where m ² is low		0.00012	0.00012	0.00012
Where m ² is high		-0.00037***	-0.00036***	-0.00036***
Additional size effect Outside five major cities		0.00005	0.00005	0.00005
<i>Alternative size measure:</i>		-0.00090***	-0.00086***	-0.00081***
1-bedroom	-0.52268***	0.00008	0.00008	0.00008
2-bedroom	0.02167	-0.00139***	-0.00143***	-0.00166***
		0.00011	0.00011	0.00012

	0.01207			
4-bedroom	0.25694***			
	0.01258			
5-bedroom	0.46701***			
	0.02544			
<i>Property type:</i>				
Apartment	-0.19161***	-0.22999***	-0.23177***	-0.21318***
	0.01409	0.01181	0.01172	0.01197
Duplex	-0.25355***	-0.26086***	-0.25810***	-0.25037***
	0.01892	0.0186	0.01854	0.01875
Bungalow	0.19110***	0.10359***	0.11689***	0.10360***
	0.01365	0.01567	0.01559	0.01569
Terraced house	-0.17250***	-0.12579***	-0.12648***	-0.12396***
	0.0082	0.00942	0.00935	0.00936
Detached house	0.23539***	0.08225***	0.08100***	0.07489***
	0.01049	0.01207	0.01201	0.01203
Newly developed property	-0.11838***	-0.13246***	-0.12764***	-0.13299***
	0.0106	0.01193	0.01168	0.0117
Constant	12.80979***	12.27826***	12.25626***	12.19981***
	0.01952	0.02526	0.0247	0.02601
R-squared	73.5%	79.8%	80.1%	80.1%
N	19 094	11 253	11 247	11 255

8.3.2 Rental

The rental models also explain a high proportion of the variation observed in rents – roughly 80% in each case. Again, variables typically have the signs expected and are statistically significant, while location-fixed effects (not shown) are also generally statistically significant.

The rent effect of energy efficiency is small but precisely estimated. For the specification comparable with other countries and regions, a one-letter improvement in energy rating is associated with a 1.4% higher rent. Unlike the sales segment, there is no statistically significant difference in the effects of energy efficiency on rents in the cities compared to the non-city areas. These results are outlined in Table 21.

Table 21: Results for Ireland, rental market

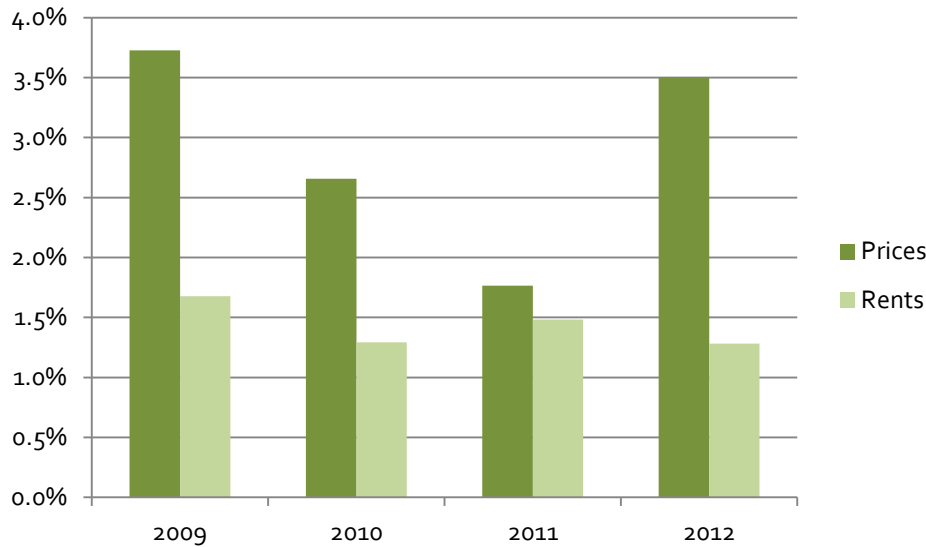
Dependent variable: Advertised rent	Model (1)	Model (3)	Model (4)
Increase in EPC (15-point A1-G scale)	-0.00571***		
Increase in EPC (7-point A-G scale)		-0.01418***	-0.01521***
Additional EPC effect		0.00084	0.001
Outside five major cities			0.00353
<i>Property size:</i>			0.00184
1-bedroom	-0.35256***	-0.35243***	-0.35251***
	0.0062	0.0062	0.0062
2-bedroom	-0.16583***	-0.16593***	-0.16596***
	0.005	0.005	0.005
4-bedroom	0.17746***	0.17730***	0.17659***
	0.00636	0.00636	0.00637
5-bedroom	0.35661***	0.35669***	0.35619***
	0.01394	0.01394	0.01394
<i>Property type:</i>			
Apartment	0.01330***	0.01387***	0.01348***
	0.00353	0.00353	0.00354
Flat	-0.21937***	-0.21598***	-0.21610***
	0.01059	0.01059	0.01059
Constant	7.09183***	7.09098***	7.09462***
	0.01006	0.01008	0.01026
R-squared	79.6%	79.6%	79.6%
N	26 647	26 651	26 651

8.3.3 Effect over time

Given the long timeframe for which Irish data are available, it is possible to examine the effect of energy efficiency on prices and rents over time. This was done through additional regressions by year. The results are shown graphically, in Figure 13 below. There is no clear pattern from the rental segment. For the sales segment, it appears that the price effect was largest immediately after the introduction of EPCs in 2009, before halving by 2011.

Evidence from 2012, however, suggests that the price effect was almost as large then as in 2009. The introduction of mandatory EPCs at the time of advertisement in 2013 may have an effect on the relationship between energy efficiency and prices (or rents).

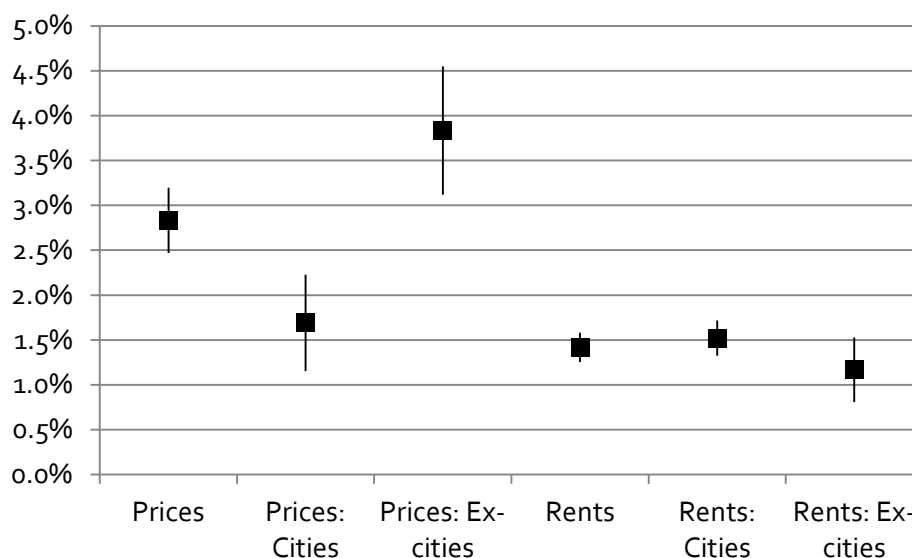
Figure 13: Effect of one-letter improvement in energy efficiency on prices and rents in the Irish property market (2009-2012)



8.3.4 Summary

Overall, there are clear signs from the property market in Ireland that energy efficiency is rewarded. The effect of a one-letter improvement in energy efficiency is estimated at 2.8% in the sales market and 1.4% in the lettings market. Overall, the effect in Ireland appears to be smaller than in other countries studied. However, as with other regions where price-rent comparisons were available, there is an attenuated rental effect when compared with the price effect. Worthy of further study, this suggests that owners benefit above the ongoing monthly benefits that accrue to occupiers. Similar to Belgium, but in contrast to Austria, there is also evidence that the price effect is larger outside the main cities than in them.

Figure 14: Effect of one-letter improvement in energy efficiency on prices and rents (and 95% confidence interval) in the Irish property market



Chapter 9: United Kingdom

9.1 Assessment of the EPC scheme

9.1.1 Presence of the label

- a) *When did the scheme come into force for which segments of the property market?*

Table 22: Introduction of EPCs in England and Wales⁴⁴

Property type	Date of entry into force
Homes when sold (marketed sales only)	Phased from 1 August 2007
Homes when built	6 April 2008
Commercial > 10 000 m ² when built, sold or rented	6 April 2008
Commercial > 2 500 m ² when built, sold or rented	1 July 2008
All remaining homes when sold (non-marketed sales)	1 October 2008
Homes when rented	1 October 2008
All remaining commercial buildings when built, sold or rented	1 October 2008

- b) *What is known about the proportion of properties (as a proportion of total rental or sales transactions) that were actually certified?*

In relation to the residential sector, Lainé (2011a)⁴⁵ found that 44% of respondents who had moved in the previous two years had received information on the energy efficiency of the property before signing a contract, while 48% had not and 8% did not know. Within this sample, 79% of buyers, 33% of social housing tenants and 31% of private sector tenants had received the information.⁴⁶ Adjei (2011) found that 69% of recent home buyers were aware that the asset had an EPC.

In relation to the commercial sector, one study (NHER 2009) found evidence of widespread non-compliance with the regulations regarding the availability of EPCs for commercial buildings that were being marketed for sale or rent over a period from the end of April to the end of May 2009. Of the 108 property agents contacted about a specific property they were marketing, 88 (81%) did not have an EPC available. When asked why, the following reasons were given by agents:

⁴⁴ Source: DCLG (2008). EPCs were introduced in December 2008 in Northern Ireland (www.dfpni.gov.uk/index/buildings-energy-efficiency-buildings/energy-performance-of-buildings.htm) and January 2009 in Scotland.

⁴⁵ Lainé (2011a) surveyed householders who had recently bought or rented a property about the EPC. Consumer Focus asked householders how information on energy efficiency informs their actions in the property market – before and after buying a home. Consumer Focus in particular wanted to know whether consumers receive the information and if so what impact that information has. Fieldwork took place in January 2011.

⁴⁶ Weighted base of 299 respondents.

- Almost half (47%, 41 agents) said they believed an EPC was not necessary or that they just did not know;
- One third (36%, 32 agents) said that they would only get an EPC at the point of sale;
- 17% (15 agents) said they believed the EPC was in the process of being undertaken.

A more recent impression can be gained from the UK interview conducted for this study. According to the policy maker concerned, 95% or more of domestic property sales transactions are accompanied by an EPC. For rentals this is likely to be lower but as there is no authoritative database this is more difficult to say. The interviewee's view was that about 60% of rental transactions are accompanied by an EPC. Data for offices are not distinguished from the rest of what is known in the UK as the commercial sector. Again, it was the policy maker's view that it would not be likely that this was greater than 60% whether it was rental or sales. In England and Wales, 5.7 million domestic EPCs and 210 000 non-domestic EPCs had been lodged by the end of 2010.⁴⁷

c) What do the regulations say about when the information in the EPCs should be made available?

This is set out in "The Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007".⁴⁸ The relevant person must make available a valid energy performance certificate to any prospective buyer or tenant free of charge (a) at the earliest opportunity; and (b) in any event before entering into a contract to sell or rent out the building or, if sooner, no later than whichever is earlier of – (i) in the case of a person who requests information about the building, the time at which the relevant person first makes available any information in writing about the building to the person; or (ii) in the case of a person who makes a request to view the building, the time at which the person views the building.⁴⁹ There were amendments to the regulations in May 2010⁵⁰ and again in April 2012.

When a prospective landlord or seller approaches an agent with a view to renting or selling they must commission the EPC and it must be available within seven days. The idea is that the EPC is available at the point in time when the prospective renter or buyer expresses a real interest. There is then a window where the prospective client may have to wait.

The estate agent is not obliged to make the EPC available. This obligation is on the landlord or seller. The agent acting on their behalf must provide it on request. This suggests a weakness, as

⁴⁷ See www.epbd-ca.org.

⁴⁸ See www.legislation.gov.uk/uksi/2007/991/contents/made.

⁴⁹ The regulations provide some useful definitions of "prospective buyer or tenant", stating that a person becomes a prospective buyer or tenant to a building when he – (a) requests any information about the building from the relevant person for the purpose of deciding whether to buy or rent the building; (b) makes a request to view the building for the purpose of deciding whether to buy or rent the building; or (c) makes an offer, whether oral or written, to buy or rent the building. The "relevant person" is in the case of sale, the seller, in the case of rental, the prospective landlord, and in the case of new buildings, the person carrying out the construction work.

⁵⁰ Department for Communities and Local Government 2010 No. 1456 BUILDING AND BUILDINGS, ENGLAND AND WALES; The Energy Performance of Buildings (Certificates and Inspections) (England and Wales) (Amendment) Regulation 2010.

the landlord or seller only has indirect contact with the prospective renter or buyer through the agent. However in the interview it was suggested that this is unlikely to be a cause for concern as the front page of the EPC must be attached to the written particulars. This means that the prospective buyer or renter will be aware of the EPC and can request the full EPC. The requirement to include the front page of the EPC with the written particulars of the property falls on the agent and was introduced in April 2012 in connection with the Green Deal (Box 2), which will require legal disclosure for whether an asset has a Green Deal on it and whether measures to improve energy efficiency have been undertaken. The requirement is slightly different from what the recast EPBD requires in relation to the inclusion of EPCs in advertisements. This was to be introduced in late 2012.

Box 2: The Green Deal

The Green Deal provides financing for people to improve the energy efficiency of their homes. It is also available in the commercial sector but is not likely to be the best option in that sector in all cases (this seems to be dependent on the scale of refurbishment). It is a way of getting over the “first cost” of energy efficiency improvements, with the “loan” being paid back through the utility bill. A “Green Deal provider” assesses the energy efficiency of the house (through the EPC) and discusses with the householder the package that s/he can afford. The package will be installed and the EPC is updated. At that point the EPC will also have a line saying that the property has a Green Deal. This is likely to be unique in the EU.

The Green Deal provides the opportunity to use the “recommendations” part of the EPC as a basis for dialogue between the householder and an informed professional. It should be noted that the recommendations part has been subject to criticism precisely as a basis for informing decision-making about refurbishment. The installation of a more formalised process of dialogue around the recommendations part of the EPC could help overcome some of this by helping the householder to understand it better and draw suitable conclusions. But even if mediated to a greater extent by expert advice, it remains crucial that the recommendations part of the EPC provides a meaningful guide to decision-making. While the Green Deal sounds like a potentially very interesting instrument, some sources still express scepticism.

- d) *Is there any information available about what actually happens in practice (regarding timing)?*

In relation to the residential sector, a study by Consumer Focus (2011a) did not ask about the timing of the information being made available but included in its recommendations that the EPC should be made available earlier. Interestingly, while Consumer Focus decided to undertake a second study to investigate more deeply why the EPC played a limited role in decision-making (Lainé 2011b), this did not investigate the issue of timing either but focused on other dimensions

of reception. There does however appear to be a belief among market actors that the provision of the EPC can be delayed until shortly before the parties enter into a contract for sale or rent (DCLG, 2011). Adjei (2011) found that 44% of the recent buyers surveyed had received the EPC before making an offer.

9.1.2 Understanding of the label

a) What information is available about buyer/renter understanding of the EPC?

Two studies commissioned by Consumer Focus (Lainé, 2011a and 2011b) in relation to the residential sector are of great value here. The first study found that 76% of those who had received an EPC said that the rating and recommendations are clearly laid out. Lainé remarks that this is “the most surprising response from consumers” as energy efficiency professionals generally consider the EPC to have a confusing layout. According to 8%, the EPC did not set out clearly the rating and the recommendations, while 16% said they did not know. The survey asked a follow-up question as to what information was clearly set out, and it is perhaps not surprising that the highest scoring item was the now familiar A-G scale, mentioned by 34% of respondents. The second highest response was “don’t know”.⁵¹ Lainé concluded that the survey had given “mixed messages” regarding the clarity of the EPC and a second study was carried out.

The second study specifically looked at the content and format of the EPC through seven focus groups. These represented a cross-section of British consumers, including buyers and renters, and included a group of property professionals who, as Lainé observes, have a crucial role in presenting the EPC. The main thing to come from the study as far as understanding of the label is concerned, is the suggestion that the EPC is not understood as well as it could be, and that this is because it has been designed more with the energy expert in mind than the buyer or tenant. Thus it would seem that the residential market understands the basic idea contained in the A-G rating but may have more difficulty engaging with some of the more detailed aspects of the information as currently presented. Nevertheless, Lainé (2011b) argues that the rating is not enough by itself as consumers cannot readily translate a specific rating into a monetary saving or loss. It should be remembered however, that part of moving towards a more carbon- and energy-literate society means mastering new skills and information for everyone, such that it may be that this information is too technical, but it should also be considered whether there is sufficient effort put into helping users of various kinds to understand it. Lainé (2011b) concludes that the layout of the document must be improved through use of plain language, colour, iconography and layout. She also asserts that “money talks” and that money should be used as the primary unit for communicating energy efficiency, as “consumers do not understand CO₂ or kWh”. Another study by Adjei (2011) reports that 64% of recent buyers surveyed reported that the EPC was “very easy” or “easy” to understand.

⁵¹ Weighted base of 101 respondents.

9.1.3 Concern about energy use and environmental impact when selecting a property

- a) *Is there information available about the role of energy use and environmental impact as dimensions of property selection?*

Lainé (2011a) asked respondents which features (from a list) in addition to size and price were most important in deciding to move into their current property. One way of looking at the results would be to say that energy was ranked fifth on a rather long list. Another way would be to state, as does the author, that 14% of prospective buyers and tenants said that they consider energy issues to be important. It should be noted that one of the motivations for the second study was that the author puzzled over why “so little importance is placed on energy efficiency, when we know consumers are very concerned about their energy bills” (Lainé 2011b), suggesting a considerable background concern about energy bills among UK households.

Adjei (2011) reports on a survey of homeowners who purchased a dwelling between January 2008 and September 2009, conducted in the context of the EC-funded project IDEAL EPBD. Part of the survey involved asking respondents about the importance of 12 factors taken into account when purchasing a dwelling. Factors such as location, price, feeling about the neighbourhood and the availability of a garden and outdoor space were considered as important by over 80% of recent homebuyers. The condition of the property was considered important by more than 60%, while the expected utility costs and type of heating system was considered important by over 40%. Over a quarter of the recent buyers surveyed deemed the EPC “not at all important” in making an offer. However, this suggests that the other 75% deemed it at least to some extent important, which appears a rather substantial share.

Lainé (2011b) also notes that “consumers are highly unlikely to negotiate on the basis of the EPC’s contents as once they have found the home they want, they do not want to ‘appear difficult’ and ‘risk losing out’”. This is rather an interesting finding that can be compared with the anticipation of sustainability chipping in the commercial market. It is not a situation that needs to be fixed in time and could be improved for example if professionals acting on either side of the transaction were better equipped to advise their clients on this dimension. This being the case, like other items that can be mobilised for negotiating the transaction price up or down, the condition of the market will also affect this as it will affect the general negotiating position of both the buyer/renter and the seller/landlord. Lainé’s findings are supported by Adjei (2011) who reports that only 3% of recent buyers had used the EPC to negotiate the price of their current home. The survey, it should be remembered, was carried out in January 2008 to September 2009.

The UK Department for Communities & Local Government (DCLG) has looked at the relevance of the information on the EPC and this led to a relaunch of the EPC in April 2012. The EPC has been simplified and greater prominence given to the kind of information that is most “relevant” to individuals and businesses. Relevance in this context is understood as the kind of information that individuals and businesses are most likely to act upon. This has led to a greater emphasis on the way in which using the information on the EPC can lead to monetary savings. In the detail, the carbon savings are retained but the money-related information is now privileged in the

design. In the judgement of the policy maker interviewee, energy does not count but running costs do.

According to the interview, the “greenness” of buildings more broadly is very low priority in property choice. However, some of the questions in the most recent Eurobarometer survey relating to Europeans’ attitudes to climate change (EC, 2011b) can serve as useful context, helping to assess the likelihood of UK buyers/renters taking into account both energy performance and environmental impact when selecting a property (Table 23).

Table 23: Attitudes to climate change in Europe and the UK⁵²

Question	UK	EU-27
% of respondents placing climate change as the most important problem facing the world	18%	20%
Seriousness of climate change on a scale of 1-10 (average ranking)	6.4	7.4
% of respondents having insulated their home to reduce energy consumption	30%	18%
% of respondents having bought a low-energy home	2%	3%

9.1.4 Trust in the information on the label

- a) *Has trust been an issue in the public debate about the introduction of EPCs? (If so, what themes have been evoked?)*

The “credibility” of EPCs has been discussed in the public domain in the UK including among professionals (Lainé (2011b) and confirmed by interviewees). There were a number of teething problems with the introduction of the EPC, including in regard to its accuracy, which had implications for the level of trust in the information it provides. According to the policy-maker interviewee this led to an attempt to address the issues of accuracy and quality as a way of improving trust. This was addressed first by looking at the software that underpins the EPC to ensure that it had the right algorithms. Secondly, the quality of the assessors was considered and there were modifications to their training and accreditation processes. Finally, a quality assurance framework was instituted to continually monitor quality and accuracy. This had been in operation for about 18 months at the time of the interview in June 2012. According to the policy maker, this approach had enabled DCLG to be transparent about what the problems had been and how these had been addressed.

A number of existing and potential future problems, e.g. arising from the 10-year lifespan of EPCs (Lainé, 2011b p.6) have been raised. It is perhaps indicative that in December 2010, the Ministers for Energy & Climate Change and Communities & Local Government apparently engaged in a joint information-gathering exercise to investigate problems with the quality and consistency of the EPC (Lainé 2011b). This suggests that there is an issue of trust in the EPC in the UK, some of which revolves around scepticism of the method for deriving the rating (Lainé, 2011b).

This is also borne out by Adjei (2011) who reported that fewer than 25% of recent buyers surveyed distrusted the EPC. Some 40% said they trusted the label. The rest said they neither trusted nor distrusted the EPC.

⁵² Eurobarometer, 2011.

b) *Are the building blocks of trust in place, in particular in terms of provisions for quality assurance of certification?*

As noted above, there has been a focused attempt to deal with early issues of trust in the information on the EPC. In the judgement of the policy-maker interviewee, this has been successful in improving trust and the fact that it has been possible to connect an arrangement like the Green Deal involving financing to the EPC is a reflection of this. In the interviewee's judgement there were trust issues from the time of implementation in 2007 until 2010. The independent expert interview suggested there is still an issue of trust in the label, in particular in the commercial sector and that this relates to the relationship between the asset rating approach and how this relates to actual energy consumption.

9.1.5 Anticipated effect of EPCs on transaction prices and rents

While it seems like a high proportion of sales transactions in the domestic market are accompanied by an EPC (95% according to the national policy maker consulted), this is less the case for rental transactions and for commercial transactions, whether rental or sales (around 60%). The EPC appears to have been poorly integrated into the decision-making process of prospective buyers and sellers until relatively recently but with the new requirements to include the front page of the EPC in written particulars, this is likely to change. It will also change in future with the requirements of the recast EPBD to include the energy rating when a property is advertised. Furthermore, energy is a relatively insignificant factor in the decision-making process (in spite of consumer concern with energy bills). This suggests that energy is also likely to be a relatively insignificant factor in the choice of properties. It may be that the situation is a little better in the commercial sector where occupiers in particular will be concerned about running costs, but this is not likely to be pronounced at present.

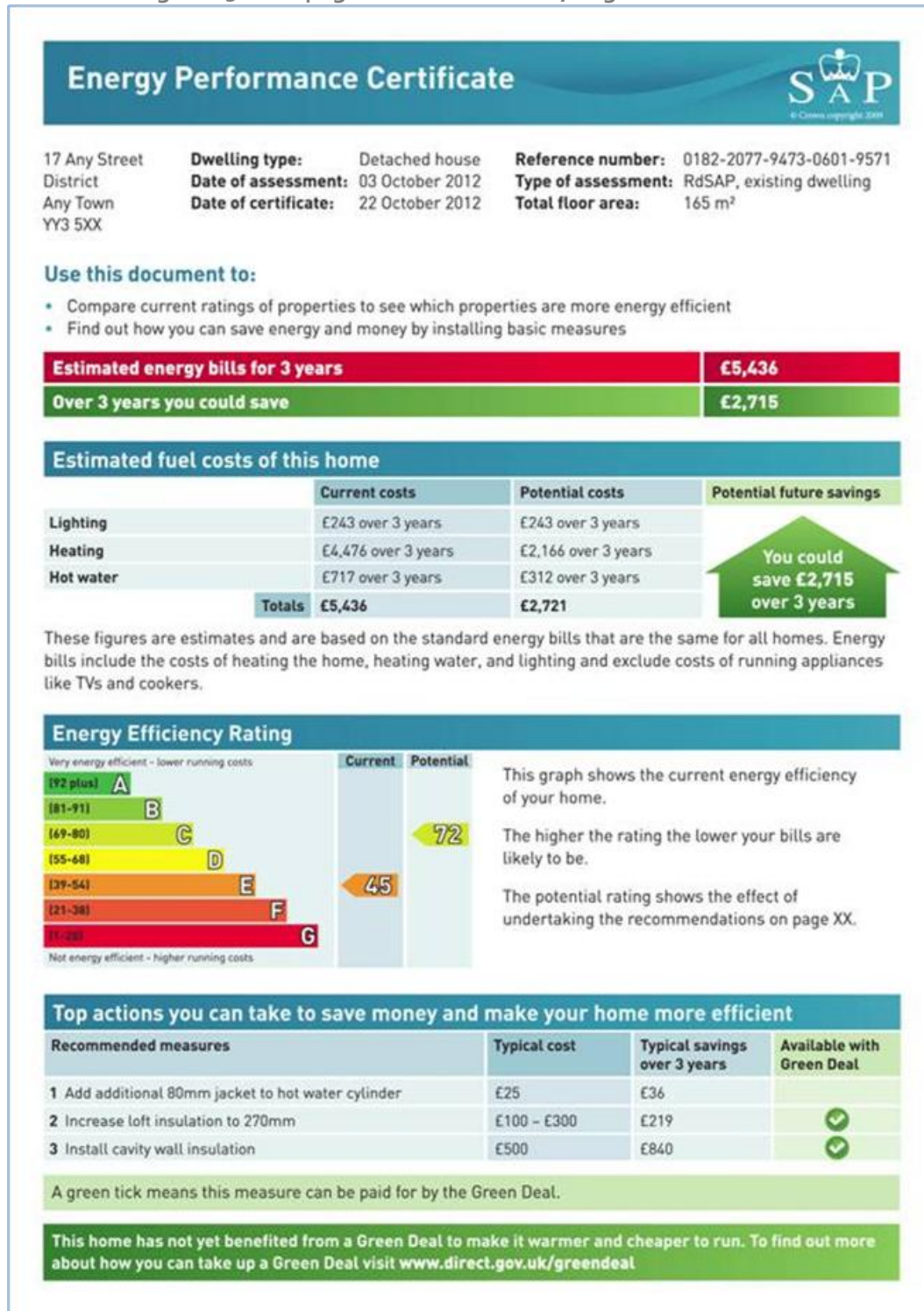
The April 2012 changes to the design of the label should mean that the information has become more "relevant" to prospective buyers and renters such that they may be more likely to react to the information. It appears that trust in the information on the EPC is improving and the building blocks are in place to ensure this improvement is maintained. However, continued concerns about the difference between calculated energy in the asset rating and actual energy consumption could potentially undermine this. There may be a need to explore how what appears to be a potential source of lack of credibility could be addressed.

The observation of the policy maker was that while it is possible to show that DIY (do-it-yourself home improvement) improves value, there is little evidence to show that increased energy efficiency improves value. Research carried out for DCLG suggests that this is because the market does not demand it. This is more likely if there is a better understanding of the reduction of running costs associated with improvements in energy efficiency. There is also an issue about the valuation community not having had access to sufficient, and sufficiently good, information about energy performance. Of course this is precisely what the EPC can do.

In summary, while a significant proportion of transactions are accompanied by an EPC in England and Wales, until very recently this information has reached the potential buyer or renter too late in their decision-making process for it to be likely that there will be a discernible impact on value

as a result of the introduction of the EPC. However, it should be clear from the above that this situation could change with the introduction of requirements to include the first page of the EPC on written particulars and also the new requirements in the recast EPBD with respect to advertising property.

Figure 15: First page of residential EPC, England and Wales⁵³



⁵³ Source: <http://gogreena.co.uk/wp-content/uploads/2012/10/energy-performance-certificate.jpg>.

9.2 Establishment of a dataset

9.2.1 EPC data

A register for England and Wales is maintained at www.epcregister.com by a company called Landmark on behalf of the UK Government.⁵⁴ The data is contributed by individual accreditation schemes. There are over 7 million EPCs on the register and around a further million are being added each year. A separate register exists for Northern Ireland.⁵⁵ The information on the certificate includes the address of the building, its energy efficiency rating, technical information the building construction and the recommended improvements.

The need for EPC data to be made available has long been recognised in the UK. For example, RICS (2010) recommended that “both EPC data and the methodology underpinning it need to be made publically available in a form that allows meaningful research to be carried out, innovative new approaches developed and tested and to allow proper market segmentation and targeting of government support measures”. Until now, the data held by the England and Wales register has been private. However, in April 2012, changes were made to the Energy Performance of Buildings framework that include opening up access to the EPC register.⁵⁶ Bulk information can now be made available to selected organisations.⁵⁷

There are about 7.3 million domestic EPCs in England-Wales as of June 2012.⁵⁸ About 1.3m of these were registered in the last 12 months. If we focus on the period 2011Q1-2012Q2 (18 months in total), we would be looking at about 2m EPCs for England-Wales as a whole.

Oxford has a population of 165 000 (0.3% of the overall population of England and Wales), and has roughly 65 000 private residences. The proportion relative to England and Wales suggests that about 300 EPCs are registered in Oxford every month and that over the period 2009Q1-2012Q2, roughly 6 000 would have been registered. Similarly, based on the number of transactions in England in recent years, there are probably about 3 200 transactions in Oxford a year, or roughly 5 000 over the period 2011Q1-2012Q2.

As 5 000 rows from each of the EPC and transaction datasets would provide too little additional benefit, we proposed to look instead at 2012Q1-Q2 data only, which for Oxford city could be about 1 500 observations, which is large enough to draw robust conclusions. Note that there will be a proportion that we will not be able to match, either due to lack of an EPC when selling or a property with an EPC failing to sell, or other issues such as wrong postcode.

For non-residential, while there are 155 000 residential transactions annually in the South-East region alone (which includes Oxford), there are just 7 000 non-residential. This suggests that

⁵⁴ See www.epbniregister.com (domestic) and www.epbnindregister.com (non-domestic).

⁵⁵ See www.niepcregister.com.

⁵⁶ See www.legislation.gov.uk/ukxi/2012/809/regulation/1/made and www.communities.gov.uk/publications/planningandbuilding/changesenergyperformance.

⁵⁷ See www.communities.gov.uk/documents/planningandbuilding/pdf/2121747.pdf. A fee is applied of GBP 0.05 per “medium data pack” reference.

⁵⁸ See www.epcregister.com/lodgementStats.html.

there are probably only 140 or so non-residential transactions in Oxford city every year and only a proportion of which will be commercial/office.

Thus we requested 2012Q1-Q2 non-residential transactions and EPC data for the entire South-East region in order to ensure that we have sufficient numbers of commercial/office transactions. Of 3 500 transactions, perhaps half may be commercial/office – the remainder being land of various sorts, retail, industrial and mixed use. Postcodes help ensure that there are sufficient geographical controls to draw robust conclusions.

9.2.2 Data on transactions

Land Registry (England and Wales) was contacted by the project team at the outset of the study and they confirmed that they could provide Price Paid information for all residential property sales in England and Wales lodged with Land Registry. The full dataset contains around 16.3 million house transfers (around 60 000 added each month) but only a tiny fraction of this is necessary for the purposes of this study.

On 23 March 2012, Land Registry launched a free Price Paid data service (ad hoc requests or older data are still provided on a fee basis). All records are now published monthly dating back to February 2012.⁵⁹ Each entry contains the following main fields:

- Price;
- Date;
- Postcode and street address;
- Property type (Detached, Semi-Detached, Terraced or Flats/Maisonettes);
- Old/New (Newly built property or established residential building);
- Duration (relates to the tenure – freehold or leasehold);
- Date (date of lodgement of the transfer deed with the Land Registry);
- PAON (Primary addressable object name – if there is no sub-building, i.e. flat);
- SAON (Secondary addressable object name – if there is a sub-building).

9.3 Regression results

The analysis for the UK is based on two official datasets as mentioned in the previous section: the database of EPCs maintained by Landmark on behalf of DCLG, and the Land Registry dataset of residential property market transactions. The full Land Registry dataset used covered the period from February to September 2012 and contained almost 500 000 observations in total, of which 1 344 were in the Oxford postcodes OX1 to OX4 for which EPC information had been obtained. The principal information available in the Land Registry is comprised of a transaction's date, price, address and postcode, as well as property type.

⁵⁹ See www.landregistry.gov.uk/public/information/public-data/price-paid-data/price-paid-data-files.

The EPC dataset was available for Oxford postcodes OX1, OX2, OX3 and OX4 (the Oxford metropolitan area) and comprised just under 2 300 properties in total. A significant proportion of these related to properties other than those sold in the market, leaving 972 valid individual properties.

A matching exercise was then undertaken in Stata, using the merge function and a concatenation of the full postcode (for example OX11HF) and the property's street or apartment number. This – plus an exclusion of properties with a price of greater than 1 million GBP – resulted in a valid sample of 253 observations being matched across EPC and Land Registry datasets, of which there were 19 detached homes, 74 terraced, 45 flats/maisonettes and the remainder semi-detached properties.

From the EPC dataset, information is available for each property across a number of main dimensions. The first is energy efficiency, both current consumption and potential, rated on a 0-100 scale. The average values in the sample are just under 60 and just over 70 respectively. For comparability with results from other countries, these can be converted into a 7-letter scale from A to G. There are a number of sub-indicators of energy efficiency, such as type of glazing or whether low-energy lighting is used. Given the small sample size involved, and given these factors are reflected in the overall energy efficiency rating, these were not included separately for analysis.

The EPC dataset also contains information on property type, in particular whether the property is detached, semi-detached, terraced or an apartment/maisonette, and on the dwelling's size (measured in square metres). A property's age, a potentially important factor in a city such as Oxford, is not available however. The closest proxy is an indicator variable recording whether the dwelling has fireplaces, predominantly a feature of older properties. Lastly, in both the EPC and Land Registry datasets, there is information on the property's three-letter postcode (OX1-OX4), a factor that is included to capture location-specific effects on price.

As with other countries and regions, the empirical specification includes a filter for outliers. The process uses a calculation called Cook's Distance to exclude those observations with a disproportionate effect on the estimation of the coefficients of the model (a statistical test for outlier status). In the case of Oxford, this resulted in the exclusion of on average 6% of observations.

9.3.1 Results for Oxford

Of potential value for the broader study is the dual nature of the EPC rating in the UK, which informs prospective buyers of both current and potential energy ratings. This allows an investigation of whether one rating is more strongly correlated with property market outcomes than the other.

To allow comparison with other countries, the principal specification (Model (1)) for both current and potential ratings is the use of the alphabet scale from A to G. The second specification (Model (2)) for each uses the continuous score.

The models for the Oxford market explain roughly 70% of the variation seen in house prices. Almost all variables are statistically significant, with prices in the OX2 postcode 30% higher than in OX4, all else being equal, but prices in OX3 on a like-for-like basis no different.

In relation to energy efficiency, confusing results emerge (Table 24). Using the current energy rating, there is no clear relationship between the rating and the price. Every letter improvement is associated with a 1% higher price, but the result is imprecise enough that there is a 70% probability that this result is generated by chance.

Table 24: Results for Oxford, both current and potential performance

	Current rating		Potential rating	
	(1)	(2)	(1)	(2)
Energy rating (A-G)	-0.01043 0.01695		0.04038** 0.01545	
Energy rating (0-100)		0.00022 0.00123		-0.00319** 0.0012
Size in m ²	0.00779*** 0.00055	0.00777*** 0.00057	0.00794*** 0.00056	0.00802*** 0.00056
Detached	0.36570*** 0.05983	0.35335*** 0.06151	0.30601*** 0.06216	0.29847*** 0.06223
Terraced	0.07650* 0.03317	0.06541 0.03405	0.08067* 0.03339	0.08160* 0.03314
Flat	-0.16515*** 0.04801	-0.16242*** 0.04866	-0.14924** 0.04548	-0.15028** 0.0454
Fireplace	0.17011*** 0.03356	0.16833*** 0.03434	0.16002*** 0.03324	0.16026*** 0.03314
ox1 fixed effect	0.21885** 0.07481	0.22988** 0.07699	0.23596** 0.0757	0.19697** 0.07204
ox2 fixed effect	0.35494*** 0.03773	0.36374*** 0.03878	0.38238*** 0.03851	0.39060*** 0.03856
ox3 fixed effect	0.01583 0.03386	0.02966 0.03469	0.03323 0.03413	0.03186 0.034
Constant	11.85332*** 0.09402	11.79635*** 0.08509	11.65795*** 0.07724	12.00862*** 0.09659
R-squared	72.6%	71.2%	72.4%	72.5%
N	236	238	236	236

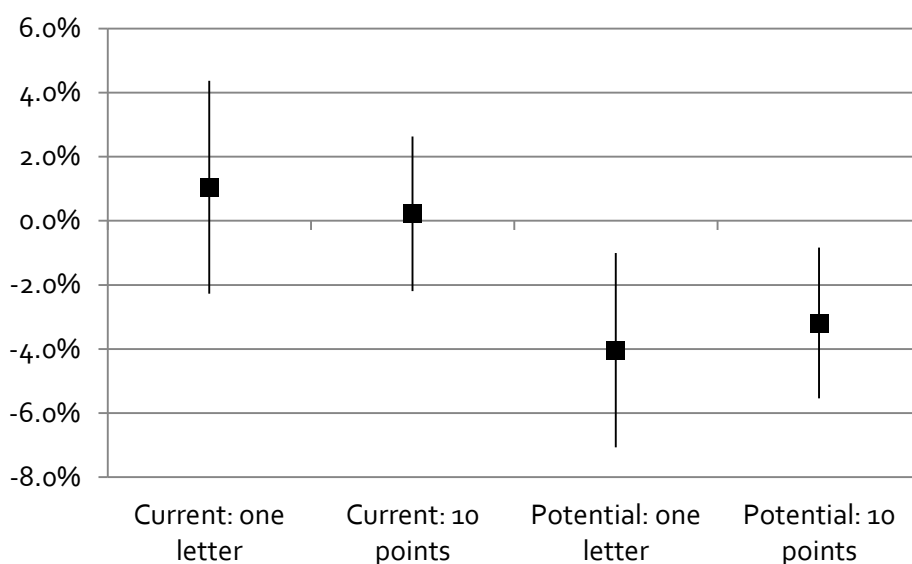
Models (1) and (2) differ in the treatment of energy rating, with Model (2) using a continuous 1-100 scale, instead of a letter based rating. Standard deviations are reported in parentheses. ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively. N refers to number of observations included in second-stage regression, which excludes outliers.

Using the potential energy rating, a clear result does emerge, but it is the opposite to both theoretical expectation and the experience of other countries and regions. A one-letter improvement in potential energy rating is associated with a 4% *lower* price, everything else being equal. It is unlikely that this result is generated by chance – the associated p -value is just 0.4%, once outliers are removed.

This result is difficult to explain.⁶⁰ It is entirely possible that it relates to the dwelling's age, an omitted variable. Significantly older properties in the Oxford area may command a premium over newer properties but be less energy efficient. Related to this, the inclusion of a variable for fireplaces improves the fit of the model from 69% to 72% and has the impact of reducing the discount for better energy efficiency potential from 4.7% to 4%. Related to this, new research that combines various housing market datasets for the UK suggests that there is indeed a positive premium to energy efficiency in the UK housing market, of roughly 5% for a C-rated property compared to an F-rated one (Fuerst et al., 2013).

An overview of the results in graphical form, including a 95% confidence interval, is shown in Figure 16. Overall, it is clear that in comparison with other countries and regions in this study, the estimated effects are significantly less precise. This is of course in part due to smaller sample sizes. Thus, future research for England and Wales on this issue would particularly benefit from larger sample sizes and coverage of other cities and regions, to investigate whether the finding here is anomalous or typical.

Figure 16: Effect of one-letter or ten-point improvement in current and potential energy efficiency on prices in the Oxford property market



⁶⁰ Inclusion of both current and potential energy rating does not alter the result and in fact slightly increases the size of the negative relationship between EPC and house price.

This page is intentionally left blank.

Chapter 10: Conclusions

In brief: This chapter summarises the results of our analysis and draws conclusions as to whether a correlation can be found between the energy performance indicator and the value of a property as expressed in its rental or sales price. In a final section, we also provide tentative recommendations for policy makers.

10.1 Summary of regression results

This study has examined the impact of energy performance certification through a series of segment-specific regressions. Segment-specific regressions (e.g. rental properties in Ireland) allow the most precise estimation of the impact of energy efficiency for the properties under consideration, as the other explanatory variables can be tailored to the available data.⁶¹

Comparing results for sales and lettings segments allows an important distinction to be made between immediate value (the ongoing service offered through energy efficiency of savings on bills, etc.) and the long-run impact (the higher asset value of the property when resold). Renters only enjoy the first of these benefits, and thus help distinguish between the two. Similarly, comparison across countries potentially allows comparison of the effect of energy efficiency across schemes and climate types (the benefits of energy efficiency may depend on climate, and results across countries or regions may shed insight into this relationship).

Data was obtained for Austria, Belgium (Flanders, Wallonia, Brussels-Capital), France (Lille, Marseille), and the UK (Oxford, South East). The analysis of property transactions and listings from residential property markets in Austria, Belgium, France, Ireland and the UK, both sales and lettings, overwhelmingly points to energy efficiency being rewarded. The only market where a positive relationship between energy efficiency and price was not found was Oxford (**UK**), where a one-letter improvement in potential energy rating was associated with a 4% lower price, everything else being equal. As noted in that section, this imprecisely estimated negative relationship may result from either age as an omitted variable or alternatively the small sample size available for analysis.

Elsewhere, however, the effects of energy efficiency are clear and positive. In **Austria**, the property market in Vienna and the surrounding region was analysed. Based on detailed property listings, the effect of a one-letter improvement in energy efficiency is estimated at 8% in the sales market and 4.4% in the lettings market. There is also strong evidence that the price effect is larger in Vienna than in the surrounding (and less urbanised) Lower Austria region.

Similarly, an analysis of 26 000 property listings in **Belgium** shows a clear relationship between a property's energy efficiency – as measured by CPEB (EPC) performance – and its advertised price

⁶¹ Pooled regressions (where observations across segments or countries are included) would have allowed consistent tests for statistically significant differences in the effect of energy efficiency across segments and countries, but appropriate datasets are not available so this was only possible across regions.

or rent. The most detailed analysis was of the Flanders market, which showed that a major improvement in energy efficiency (of 100 points in the CPEB metric) is associated with a 4.3% higher price on average. The rental effect was smaller but still statistically and economically significant: an improvement of 100 points in the CPEB is associated with a 3.2% higher rent.

Results for Wallonia and Brussels, based on significantly smaller sample sizes, were in line with those for Flanders. A major improvement in energy efficiency is associated with a 5.4% higher price in Wallonia and a 2.9% higher price in Brussels. In the rental market, a similar improvement in energy efficiency is associated with a 1.5% higher rent in Wallonia and 2.2% higher in Brussels.

In **France**, an analysis of just under 3 500 transactions yielded results for both Marseille and Lille. For Marseille, a strong positive relationship between energy efficiency and the price of a dwelling was found. Each one-letter improvement in a property's energy label is associated with a 4.3% higher price. Additional analysis found that, in the sample available, this effect is driven by apartments, with no statistically significant effect of energy rating on the price of a house. As with Oxford, however, caution must be exercised when noting this result, as the sample of houses in Marseille is small.

For Lille, there is again a strong positive relationship between a property's energy label and its value, although the effect of a one-letter improvement on value is smaller than for Marseille (3.2% compared to 4.3%). This runs counter to the intuition that energy efficiency would be rewarded more in regions with a greater dependence on energy for comfortable conditions of habitation. It should be noted however that in the case of Lille it is houses rather than apartments that drive this relationship. Each one-letter improvement in label is associated with a 4.7% higher price, while for apartments the effect is 1.5% and only marginally statistically significant.

Lastly, with **Ireland** there are again clear indications from the property market that energy efficiency is rewarded. The effect of a one-letter improvement in energy efficiency is estimated at 2.8% in the sales market and 1.4% in the lettings market. The effect in the sales market fell between 2009 and 2011, but was as large in 2012 as it had been in 2009. The introduction of mandatory display of EPC rating in advertisements in early 2013 may have an impact on the relationship between property prices and energy efficiency in Ireland.

As noted above, a number of segments would benefit from further study with larger datasets, when possible, to not only enhance the precision of the estimated effects but also allow further robustness checks and analysis by market segment (region, property type or period). As it stands, there are a number of additional points that emerge from the analysis undertaken here.

Firstly, in all three countries for which information on both sales and **rental** markets was available – Austria, Belgium and Ireland – the estimated rental premium for energy efficiency was smaller than the estimated sales price premium. This attenuated rental effect suggests that owners reap a benefit that is additional to the ongoing monthly benefits, i.e. reduced energy bills, which accrue to all occupiers including tenants.

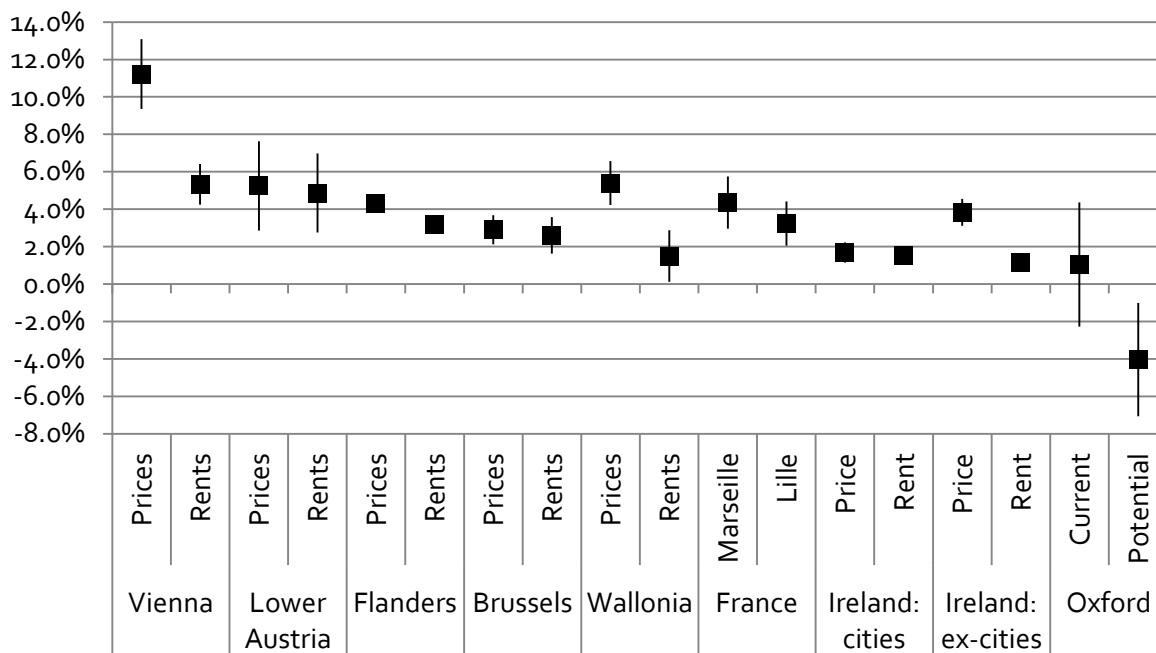
Secondly, there is contrasting evidence about how the energy efficiency premium varies by location. In Ireland and in Belgium, the effect is smaller – in percentage terms – in **cities** than in non-city areas. This seems plausible, as potential savings (in €/m² terms) would not vary much by location, while the €/m² cost of a dwelling will be significantly greater in central urban areas.

Nonetheless, in Austria, the evidence is to the contrary: the percentage effect is larger in Vienna than in the surrounding area. An explanation may lie in **market conditions**. In the falling Irish market, conditions were tougher in rural areas, meaning that energy efficiency is an area of differentiation. A similar effect might be at work in Belgium, where the market in 2012 was largely static in real terms (up 2.7% in nominal terms, in mid-2012). In Austria, however, the real estate market was booming in mid-2010 (+10% year-on-year, and even greater in Vienna). Further research on whether market conditions matter to the value market agents place on energy efficiency ratings would be necessary, but comparing across countries, the percentage effect of the EPC appears stronger where selling conditions are easier.

A final note should be made about the use of **listings data** due to constraints in relation to data availability. Recent research has highlighted that listings data offer a good proxy for transactions prices, even in extreme market conditions, capturing variation both over time and across space.⁶² Nonetheless, properties listed for longer without successful sale or lease may be associated with lower transaction prices, everything else being equal. This may understate the effects of energy efficiency on property market outcomes, if energy efficiency is positively correlated with general property quality, and quality in turn is positively correlated with faster sale or lease.

Each country operates its own specific EPC scheme, and a separate dataset was gathered for each one. In that sense, **cross-country comparisons** must be made with caution. Nonetheless, in each country, a one-letter improvement in EPC is likely to be interpreted by consumers as a significant improvement in energy efficiency, as would a 100-point improvement in the CPEB scale in Belgium. Using that benchmark, an overview of the effect of a significant improvement in energy efficiency across all markets covered in this study is shown in Figure 17 below.

Figure 17: Effect of one-letter or equivalent improvement in EPC rating across European property markets (95% confidence interval shown; see also notes in the text)



⁶² Lyons, R. (2013) *Price signals and bid-ask spreads in an illiquid market: The case of residential property in Ireland, 2001-2012*, SSRN Working Paper.

10.2 Lessons from the assessment of EPC schemes

This section gives an overview of what the assessment of EPC schemes tells us about the differences between countries and regions, about the extent to which we can generalise the results in this study to the EU level, and about issues to be tackled so that the benefits of EPCs can be maximised.

10.2.1 Presence of the label

The proportion of transactions accompanied by an EPC until now has varied across Member States – from 10% (Cyprus) to 20% (Austria) to around 95% (UK) and virtually 100% (Portugal, France). It is clear that in some cases this is very low while in other cases it is near-complete. Take-up is likely to be increasing over time as awareness grows and legislation is implemented. However, even in cases where a significant proportion of transactions are accompanied by an EPC, it is often provided only at the moment the contract is signed, i.e. too late in the decision-making process to have an impact.

The requirements on advertising property under the recast EPBD go some way to amending this situation. They have been obligatory since 9 January 2013. Some countries, for example Austria, Belgium and France, brought the requirement in earlier. For other countries such as Ireland, it comes too late to affect the analysis in this study. Thus, the implementation of the recast EPBD this will have an effect in this regard over the next few years, with prospective buyers/tenants aware of the EPC rating in advance.

10.2.2 Understanding of the label

In addition to the timing of the availability of the EPC in the purchasing/rental process, understanding of the label, and therefore how information is presented and laid out, is important if the EPC is to play a more important role in future purchase/rental decisions.

There is a high level of public awareness of the general concept of energy certification of buildings. In Ireland for example, “consumer awareness and attitude surveys have shown a high level of recognition of the concept of energy certification for buildings among the general public” (IEA, 2010). However, understanding of the EPC itself may not run very deep, for a variety of reasons – either because the practical use is not understood, or because the terminology used or role of the EPC in the purchasing/renting process is not understood.

According to interviews, there is some public confusion about the information presented (e.g. in Flanders that ratings are based on standardised assumptions and not on actual consumption of the assets in question), or what it means (e.g. the A-G scale is well recognised but with questionable understanding of what the ratings mean). According to BPIE (2010), the Austrian EPC for example is not transparent enough and does not give building owners useful information, despite being very detailed. Recommendations to improve energy efficiency are not always clear. Limited transparency and limited practical usability of the EPC creates a barrier to its use and affects public acceptance.

Even when the public is aware of what the rating means and knows that there are actions that they can take to improve energy efficiency and reduce greenhouse-gas emissions, it is difficult for them to understand the effective benefits of energy efficiency and renewable technologies recommendations. There is an up-front investment cost but the amount of energy (and money) they can save over time is more difficult to calculate. The need to take into consideration the understanding of the average person in the street, rather than property professionals who better understand technical terms and the meaning behind ratings, cannot be overemphasised.

In France, ADEME has conducted three studies among the general public and property professionals (estate agents and solicitors), the most recent one in January 2012. Some 63% of estate agents and 72% of solicitors agreed with the statement that the EPC is “simple to understand and explain”, while 56% of estate agents and 32% of solicitors agree with the statement that it is “easy to apply and implement”. These results suggest that key property market professionals understand the EPC. However, there is room for improvement both in terms of the capacity to understand and explain the EPC, and in terms of its application. The survey addressed to households did not ask about the understanding of the EPCs.

In Ireland, market research has been commissioned on the EPC annually since 2008. 2011 results show that awareness of the term “BER” (i.e. EPC) for homes or buildings amongst a sample of residential buyers or renters was 21% in 2008, and this increased substantially to 54% (2009), 59% (2010) and finally to 69% (2011). In relation specifically to *homes*, the awareness level is even higher. Whether in relation to homes for sale or rent, as a seller/landlord or buyer/renter, awareness levels hover between 83% and 87%.

In the UK, two studies commissioned by Consumer Focus (Lainé, 2011a and 2011b) in relation to the residential sector are of interest here. The first found that 76% of those who had received an EPC said that the rating and recommendations are clearly laid out. Lainé remarks that this is “the most surprising response from consumers” as energy efficiency professionals generally consider the EPC to have a confusing layout. The survey asked a follow-up question as to what information was clearly set out, and the highest scoring item was the now familiar A-G scale, mentioned by 34% of respondents. The second highest response was “don’t know”.⁶³

The second study specifically looked at the content and format of the EPC using focus groups. These represented a cross-section of British consumers including buyers and renters, and included a group of property professionals, who have a crucial role in presenting the EPC. The main finding of the study as far as understanding of the label is concerned, is the suggestion that the EPC is not understood as well as it could be, and that this is because it has been designed more with the energy expert in mind than the buyer or tenant. Thus it would seem that the residential market understands the basic idea contained in the A-G rating but may have more difficulty engaging with some of the more detailed aspects of the information as currently presented. Lainé (2011b) argues that even the rating is not enough by itself as consumers cannot readily translate a specific rating into a monetary saving or loss.

Many countries have some kind of national communication campaign that covers EPCs. In France for example, a network of 500 experts provides advice to households on all aspects of energy via

⁶³ Weighted base of 101 respondents.

the *Espaces Infos Energies* created by ADEME. In some Austrian *Länder*, more than 50% of residential buildings benefit from support for energy consulting including a comprehensive explanation of the role and function of EPCs.

10.2.3 Concern about energy use and environmental performance when selecting a property

The purpose of this part of the assessment was to try to understand whether there was any data available on concern about energy use (compared to other characteristics) when selecting a property. The motivation was to understand the likely relevance of energy use in the decision-making process. This is because, assuming that the information is available early enough (10.2.1) and assuming it is understood (10.2.2), if the information does not matter to the decision maker it will still not count in the decision-making process.

We received anecdotal evidence via interviews or written responses that there is a perceived importance attached to expected energy costs. However, survey data from France suggests that there is a gap between the attitudes of the general public to energy performance and the attitudes of actual purchasers.

One of the studies undertaken in the UK (Lainé, 2011b) found that once someone has found the home they want to buy, they are unlikely to use the EPC as a basis for negotiating on price. This is partly because they do not want to risk losing the asset to another potential buyer who could be considered easier to negotiate with. Evidence from France (ADEME and TNS, 2012b), however, suggests that the EPC is used as a bargaining chip at the negotiation phase. The condition of the market can affect the level of influence on decision-making of the EPC and so it would be important to ensure that property professionals (to the extent that these are used by buyers/renters) understand the value of the EPC in negotiating a better price for the asset.

Aside from energy use and associated costs, concern about environmental performance could be a possible trigger to favouring energy efficiency. Below we provide a synthesised table of the responses to a 2011 Eurobarometer study we used as a proxy for the importance of energy use among decision-making buyers/renters. Interestingly, a much higher proportion of respondents had insulated their homes (in four of the countries, one quarter to one third had installed insulation) than had purchased a low-energy home (only 1-6%). These figures are likely to continue to increase in future, given interest by owners (rather than renters) in reducing household running costs, and supported in some cases by public financial incentives to improve energy efficiency of buildings. Similarly, as more assets earn better energy ratings in future, it is likely that buyers/renters will more easily find better-rated assets to buy/rent, thereby increasing the percentage of respondents who have bought a low energy home.

Table 25: Summary of attitudes to climate change by country⁶⁴

Question	AT	CY	BE	FR	IE	PT	UK
% of respondents placing climate change as the most important problem facing the world	19%	23%	24%	20%	13%	7%	18%
Seriousness of climate change on a scale of 1-10 (average ranking)	7.7	7.7	7.1	7.4	7.0	7.7	6.4
% of respondents having insulated their home to reduce energy consumption	13%	10%	32%	26%	28%	7%	30%
% of respondents having bought a low-energy home	1%	2%	6%	4%	3%	2%	2%

10.2.4 Trust in the information on the label

Trust was found to have been an issue, and in some cases it still is. The most cited issue of (lack of) trust was in relation to the discrepancy between the energy rating and actual energy consumption by owners/renters. This is at least partly due to confusion (and therefore poor or no understanding about the label) among the public about what the rating means. However, confusion does not necessarily affect the level of trust in the label. In some countries, the assessment method and quality of assessments is considered an issue, in others the fairness of the methodology is questioned.

All the countries/regions have focused on improving quality assurance of assessors and EPCs, including accreditation of assessors (Flanders, France, Ireland, Portugal, UK), a code of practice for assessors (Ireland), quality control of EPCs via EPC databases (Flanders, France, Ireland, Portugal), penalties for inaccurate EPCs (Flanders, Ireland, Portugal), and banning experts who have made a high number of errors (Flanders, Portugal). Efforts targeted specifically at the public include greater transparency of the information available on the label (France), and an awareness-raising campaign about EPCs aimed at the public (Flanders, Portugal).

Again the aspect of time is important. In some countries such as France and the UK there were clearly trust issues to begin with, which the authorities are trying to address in a systematic way.

10.2.5 Implications for the effect of EPCs on transaction values

It is clear from the above overview that, on the whole, EPCs are unlikely to be fully capitalised in property values yet. This is not because there is something fundamentally wrong with providing information on energy performance in property markets. The fundamental case for correcting this information market failure remains intact. What we have attempted to show above is that several of the fundamental factors that must be in place in order for there to be a strong effect are not in fact in place yet. To begin with, in some cases the proportion of transactions accompanied by an EPC is simply very low and so the potential of the EPC to affect what is valued in property markets stops here. Even where the proportion of transactions covered by an EPC is relatively high, it may be that (as is in most cases examined) the prospective buyer/renter

⁶⁴ EC, 2011b. No explanation of the term “low-energy home” was provided to respondents.

is, or has been until very recently, simply presented with the information too late in the decision-making process for it to influence the decision.

At least as important is the salience of the information, i.e. does the information count for the prospective buyer/renter? This is in part a chicken-and-egg situation. When the information is well established in the market and the market can take account of it, then it is more likely to count. Conversely, to the extent that the information does count it is more likely to be integrated into market practices, including valuation. Finally, lack of confidence in the information on the EPC has the capacity to “trump” all of the preceding factors even if these all line up. It is clear that while in many cases the reliability of the information is being addressed, this is a continual process that must be maintained. There may also be a need for additional thinking about the relationship between asset ratings and actual energy consumption.

In some cases, the requirement to supply EPCs has existed long enough to provide insight into their relevance in transactions and their potential influence on property values. However, as stated previously, in some countries and regions the availability of the EPCs still occurs too late in the decision-making process to have a significant influence on the decision. Given that the recast EPBD seeks to improve this situation, future studies will be better able to assess the influence of the EPC on the decision to buy/rent a property with higher/lower energy rating. In the meantime, Member States should be encouraged to (continue to) focus on quality assurance of the EPC, and improve public trust in and understanding of the label (via communications campaigns).

10.3 Policy implications

There is an information gap preventing people from making decisions that express fully their preferences, whether for lower energy bills or better energy performance. This information gap is likely to have been only partially filled by EPCs up until now for reasons described earlier in this chapter: lack of visibility of the EPC, in particular at the point of decision making, lack of understanding of the information contained on the EPC, lack of trust in that information, etc.

This report has reconfirmed that current implementation of EPC schemes is patchy and needs to be strengthened. It goes almost without saying that the requirements of the recast EPBD, in particular as regards display of the EPC in advertising, should be fully implemented in all Member States as soon as possible.

More specifically, there are a range of recommendations that can be made to improve implementation at Member State level. For example, a recently completed Intelligent Energy Europe project on “Renovation through quality supply chains and energy performance certification standards” focused on how to increase the uptake of energy saving retrofit measures by strengthening the role of EPCs. It demonstrated that EPCs can drive households to action by means of detailed recommendations and claims that linking EPCs to wider policy programmes, financial support programmes and training and information campaigns can significantly increase the number and the quality of energy saving renovations.⁶⁵ Other useful guidance from the IEA and the BPIE has been highlighted in this report.

⁶⁵ See www.building-request.eu.

Of key importance, the information on EPCs should be made more practical and easy to understand. For example, today it is extremely difficult for purchasers/tenants to compare a higher rent (or mortgage payment) for a more energy efficient dwelling and a lower energy bill due to energy efficiency. A 2% premium in rural Ireland may pay for itself easily but a 5% premium in Austria or Wallonia may just pay off (itself perhaps an indication of efficient markets).

According to Lainé (2011b), the layout of EPCs must be improved through use of plain language, colour, iconography and layout. In addition, money should be used as the primary unit for communicating energy efficiency, as “consumers do not understand CO₂ or kWh”.

The recommendations of CA-EPBD (2010) are also still relevant: that the front page of the EPC should be eye-catching, clearly displaying the energy performance for everyone to see, and if possible using an expressive graphic presentation; and that the effect of the “recommended actions” when carried out should be clearly shown.

At the same time, it should be remembered that part of moving towards a more carbon- and energy-literate society means mastering new skills and information for everyone, such that it may be that this information is too technical, but it should also be considered whether there is sufficient effort put into helping users of various kinds to understand it. National communication campaigns that cover EPCs should be supported and even amplified as the early years of implementation of labelling schemes are vital to their long-term success.

Many Member States have opted for asset-rating based EPCs as opposed to certificates based on monitored energy consumption. Asset-rating based EPCs seem to be more appropriate for comparing buildings as they exclude the effect of differences in the use of a similar property. However, in order to ensure that a shift to potential greater energy performance of buildings is achieved, a number of accompanying measures including monitoring of actual energy consumption in a standardised way (e.g. defining the typical use) will be required.

The issues explored in this report may also have broader implications, for example for the financial sector. Energy efficiency could arguably be incorporated into a bank’s mortgage lending policy or processes in some way, perhaps facilitating more expensive homes but with lower energy bills and a potentially lower risk of default.

Another related issue is that Member States should consider switching away from property taxes that punish energy efficiency (such as market-value taxes) and towards those that reward it (such as site-value taxes, as already exist in Denmark and Estonia). Such systems would have the likely effect of increasing the percentage premium for energy efficiency. As the associated capital gain would not be taxed on an annual basis, the private benefits would be increased. This would increase the likelihood, of private action (i.e. investment in energy efficiency), reducing the need for government intervention.

The practical policy implications of these two points are beyond the scope of this study but worthy of further examination in light of our results. Such policies and measures would also have to be coherent with broader economic and financial policy objectives.

Finally, the importance of data quality also needs to be emphasised. The more data are publicly available, the easier it is to measure more precisely the relationship between energy efficiency and property market outcomes, and to evaluate EPC schemes more generally. The confidence

intervals (margins for error) in our econometric analysis are largest for countries with small sample sizes.

Not all countries or regions have central EPC registers in place, which makes research difficult but also implies that quality control and policy monitoring will be less robust. Of those that do have central databases, most only allow access to one or a few EPCs at a time, i.e. for individual owners, or in some cases for real estate agents. Very few make the data easily accessible for researchers. Recent initiatives by Ireland and the UK to make this data more easily available in order to promote research and improve policy making are therefore commendable as best practices.

In this study we have looked specifically at the effect of EPCs on property values, and suggested that they can have an even more important role in shifting the market towards better energy performance than has sometimes been acknowledged. However, EPCs are not a silver bullet; they must work in combination with other policy instruments. Minimum performance requirements, both for energy-related products such as windows or insulation (via the Ecodesign Directive), and for buildings themselves via stricter national building codes, should be considered in order to penalise buildings with low energy performance and ensure that the worst-performing buildings are renovated as a priority, and that new buildings move toward a zero-energy future.

10.4 Concluding remarks

Society can be said to be on a journey that began in the 1990s towards greater environmental “readability” and literacy in consumption choices. Such policies have already proven to be very successful, for example the energy labelling of household appliances. Energy certification of buildings can contribute to the readability of consumption choices in a similar manner but there is still some way to go in this respect.

It is clear that there are a number of obstacles to transforming property markets towards better energy performance, and information market failure is one of these. Rather than thinking about the barriers to energy efficiency in buildings as a set of discrete problems, it is helpful to conceptualise them in the context of a dynamic interplay of actors. Moreover, the provision of information about relative energy performance of properties through EPCs should be seen as part of a broader information challenge that has to be addressed to move to more sustainable buildings.

While EPCs are key enablers in making energy performance count in the market by providing greater transparency on relative energy performance, other challenges will persist. The dynamics of property markets can be thought about in terms of a set of interlinked practices that all have to take on a certain amount of change before energy performance will count sufficiently. Thus, getting EPCs right is a necessary but not sufficient condition to ensure that markets value energy performance.

In general, consumers in the housing market seem rational about energy efficiency, paying more for a property up-front when it saves them money in the long run. Nonetheless, a more formal study comparing the costs and benefits of more energy efficient dwellings would highlight

potential limitations to the market and thus identify where public resources could be best used to increase the energy efficiency of the EU's building stock.

The policy framework for transforming the building stock (through both renovation of existing buildings and construction of new buildings) should and can lead to the reduction of energy consumption in buildings. In particular in the current economic climate and as Europe moves towards Nearly Zero Energy Buildings (nZEBs), EPCs (ratings and recommendations) can play an important role in encouraging property developers and the rest of the market in that direction.

Annex A: What EU-level legislation requires of Member States

Directive 2002/91/EC required Member States to bring into force the necessary laws, regulations and administrative provisions by 4 January 2006 at the latest. This could be extended for Articles 7, 8 and 9 by a maximum of three years if Member States could show that there was a lack of qualified and/or accredited experts. The Directive in effect provided a framework within which Member States had substantial scope for defining their own approach to the energy performance certification of buildings. The Directive required Member States to ensure that when buildings are constructed, sold or rented out an EPC is made available to the owner or by the owner to the prospective buyer or tenant. Member States were permitted to exclude certain categories of buildings.⁶⁶

Member States were required to take measures to ensure that certain buildings frequently visited by the public should have their EPC displayed in a prominent place clearly visible to the public.⁶⁷ The Directive did not make any special requirements with respect to the design of the label but it did contain requirements regarding the content of the label. EPCs for buildings should include reference values such as current legal standards and benchmarks in order to make it possible for consumers to compare and assess the energy performance of buildings. However, there was no prescribed methodology for calculating energy performance. Instead, the Directive (Art. 3) requires Member States to adopt their own methodology based on a general framework set out in an Annex to the Directive. The framework gives guidance on the taxonomy of building types, the kinds of information that must be included in the calculation (such as thermal characteristics, heating installation, hot water supply, air conditioning, ventilation, passive solar systems, indoor climatic conditions, etc.), and requires that the positive influence of certain aspects (such as active solar systems, natural lighting, etc.) be taken into account in the calculation. Member States were thus free to develop their own calculation methodologies. In addition, certificates must be accompanied by recommendations for the cost-effective improvement of energy performance.

The EPBD was subsequently “recast” to become Directive 2010/31/EU. The recast dealt with some of the implementation challenges of the 2002 Directive. The text covering energy performance certification was expanded to three Articles (11, 12 and 13) instead of one in the 2002 Directive. The text is a lot more extensive, and more of the details are pinned down. On the content side, additional information such as annual energy consumption for non-residential

⁶⁶ These are set out in Article 4 § 3 of the Directive: 1) officially protected buildings and monuments where compliance with the requirements would unacceptably alter their character or appearance; 2) buildings used as places of worship and for religious activities; 3) temporary buildings with a planned time of use of two years or less, industrial sites, workshops and non-residential agricultural buildings with low energy demand and non-residential agricultural buildings which are in use by a sector covered by a national sectoral agreement on energy performance; 4) residential buildings which are intended to be used less than four months of the year; 5) stand-alone buildings with a total useful floor area of less than 50 m²

⁶⁷ Article 7 §7 defines these as “buildings over 1 000 m² occupied by public authorities and by institutions providing public services to a large number of persons and therefore frequently visited by these persons”.

buildings and the percentage of energy from renewable sources in total energy consumption can be included. There is greater definition of what information should and could be included on the EPC in terms of recommendations for improving the energy performance of a given building. This should lead to a greater likelihood of owners and/or occupiers acting on the recommendations. In addition, while in the 2002 Directive, recommendations should be based on what was cost-effective, the 2010 recast states that they can be cost-effective or cost-optimal. The calculation method of cost-optimality is defined in the Directive in a separate Article. The 2010 recast contains new requirements on Member States, subject to national rules, to encourage public authorities to take into account the leading role they should play in the field of energy performance of buildings, inter alia by implementing the recommendations included in EPCs issued for buildings owned by them within the validity period. Also new is the provision for the adoption of a voluntary common European Union certification scheme for the energy performance of non-residential buildings.

In addition to Article 11, which sets out some general provisions with respect to EPCs, the recast Directive now contains two separate articles dealing with the issuing and the display of EPCs specifically. The timing of the issuing of certificates is an important dimension in the debate about their effectiveness. It is assumed here that, *ceteris paribus*, the sooner and more consistently a prospective buyer or renter is made aware of the energy performance of a building the more likely this dimension is to be taken into account in the purchasing decision. The 2002 Directive simply required that Member States ensure that when buildings are constructed, sold or rented out, an EPC is made available to the owner or by the owner to the prospective buyer or tenant (Art. 7 §1). The 2010 Directive sketches this requirement much more fully, and is much more prescriptive. For example, the certificate is "shown to the prospective new tenant or buyer and handed over to the buyer or new tenant" instead of the old provision "made available" (which needed clarification). Furthermore, it introduces the requirement that the EPC is shown in advance of construction.

Importantly, Member States must now require that when buildings or building units have an energy certificate, the energy performance indicator of the EPC of the building is stated in the advertisement in all commercial media. In addition, the threshold for buildings occupied by public authorities has been dropped from 1 000 m² to 500 m², and from 2015 to 250 m², broadening the scope for displaying the EPC in buildings frequently visited by the public. The general framework for calculating the energy performance of buildings (Art. 3 and Annex 1) has been tightened up and has been upgraded such that it is now referred to as the "common general framework". Annex 1 now explicitly distinguishes between energy performances assessed based on the calculated or actual annual energy that is consumed in order to meet the different needs associated with its typical use, leaving Member States the choice between the two approaches. It requires Member States to express energy performance in a transparent manner (no new requirement) and that this should include an energy performance indicator and a numeric indicator of primary energy use based on primary energy factors per energy carrier. With respect to independent experts (Art. 10 in the 2002 Directive, Art. 17 in the 2010 Directive), Member States are now required to make information on training and accreditation available to the public and ensure that regularly updated lists of qualified and/or accredited experts, or accredited companies that offer the services of such experts, are made available to the public. The recast

Directive also requires Member States to establish an independent control system of EPCs (Art. 18 and Annex II).

Member States were required to apply Articles 3, 11-13, and 18 (referred to above) to buildings occupied by public authorities from 9 January 2013 at the latest and to other buildings from 9 July 2013 at the latest.

The 2002 Directive provided a framework with relatively wide room for Member States to define their own schemes. However, in view of the implementation challenges that have affected the EPBD, the 2010 Directive is more precise. In addition, it provides the possibility for a more harmonised approach in the context of non-residential buildings on a voluntary basis in the future.

► Key requirements related to EPCs under the 2002 Directive

The key requirements of Member States under the 2002 Directive with respect to energy performance certification can be summarised as follows:

1. Bring the necessary laws, regulations and administrative provisions into force by 4 January 2006, or if extended by 4 January 2009.
2. Ensure that when buildings are constructed, sold or rented out, an EPC is made available to the owner or by the owner to the prospective buyer or tenant (option to exclude certain defined categories of buildings).
3. Take measures to ensure that certain buildings frequently visited by the public have their EPC displayed in a prominent place clearly visible to the public.
4. Certificates to include reference values such as current legal standards and benchmarks in order to make it possible for consumers to compare and assess the energy performance of buildings.
5. Adopt own methodology for calculating energy performance of buildings based on a general framework set out in the Annex of the Directive.
6. Certificates to be accompanied by recommendations for the cost-effective improvement of energy performance.
7. Requirement to ensure that certification and drafting of accompanying recommendations are carried out in an independent manner by qualified and/or accredited experts.

► Key requirements related to EPCs under the recast 2010 Directive

The recast EPBD clarified, strengthened and extended the scope of the 2002 Directive. Key changes included:

1. The Directive must be transposed into national law by 9 July 2012 (Art. 2-18 and 20-27). Member States to apply the necessary laws, regulations and administrative provisions by 9 January 2013 (Art. 2,3,9,11-13,17,18,20,27 and Art. 4-8,14-16 to buildings occupied by public authorities) and by 9 July 2013 (Art. 4-8, 14-16 to all other buildings).
2. Mandatory energy certification for all properties constructed, sold or rented out, and for all buildings over 500 m² occupied by public authorities and frequently visited by the public (as of 2015: 250 m²).

3. Inclusion of more detailed recommendations in the EPC of cost-optimal or cost-effective improvement of the energy performance of a building or building unit. Encouragement of public authorities to implement those recommendations within the validity period of the EPC.
4. Requirement to ensure that certification and inspection of heating and air-conditioning systems is carried out in an independent manner by qualified and/or accredited experts.
5. Requirements to establish independent control systems for both, EPCs and reports on inspections of heating and air-conditioning systems.
6. Requirement for Member States to establish penalties for non-compliance.

Annex B: Cyprus – assessment of the EPC scheme

► Presence of the label

a) *When did the scheme come into force for which segments of the property market?*

Table 26: Introduction of EPCs in Cyprus⁶⁸

Property type	Date of entry into force
All residential buildings (new construction and existing)	January 2010
All other building types (new construction and existing)	September 2010

b) *What is known about the proportion of properties (as a proportion of total rental or sales transactions) that were actually certified?*

For sales or rental of existing buildings, the interview suggests that this was very low at the time: around 10% of transactions (500 certificates, 5 000 transactions). There was no big difference in that respect between the residential and office sectors, although since companies and lawyers are involved in office transactions, they may be more likely to ask for a certificate.

For newly constructed buildings, compliance is close to 100%. The way the Directive was transposed for new buildings is that an EPC has to be issued as a prerequisite for getting a building permit. For any new building constructed after 2010 that is sold, most of them have EPCs and have to follow minimum requirements. Most new buildings are the property of a development company and product of a business. As a result, more than 85% of new buildings are constructed with the intention to be sold or rented out. Each one has an EPC.

c) *What do the regulations say about when the information in the EPCs should be made available?*

The law states that when buildings are sold or rented, an EPC is made available to the owner or by the owner to the prospective buyer or tenant, as the case may be. There is no specification on timing, and EPCs can be made available just prior to completion of contract.

d) *Is there any information available about what actually happens in practice (regarding timing)?*

In most cases the information comes too late to influence the decision-making process of the prospective buyer or renter. The EPC is often presented in connection with exchange of contract. It may be that the situation is a bit better in the office sector, such that the information may be available a bit earlier in the decision-making process. However, this observation applies to offices rented by public sector organisations.

⁶⁸ Concerted Action (2010).

► **Concern about energy use and environmental impact when selecting a property**

- a) *Is there any information available about the role of energy use or environmental impact as dimensions of property selection?*

Some of the questions in the most recent Eurobarometer survey relating to the attitude of Europeans to climate change (EC, 2011b) can serve as useful context, helping to assess the likelihood of Cypriot buyers/renters taking into account energy performance or environmental impact when selecting a property.

Table 27: Attitudes to climate change in Cyprus and Europe⁶⁹

Question	Cyprus	EU-27
% of respondents placing climate change as the most important problem facing the world	23%	20%
Seriousness of climate change on a scale of 1-10 (average ranking)	7.7	7.4
% of respondents having insulated their home to reduce energy consumption	10%	18%
% of respondents having bought a low-energy home	2%	3%

► **Trust in the information on the label**

- a) *Has trust been an issue in the public debate about the introduction of EPCs? If so, what themes have been evoked?*

There was a general debate about the discrepancy between the asset rating, which is the basis for the Cypriot EPC, and the actual energy use by owners/renters, and whether this represented the consumption of the building “fairly”. There was also concern about the quality assurance processes of the broader building sector, whether in the case of new buildings these actually conform to what was stated. The EPC for new buildings is issued on the basis of drawings in connection with getting a building permit, not the building as built.

- b) *Are the building blocks of trust in place, in particular in terms of provisions for quality assurance of certification?*

The Energy Service in Cyprus has a central registry for EPCs and checks their quality. Concerted Action (2010) reported that some 16% of all EPCs submitted had been checked by the end of 2010, which is also the year when the scheme became mandatory. According to the interview, the quality of the experts undertaking EPCs is very high. Only qualified engineers can undertake this work and only certain engineering fields can participate. However, this does not take care of the broader problem for new buildings referred to above. There was a debate in Cyprus as to whether an updated EPC should be required once a building has been built but it was concluded that this would be too expensive.

► **Anticipated effect of EPCs on transaction prices and rents**

Only a very low proportion of transactions are accompanied by an EPC. Although the compliance situation for new buildings is much better, there are trust issues pertaining to the information on the EPC. This is not so much to do with the quality of the assessments but more to do with the

⁶⁹ EC, 2011b. No explanation of the term “low-energy home” was provided to respondents.

fact that Cyprus, unlike for example England and Wales, does not require EPCs to be updated once the building is constructed.

Figure 18: Residential EPC, Cyprus

ΠΙΣΤΟΠΟΙΗΤΙΚΟ ΕΝΕΡΓΕΙΑΚΗΣ ΑΠΟΔΟΣΗΣ ΚΤΙΡΙΟΥ

Κατοικία

Ταχ. Κώδικας: 1028
 Επαρχία: Λευκωσία
 Δήμος / Κοινότητα: Λευκωσία
 Κατηγορία έργου: Κατοικία
 Η πιστοποίηση έγινε: Μετά την κατασκευή
 Αριθμός Πιστοποιητικού: 10000000100001101
 Ημερομηνία έκδοσης: 10/01/2010
 Ισχύς πιστοποιητικού μέχρι: 09/01/2011

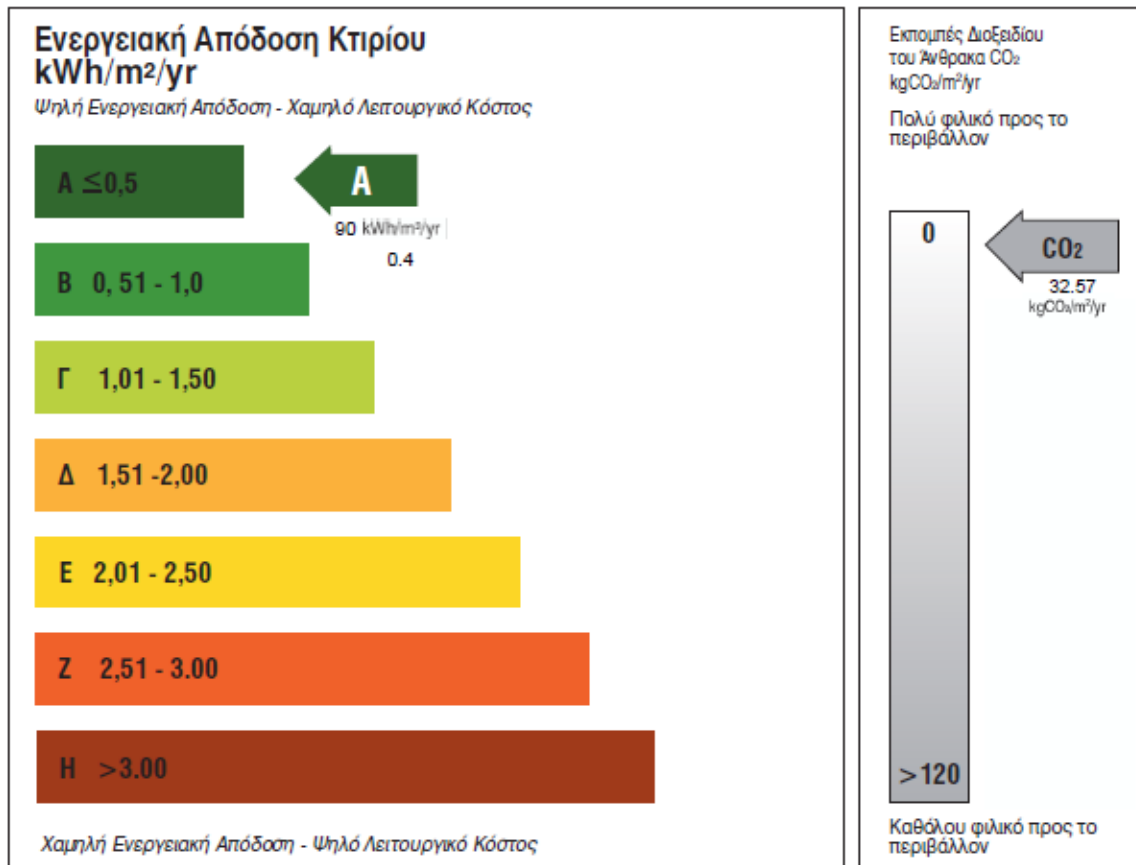
Το παρόν πιστοποιητικό αποτελεί μια ένδειξη της Ενεργειακής Απόδοσης για το συγκεκριμένο κτίριο. Περιλαμβάνει την κατανάλωση ενέργειας για σκοπούς θέρμανσης και ψύξης του κτιρίου για παραγωγή ζεστού νερού χρήσης, για εξασρισμό, για φωτισμό του κτιρίου, υπολογισμένα βάσει της συνήθους χρήσης του κτιρίου. Η Ενεργειακή Απόδοση του κτιρίου εκφράζεται ως η πρωτογενής ενέργεια που καταναλώνεται ανά τετραγωνικό μέτρο συνολικής ωφέλιμης επιφάνειας ανά έτος (kWh/m²/yr)



ΥΠΟΥΡΓΕΙΟ
ΕΜΠΟΡΙΟΥ
ΒΙΟΜΗΧΑΝΙΑΣ
ΚΑΙ ΤΟΥΡΙΣΜΟΥ

Στοιχεία Ειδικευμένου Εμπειρογνώμονα

Όνομα:
 Αρ. Εγγραφής στο Μητρώο:



Σημείωση: Η συνολική ετήσια κατανάλωση πρωτογενούς ενέργειας στο κτίριο είναι: 100kwh/m²/yr
 Η κατανομή ενέργειας από συμβατικές πηγές είναι 90kwh/m²/yr
 και από ΑΠΕ είναι 10kwh/m²/yr
 Προειδοποίηση:

► EPC data

There is a central register for all the EPCs issued in Cyprus and the competent authority is the Energy Service of the Ministry of Commerce, Industry and Tourism. The register contains around 11 507 valid EPCs issued between 1 January 2010 and 31 March 2012. However, access is restricted to energy inspectors under personal data protection law (the provisions of paragraphs (3) and (4) of regulation No 19 of the Energy Performance of Buildings (Energy Certification for Buildings) Regulations of 2009, Κ.Δ.Π. 164/2009).

The Energy Service could not provide “personal” data, i.e. no exact addresses (as would be required for our analysis in order to match with price data) and no identification of the qualified expert. The building information that could have been provided is:

- Municipality;
- District;
- Type of building (dwelling/non-residential);
- Certification (before construction/as built);
- Issue date;
- Energy category class (A/ B/ Γ/ Δ/ E/ Z/ H);
- Energy rating (ratio range 0.00 to 3.00);
- CO₂ emissions (kgCO₂/m²/yr);
- Primary energy consumption (kWh/m²/yr);
- Primary energy consumption covered by RES (kWh/m²/yr).

Data is only available from November 2010 onwards. In addition, the following points should be noted:

- The EPC Register began operation in January 2010;
- Over 90% of EPCs in the register are issued for buildings before construction;
- Less than one thousand EPCs have been issued and registered for buildings as built;
- Most dwellings in Cyprus are constructed for owner occupancy;
- Building construction is generally completed in less than 18 months.

Therefore, the vast majority of the EPCs issued are for buildings that are still under construction or that have not yet been made available on market for sale or rental.

We also contacted alternative sources such as commercial websites and real estate agents that could have datasets with both price and EPC information. However, for the reason mentioned above, it was deemed not yet feasible to make the analysis for Cyprus.

► Data on transactions

The Cyprus Land Registry is the main source of transaction data. However, its database records only the registration number of the plot and the transaction date and price. It does not record the

characteristics of the properties transacted nor their addresses. Moreover, only registered evaluators in Cyprus can have access to the data, which they then have to purchase on a quarterly basis.

This page is intentionally left blank.

Annex C: Portugal – assessment of the EPC scheme

► **Presence of the label**

a) *When did the scheme come into force for which segments of the property market?*

Table 28: Introduction of EPCs in Portugal⁷⁰

Property type	Date of entry into force
New residential / non-residential with floor area greater than 1 000 m ²	July 2007
All new buildings regardless of floor area	July 2008
Existing buildings offered for sale or rent	January 2009

b) *What is known about the proportion of properties (as a proportion of total rental or sales transactions) that were actually certified?*

Portugal’s register contains around 500 000 EPCs dating back to July 2007, about 70% of which for existing buildings and 90% residential (mostly two- and three-room apartments).⁷¹ According to BPIE (2010), about 90% of “building completion and transactions” were accompanied by an EPC. The share is likely to be lower in the rental sector. This was borne out by interviews conducted for this study with ADENE (the Portuguese energy agency). More than 90% of all transactions in 2009 were accompanied by an EPC.⁷² That data does not distinguish between rental and sales. ADENE also has data from 2011 for sales only, when nearly 100% of sales transactions were accompanied by a certificate. It is more difficult to access data on rentals.

It should be noted that because of the economic crisis the rental market in Portugal is increasing at the expense of the sales market. This means that the overall compliance rate for the Portuguese market may have decreased to less than 93% as rentals, where compliance is thought to be lower, make up a higher proportion of transactions. The economic crisis could cause a decrease in the number of certificates being issued (this effect seems to have occurred in Portugal in 2011). An EPC has to be included with the “declaration of conformity” for new buildings.

According to ADENE, the system has been established in such a way that technical verification of compliance with energy performance requirements is made in two steps: when requesting the building permit, and after completion of the building. Enforcement of the regulation is the responsibility of the municipality where the building is located, based on verification of the existence of the Declaration of Compliance (a kind of “pre-EPC”) with the building regulations issued by an accredited expert registered with the SCE (Building Energy Certification System).

⁷⁰ IEA (2010), p.51.

⁷¹ Source: ADENE.

⁷² eceee (2009), confirmed by ADENE.

After the completion of the building, the final EPC, reflecting the built reality, is needed for the municipality to release the usage permit. Now, practically all municipalities have included the Declaration of Compliance or the EPC in the list of documents required in a licensing process. Nearly 100% of these have an EPC according to ADENE.

Thus we can conclude that overall, this aspect of compliance is high in Portugal and has been high for existing buildings since 2009, the year the EPC scheme became mandatory. This is the case for sales transactions and also, but to a lesser extent, for rental transactions. The information was not available broken down by use type, so we have to assume for the purposes of this study that the situation is similar in the residential segment and in the office segment.

c) *What do the regulations say about when the information in the EPCs should be made available?*

According to Concerted Action (2010), the Portuguese regulations provide that “as of January 2009, all existing residential and non-residential buildings need to be certified when they are sold or rented. The owner must present a valid EPC to the buyer when the selling or renting contract is established.” Neither BPIE (2010) nor IEA (2010), which contain sections dedicated to Portugal, have any information on this. The Concerted Action summary suggests that as long as the EPC is presented prior to completion, the owner is in compliance. This interpretation was also borne out by the interview with ADENE.

This will change with the implementation of the recast EPBD into the Portuguese regulations. However this has not yet taken place and the new requirement to include the energy performance indicator of the energy performance certificate when a property (which has a certificate) is advertised. While this will increase the likelihood that prospective buyers/renters take account of this information in their decision-making process, it comes too late to affect any data analysed for the purposes of the present study.

d) *Is there any information available about what actually happens in practice (regarding timing)?*

In Portugal, EPCs are issued in about 90% of transactions (fewer in the rental market) but not issued in advance of the finalisation of the transaction. Fonseca et al. (2011) observed that buyers usually decide about buying a house before they know its energy performance. The certification of buildings is seen as an additional cost for “building promoters” and therefore is seen as a penalty in the marketing of buildings. The certificate is ordered just because it is mandatory for the notary when the house is being registered.

As far as new buildings and renovations are concerned, Fonseca et al. (2011) point to criticisms among those interviewed as regards the timing of the provision of the certificate. This is at the time of registration with the notary and thus a preliminary EPC does not appear to be provided.

Interviews with ADENE give a slightly more optimistic picture based on ADENE’s exchange with the Portuguese national association of realtors with whom a co-operation agreement has been in place since early on in the implementation of the EPC. Anecdotal evidence through this channel suggests that estate agents in Portugal are using EPCs in the marketing of (better-performing) properties. This would suggest that the EPC has at least to some extent been integrated into the

practices of estate agents. ADENE suggests that this is as a result of early engagement with the industry through which among other things, training has been provided.

However overall, it would probably be wise to err on the side of caution and assume that in most cases the EPC is presented too late in the decision-making process to have a real effect. While the proportion of transactions in Portugal accompanied by an EPC may be relatively high, the timing is such that in practice, this information is not likely in most cases to influence the decision-making process. This means that the issues examined below (understanding of the label, extent to which energy and/or environmental impact are salient parameters in the decision-making process, whether the information on the label is trusted) are less pertinent to examine for the purposes of establishing whether EPC rating is reflected in property value in Portugal as they do not usually come into play. As noted in the previous section, this should change under the recast EPBD.

► Understanding of the label

a) What information is available about buyer/renter understanding of the EPC?

Fonseca et al. (2011) report on consumer research directed at residential sales carried out in the context of the EC-funded project IDEAL EPBD. Interviews suggested that although the appliance label is well known, people do not understand the meaning of the buildings certificates, and moreover that they do not understand the type of language used and their role in the process. As IDEAL EPBD was particularly interested in the uptake of the recommendations on how to improve the energy performance of a property shown on certificates, it is not clear whether this lack of understanding applies to all aspects of the certificate or just the so-called “recommendations” part.

The ongoing Intelligent Energy Europe project REQUEST also focuses on renovation. A pilot study has been conducted on Portugal, which includes a limited amount of data on understanding of the EPC. The study is however still ongoing. It should also be noted that this data applies to the residential sales segment, and we have no data for the residential rental segment or for the office segment (whether rental or sales).

According to ADENE, completely different results were found in a telephone survey performed during April and May 2011 on a sample of 560 owners of houses across the country that have been certified in the last two years. The purpose of this study was to assess whether the public knows about the EPC and if they consider the recommendations provided on energy improvement in the EPC when they undertake refurbishment works. The interviews showed that 77.5% of those who live in a house with an EPC actually read it, and of the total respondents that perform improvement works or refurbishments, 76% had taken the recommendations on the EPC into consideration. The survey also showed that most owners would perform improvement works if a return on investment of less than eight years was guaranteed.

Also according to ADENE, another recent survey points towards consumers’ sensitivity to costs and their lack of awareness as important constraints on the promotion of energy efficiency and renewable solutions. Portuguese consumers are very cost-oriented and prefer to invest in cheaper technologies rather than environmentally friendly ones.

► **Concern about energy use and environmental impact when selecting a property**

- a) *Is there any information available about the role of energy use or environmental impact as dimensions of property selection?*

In the judgement of interviewees, “green buildings” are becoming more important but are suffering from the present economic crisis. The most recent Eurobarometer survey relating to the attitude of Europeans to climate change (EC, 2011b) is shown in Table 29 as part of the broader societal context to the property market in Portugal.

Table 29: Attitudes to climate change in Portugal and Europe⁷³

Question	Portugal	EU-27
% of respondents placing climate change as the most important problem facing the world	7%	20%
Seriousness of climate change on a scale of 1-10 (average ranking)	7.7	7.4
% of respondents having insulated their home to reduce energy consumption	7%	18%
% of respondents having bought a low-energy home	2%	3%

► **Trust in the information on the label**

- a) *Has trust been an issue in the public debate about the introduction of EPCs? If so, what themes have been evoked?*

Fonseca et al. (2011) report some controversy around the fairness of the methodology for assessing energy performance. According to interviews (undertaken June 2012), quality and trust have been topics of discussion from the outset of the scheme, but are however not perceived to be a significant problem in Portugal due to the quality assurance scheme and efforts to explain the scheme to different actors in the market (see below).

- b) *Are the building blocks of trust in place, in particular in terms of provisions for quality assurance of certification?*

Fonseca et al. (2011) asserted that quality control of certificates should be improved. The picture that emerges from the interviewees is that Portugal has a quality control system in place that goes some way to assuring quality and trust in the scheme. ADENE routinely conducts quality checks of EPCs. There are two dimensions to this: 1) some 1% of EPCs are subjected to detailed checks that involve the replication of the work undertaken by the “qualified expert”, including a visit to the site; 2) some 6% of EPCs uploaded on the national website are checked in a more superficial way for anything that looks strange. If there is reason to think that there is something wrong with the quality of the EPC, this is forwarded for a more detailed check. A report is sent to the qualified expert requiring him/her to amend or redo the EPC.

An agreement has been concluded with the main consumers’ organisation in Portugal such that when there is a concern about an EPC or a need for more information to improve understanding, individuals and presumably also organisations know where to go. They can choose whether to contact ADENE or the consumers’ organisation. This transparency, assuming that there is wide

⁷³ EC, 2011b. No explanation of the term “low-energy home” was provided to respondents.

awareness of this possibility to address concerns and get more information, should also go some way to ensuring trust.

Thus overall, it seems that trust at present is unlikely to be a significant barrier when it comes to EPCs being integrated into market practices. This is however a situation that has to be continually maintained through the quality assurance system.

► Anticipated effect of EPCs on transaction prices and rents

Although a high proportion of transactions receive a certificate, on the basis that this is likely to be presented to the buyer/renter just before contract completion, we do not expect this to have much if any influence on property value while this is still the case. Changes under the recast EPBD would seem likely to reduce this barrier, although this effect may play out differently in the context of different practices of property procurement.⁷⁴

Interviewees suggested that “green buildings” are becoming increasingly important, but that this trend had declined due to the economic crisis. Making energy count in the property selection process will also be an important dimension of integrating EPCs into market practices, although there is a degree of “chicken and egg” here, as EPCs are intended to help make energy performance more visible and hence count in the property selection process. Trust seems unlikely to present a barrier to the integration of EPCs into market practices, and this situation is clearly something which has to be continually worked at to be maintained.

► EPC data

The central *certificação energética e ar interior* database is managed by the Agência Portuguesa do Ambiente.⁷⁵ EPCs can be searched for and viewed online (one at a time), by EPC number, date of issue, address, municipality, region and expert.⁷⁶ The certificate contains:

- Identification of the building (address);
- Energy performance rating (A+ to G);
- CO₂ emissions;
- Energy needs for heating, cooling and hot water (kWh/m₂ per year);
- Other information (typology, area, type of walls, floor, roof, windows, HVAC and hot water equipment, ventilation).

The recommendations section contains a short description, a range of values for reduction of the energy bill, estimated cost of investment and payback period, and the new energy rating if the recommendations are implemented. New buildings have to have an A or B rating. About 60% of existing buildings have C ratings or lower.

The project team contacted the Agência and ADENE regarding access. They could send a sample with the location (city) and energy rating of the properties but without addresses and so the dataset was not used for this study. An alternative source such as a commercial website or real


⁷⁴ It is worth noting that this may play out differently in the residential and non-residential sectors due to different procurement processes for property. This also means that there may be differences within the non-residential sector where some parts of the market may be much more professionally mediated.

⁷⁵ See www.apambiente.pt/POLITICASAMBIENTE/AR/QUALIDADEARINTERIOR/Paginas/default.aspx.

⁷⁶ See www.adene.pt/ADENE/Canais/SubPortais/SCE/EdificiosCertificados/Pesquisa.


estate agents database that would have both price and EPC data was not found (see also Annex on data sources).

Figure 19: Page 1 of Residential EPC, Portugal⁷⁷



Certificação Energética e Ar Interior
EDIFÍCIOS

Nº CER 1234567/2007



CERTIFICADO DE DESEMPENHO ENERGÉTICO E DA QUALIDADE DO AR INTERIOR

TIPO DE EDIFÍCIO: EDIFÍCIO HABITAÇÃO UNIFAMILIAR / FRACÇÃO AUTÓNOMA DE EDIF. MULTIFAMILIAR

Morada / Situação: _____

Localidade _____ Freguesia _____

Concelho _____ Região _____

Data de emissão do certificado _____ Validade do certificado _____

Nome do perito qualif. _____ Número do perito qualif. _____

Imóvel descrito na Conservatória do Registo Predial de _____

sob o nº Art. matricial nº _____ Fração autón. _____

Este certificado resulta de uma verificação efectuada ao edifício ou fracção autónoma, por um perito devidamente qualificado para o efeito, em relação aos requisitos previstos no Regulamento das Características de Comportamento Térmico dos Edifícios (RCCTE, Decreto-Lei 80/2008 de 4 de Abril), classificando o imóvel em relação ao respectivo desempenho energético. Este certificado permite identificar possíveis medidas de melhoria do desempenho aplicáveis à fracção autónoma ou edifício, suas partes e respectivos sistemas energéticos e ventilação, quer no que respeita ao desempenho energético e à qualidade do ar interior.

1. ETIQUETA DE DESEMPENHO ENERGÉTICO


INDICADORES DE DESEMPENHO

Necessidades anuais globais estimadas de energia primária para climatização e águas quentes kgep/m².ano

Valor limite máximo regulamentar para as necessidades anuais globais de energia primária para climatização e águas quentes (limite inferior da classe B*) kgep/m².ano

Emissões anuais de gases de efeito estufa associadas à energia primária para climatização e águas quentes toneladas de CO₂ equivalentes por ano

CLASSE ENERGÉTICA



2. DESAGREGAÇÃO DAS NECESSIDADES NOMINAIS DE ENERGIA ÚTIL

Necessidades nominais de energia útil para...	Valor estimado para as condições de conforto térmico de referência	Valor limite regulamentar para as necessidades anuais
Aquecimento	<input type="text"/> kWh/m ² .ano	<input type="text"/> kWh/m ² .ano
Arrefecimento	<input type="text"/> kWh/m ² .ano	<input type="text"/> kWh/m ² .ano
Preparação das águas quentes sanitárias	<input type="text"/> kWh/m ² .ano	<input type="text"/> kWh/m ² .ano


NOTAS EXPLICATIVAS

As necessidades nominais de energia útil correspondem a uma previsão da quantidade de energia que terá de ser consumida por m² de área útil do edifício ou fracção autónoma para manter o edifício nas condições de conforto térmico de referência e para preparação das águas quentes sanitárias necessárias aos ocupantes. Os valores foram calculados para condições convencionais de utilização, admitidas como idênticas para todos os edifícios, de forma a permitir comparações objectivas entre diferentes imóveis. Os consumos reais podem variar bastante dos indicados e dependem das atitudes e padrões de comportamento dos utilizadores.


As necessidades anuais globais de energia primária (estimadas e valor limite) resultam da conversão das necessidades nominais de energia útil em kilogramas equivalente de petróleo por unidade (kgep) de área útil do edifício, mediante aplicação de factores de conversão específicos para a(s) forma(s) de energia utilizada(s) (0,290 kgep/kWh para electricidade e 0,085 kgep/kWh para combustíveis sólido, líquido ou gasoso) e tendo em consideração a eficiência dos sistemas adoptados ou, na sua indefinição, sistemas convencionais de referência.

As emissões de CO₂ equivalente traduzem a quantidade anual estimada de gases de efeito de estufa que podem ser libertados em resultado da conversão de uma quantidade de energia primária igual às respectivas necessidades anuais globais estimadas para o edifício, usando o factor de conversão de 0,0012 toneladas equivalentes de CO₂ por kgep.


A classe energética resulta da razão entre as necessidades anuais globais estimadas e as máximas admissíveis de energia primária para aquecimento, arrefecimento e para preparação de águas quentes sanitárias no edifício ou fracção autónoma. O melhor desempenho corresponde à classe A*, seguida das classes A, B, B*, C e seguintes, até à classe G de pior desempenho. Os edifícios com licença ou autorização de construção posterior a 4 de Julho de 2005 apenas poderão ter classe energética igual ou superior a B*. Para mais informações sobre o desempenho energético, sobre a qualidade do ar interior e sobre a classificação energética de edifícios, consulte www.adene.pt.



Entidade gestora



Entidade supervisorada do SCE



AGÊNCIA PORTUGUESA DO AMBIENTE

1/4

⁷⁷ For full-length examples of both residential and non-residential EPCs, see www.adene.pt/pt-pt/SubPortais/SCE/Apresentacao/Certificacaodeedificios/Paginas/Exemplosdecertificados.aspx.

This page is intentionally left blank.

Annex D: Further information on datasets not used

► Austria

The company Immounited runs a website called lexunited⁷⁸ and maintains a database of sales prices, addresses, square metres and other characteristics. As the authorised clearing body of the Republic of Austria in charge of land registry, lexunited receives around 8 000 new transactions each month (sales only, no rental) and the series dates from January 2009 (January 2008 for large cities). A small sample of data was provided by lexunited in order for the project team to assess the relevance of these data for the purposes of this study. However, the database does not contain EPC information. Available variables include:

- Transaction prices (€);
- Addresses of dwellings;
- Floor areas (m²);
- Dummy variables distinguishing properties sold directly by a builder/property developer from those sold by any other person or company (this variable would allow extraction of a sample of new properties in order to circumvent the lack of information on construction years); and
- Number of rooms.

Österreichische Notariatskammer (Austrian Chamber of Civil Law Notaries) was contacted and confirmed that it does not hold a database of transactions.

Wirtschaftskammer Österreich (Austrian Economic Chamber) uses estimated values for its property market analysis.⁷⁹

Fachverband der Immobilien- und Vermögenstreuhänder (Real Estate Association of the Chamber of Commerce) and Statistics Austria have general data on housing costs, building stocks, etc.⁸⁰

Dr. Wolfgang Feilmayr (Vienna University of Technology) is involved in the statistical work undertaken by the National Bank of Austria and the Austria Real Estate Exchange (A!B) to compute a quarterly residential property price index.⁸¹ However, the database used to build the index does not contain information on EPCs.

► Belgium

In order to circumvent the issue of privacy protection, the project team tried to get an exemption from the Belgian commission for the protection of privacy in order to access data from the *Cadastre du SPF Finances*. The exemption process would have required asking Statistics Belgium to match transaction prices and EPC samples using the address. Statistics Belgium could then

⁷⁸ See www.immounited.com and www.lexunited.com.

⁷⁹ See <http://portal.wko.at/wk/startseite.wk>

⁸⁰ See Statistics Austria website at www.statistik.at/web_en/statistics/dwellings_buildings/index.html.

⁸¹ Residential Property Price Index:
www.oenb.at/en/stat_melders/datenangebot/preise/preisentwicklung/notes_66.jsp#tcm:16-173663.

have provided us with “coded data” from which addresses would be deleted. However, in order to have the authorisation to access these “coded data” from the commission for the protection of privacy, the European Commission would have had to be the recipient of the data and the procedure would have taken several months.

The CIB Flanders real estate professionals association, the *Beroepsinstituut van Vastgoedmakelaars* (BVI) real estate agents association and the *Chambre des Experts Immobiliers de Belgique* (KAVEX) do not gather or cannot provide price data..

At federal level, the *Administration Générale de la Documentation Patrimoniale* is the public service in charge of property services.

Statistics Belgium provides some aggregated data on property prices.⁸²

► Cyprus

The Cyprus Real Estate Agents Association (CREAA), part of the Cyprus Chamber of Commerce and Industry was contacted and confirmed that they do not hold a dataset on transactions and rentals.⁸³

RICS publishes a quarterly Property Price Index for Cyprus. The Index tracks property and rental prices across all districts and main property types.⁸⁴ However, RICS Cyprus confirmed that the RICS Price Index is based on hypothetical properties that are directly valued by members of the association.

Cyprus’ statistical services provide general data on building permits but do not hold a dataset on transactions and rentals.⁸⁵

► France

ADEME is creating a central EPC database but it was not publicly accessible by the end of 2012 and it is not set to contain data prior to July 2012.

The French association of real estate agents FNAIM holds a database containing sales, rental and EPC data,⁸⁶ about 140 000 observations on both transactions and rentals for each year since 1990. Although data is not available for public disclosure, FNAIM at first agreed to share its database for research purposes related to EPCs but in the end did not do so.

The small ads website pap.fr was also contacted, via internet and telephone. However, its data is not available for public disclosure.

► Portugal

In June 2011, *Confédération Européenne de l’Immobilier* (CEI) and *Conseil européen des Professions immobilières* (CEPI) agreed to form a common platform representing around 175 000 real estate agents and managers. The online database of CEI (www.webcei.com) uses Daft.ie technology and contains 326 200 sales entries for Portugal (by region), 862 rental and 30 759 “Commercial”.

⁸² See http://statbel.fgov.be/fr/statistiques/chiffres/economie/construction_industrie.

⁸³ See www.skek-creaa.com.

⁸⁴ www.joinricsineurope.eu/en/na/view/rics-cyprus/rics-cyprus-property-price-index/rics-cyprus-property-index-q4-2011-779/

⁸⁵ See www.mof.gov.cy/mof/cystat/statistics.nsf/index_en/index_en?OpenDocument.

⁸⁶ See www.fnaim.fr.

CEI and CEPI were contacted but due to organisational changes were unable to respond. We also contacted FRONTAL, the main Portuguese real estate agent providing data but without response.⁸⁷

The *Notarios* of Portugal were contacted but confirmed that they do not hold a database on transaction prices.

RICS Portugal,⁸⁸ the *Instituto Nacional da Construção e do Imobiliário* and the Institution of Engineers were also contacted.⁸⁹

► Other countries

As it was proving difficult to obtain data, at one stage during the project we investigated whether data was readily available for some other countries. For Denmark for example, payment would have been required for both access to data and data handling, and the data would not have been available until after the completion of this study. For Germany, data from commercial websites was considered.⁹⁰ The project team also investigated the availability of data in Spain. EPCs in Spain are managed by the regional governments. The regions of Navarra, Valencia and Andalusia have online databases allowing individual EPCs to be downloaded.⁹¹ However, bulk data are not readily available and samples are not large enough to carry out robust econometric analysis (15 observations for Valencia, 384 for Andalusia). Having investigated several alternative countries in this way, efforts were instead focused on the original countries within the scope of the study, adding additional data comparisons and regions within countries in order to maximise the usefulness of the analysis.

► Other labels

In case it would not have been possible to analyse EPC data, analysis of other energy or environmental performance labels to complement EPC data was considered at one stage during the project. Examples of such methodologies for non-residential buildings include: BREEAM (UK), HQE⁹² (France), DGNB (Germany), ITACA-SBC, VERDE, GBTOOL, DISTINTIU, LEED, Green Star and CASBEE. For residential buildings, the Minergie⁹³ (mainly Switzerland, also 100-200 for France and a handful for other countries that neighbour Switzerland), LEED and BREEAM labels exist.

Some work has already been done on BREEAM office buildings in the UK. Chegut et al. (2011) used information from four different sources (EGI, RCA, CoStar Focus and BREEAM⁹⁴) and collected some data by hand (site visits). As of August 2012, the BREEAM database contained 2 263 buildings, with the following variables: Building/Asset Name, Client/Developer, Scheme, Rating/Score, Stage/Valid Until, Cert. No., Assessor/Auditor, Town/Postcode/Zip Code and Country.

⁸⁷ See www.frontal.pt/contactos.

⁸⁸ See www.rics.org.

⁸⁹ See www.inci.pt and www.engenheiros.pt.

⁹⁰ See for example Kholodolin and Mense (2012).

⁹¹ www.juntadeandalucia.es/economia/innovacion/ciencia/oficinavirtual/errorSeguridad.do.

⁹² Database under construction at www.ascomade.org/hqe/home.php?idMarque=3&langue=1.

⁹³ Database at www.minergie.ch/liste-des-batiments.html.

⁹⁴ Database at www.greenbooklive.com/search/advancedsearch.jsp?partid=10023#scheme_search.

The European Commission (DG ENV with JRC IPTS) is working to develop an Ecolabel for the “Buildings” product group. A draft study of office buildings (JRC, 2011) found a vacancy premium (lower vacancy rates) for ecolabelled buildings of between 2% and 18%.

Annex E: Note on avoiding selection bias

In any econometric analysis there is a potential for endogeneity problems, i.e. the fact that explanatory variables might be correlated: energy efficiency is likely to be correlated with other quality characteristics of properties (age, apartment building compared to detached house, etc.). Therefore, two-stage regressions are used (first energy efficiency on explanatory variables, then property prices on the estimate of energy efficiency and other explanatory variables).

Not all entries in databases of transaction values contain an EPC rating (e.g. not all property listings on Daft.ie include an EPC rating). Thus, properties with an EPC might not be representative of the property market in general. If such sample selection bias occurs, the inference from the hedonic regression cannot be extended to unobserved groups. The estimated value of the EPC may be true for properties with an EPC but not necessarily for other properties, which may be systematically different.

Put another way, it is possible that in the case of property prices and EPCs, better quality homes are more likely to have an EPC and command a higher price. An unobserved “quality” effect affects both the decision to obtain an EPC and the value of a property. Therefore, in these circumstances, it is appropriate to use a two-stage approach that avoids selection effects.

Hyland, Lyons and Lyons (2012) develop a two-stage model of the relationship between energy efficiency and property market outcomes, for the Irish market. They employ the standard selection model, developed by Heckman (1979). According to Heckman, when individuals self-select into a sample “fitted regression functions confound the behavioural parameters of interest with parameters of the function determining probability of entrance into the sample”. Greene (2002) outlines in detail the Heckman procedure for dealing with selection effects. In brief, the problem of non-randomly selected samples can be formulated in a two-equation model. The first equation determines selection into the sample and takes the following form:

The second equation is the outcome equation, which is the equation of interest:

This second equation is analogous to the Rosen equation from earlier, where the beta-vector comprises h, l, c . Where y is observed if x is greater than zero, i.e.:

The two error terms, ϵ_1 and ϵ_2 , are bivariate normal with a correlation coefficient ρ :

Where there is no correlation between ϵ_1 and ϵ_2 ($\rho = 0$), the two-stage process is redundant, as estimating the selection and outcome equations with Ordinary Least Squares (OLS) will yield

consistent estimates of β . As discussed above, however, the error terms from the two equations – whether to obtain an EPC and the price equation – are likely to be correlated.

As described by Hyland, Lyons and Lyons (2012), the first stage of the Heckman procedure models the decision by sellers/landlords to obtain an EPC while the second stage models the effect of the EPC on property prices (or rents). In order to employ the Heckman model, it is necessary to have an instrument that is an important determinant of the decision to obtain an EPC (the selection equation) but that is uncorrelated with property price (the outcome equation).

For Ireland for example, the instrument used can be the mandatory EPC legislation: as of 1 January 2009, all homes offered for sale or rent were obliged to have an EPC and thus a dummy variable for this date is included, which is an important determinant of whether or not a property has an EPC. It is important in the second stage of the model that the instrument is independent of property value. Therefore, to control for any correlation between property prices/rents and the instrument, time dummies are included in the regressions.

Results of the selection equation for Ireland show that property type is typically an unimportant predictor of the decision to obtain an EPC. Size, on the other hand, is an important factor: the number of bedrooms in a home does have an effect on the decision to obtain an EPC. Relative to three-bedroom homes, one-bedroom homes are significantly less likely to be certified, while four- and five-bedroom homes are more likely to be certified; these results hold for both the sales and lettings models.

Location also matters for the decision to obtain an EPC: in general, urban areas are most likely to have an EPC, in both sales and lettings markets, with rural areas less likely to have this information.

Another important dimension, particularly for policy makers looking to judge the success of the scheme, is time. EPC adoption is increasing over time: in both the lettings and sales models, the coefficient on a continuous time variable was positive and significant.

Qualitatively, the estimated relationships between energy efficiency and property values that results from this two-stage analysis are not different from a one-stage model that uses only the sub-sample with EPC information. Thus, the one-stage models presented throughout this report may be taken as valid for properties that have chosen to obtain an EPC. As with a two-stage model, it is not possible to state for certain that the same relationship between EPC and property market outcomes would hold for those properties that do not have an EPC.

Annex F: Acronyms

ACTHERS	Australian Capital Territories Home Energy Rating System
ADENE	Portuguese energy agency
ADEME	French energy and environment agency
BER	Building Energy Rating
BIEN	Database of the Notaires of France for the Ile-de-France region
BREEAM	Building Research Establishment Environmental Assessment Method
CASBEE	Comprehensive Assessment System for Built Environment Efficiency
DPE	<i>Diagnostic de performance énergétique</i>
eccee	European Council for an Energy Efficient Economy
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
HQE	<i>Haute qualité environnementale</i>
IEA	International Energy Agency
LEED	Leadership in Energy and Environmental Design
OLS	Ordinary Least Squares
PERVAL	Database of the Notaires of France for regions other than Ile-de-France
R&D	Research and Development
RMI	Repair, Maintenance and Improvement
SEAI	Sustainable Energy Authority of Ireland
TGBP	Tokyo Green Building Programme
TGLSC	Tokyo Green Labelling System for Condominiums
US EPA	United States Environmental Protection Agency

This page is intentionally left blank.

Annex G: References

- Addae-Dapaah K. and S.J. Chieh (2011) "Green Mark Certification: does the market understand" in *Journal of Sustainable Real Estate*, Vol. 3, No. 1: 162-191, www.costar.com/uploadedFiles/JOSRE/JournalPdfs/09.162_191.pdf.
- ADEME (2012) "Emergence de la "valeur verte" dans l'immobilier: anticiper les bénéfices de la performance énergétique" in *Lettre ADEME et Vous*, No. 32, 13 Avril 2012, <http://ademe-et-vous.ademe.fr/sites/default/files/strategie-etudes/32/ademetudestrat32.pdf>.
- ADEME and Sogreah Climat Energie (2011) *Analyse préliminaire de la valeur verte pour les logements*, www2.ademe.fr/servlet/getDoc?cid=96&m=3&id=82882&p1=02&p2=0703&ref=17597.
- ADEME and TNS (2012a) *Perception du Diagnostic de Performance Énergétique*. Étude Grand Public, Powerpoint presentation.
- (2012b) *Perception du Diagnostic de Performance Énergétique*, Étude Professionnels, Powerpoint presentation.
- Adjei, A. (2011) *Research results and policy recommendations of the IDEAL EPBD project addressing homeowners' experience of the Energy Performance Certificate in England*, www.ideal-epbd.eu/download/pap/UK_findings_recommendations.pdf.
- Akerlof, G.A. (1970) "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism" in *Quarterly Journal of Economics*, Vol. 84, Issue 3, pp. 488-500.
- Amecke, H. (2011) *The Effectiveness of Energy Performance Certificated – Evidence from Germany*, CPI Report, DIW, Berlin.
- Andaloro, A.P.F., Salomone, R., Ioppolo, G. and L. Andaloro (2010) "Energy certification of buildings: A comparative analysis of progress towards implementation in European countries" in *Energy Policy* 38, 5 840-5 866.
- Backhaus, J., Tigchelaar, C. and M. de Best-Waldhober (2011) *Key findings & policy recommendations to improve effectiveness of Energy Performance Certificates & the Energy Performance of Buildings Directive*, report in the context of the project "Improving Dwellings by Enhancing Actions on Labelling for the EPBD", www.ideal-epbd.eu.
- Bloom, B., Nobe, M.C. and M.D. Nobe (2011) "Valuing Green Home Design: A study of ENERGY STAR Homes" in *JOSRE*, Vol.3, No. 1, 109-126, www.costar.com/uploadedFiles/JOSRE/JournalPdfs/06.109_126.pdf.
- Boardman, B. (2012) *Achieving zero – delivering future-friendly buildings*, Environmental Change Institute, University of Oxford.
- Brounen, D. and N. Kok (2010) *On the economics of energy labels in the housing market*, RICS Research, Maastricht University, June 2010, www.rics.org/site/download_feed.aspx?fileID=7754&fileExtension=PDF.

- (2011) "On the economics of energy labels in the housing market" in *Journal of Environmental Economics and Management* 62:166-179,
www.sciencedirect.com/science/article/pii/S0095069611000337.

Buildings Performance Institute Europe (2010) *Energy Performance Certificates Across Europe: From design to implementation*, www.bpie.eu/energy_performance_certificates.html.

- (2011) *Europe's Buildings Under the Microscope: A country by country review of energy performance*, www.europeanclimate.org/documents/LR_%20CbC_study.pdf.

Bullier, A. et al. (2011) "Assessing Green Value: A key to investment in sustainable buildings" in *Proceedings from the 2011 ECEEE Summer Study on Energy Efficiency in Buildings*, Stockholm, European Council for an Energy-Efficient Economy.

Carassus, J. (2011) *Les immeubles de bureaux "verts" tiennent-ils leurs promesses? Performances réelles, valeur immobilière et certification "HQE Exploitation"*, Centre Scientifique et Technique du Bâtiment, Mars 2011,
www.certivea.fr/ressource/data/newsletters/newsletter10/J_Carassus_FR.pdf.

Cerqual (2011) *Etude économique sur la valeur verte de l'immobilier de logements - la valeur verte dans le résidentiel: une réalité aujourd'hui*, Décembre 2011,
www.qualitel.org/fileadmin/user_upload/images_actu/valeurverte.pdf.

Concerted Action (2010) *Implementing the Energy Performance of Buildings Directive (EPBD), Featuring Country Reports 2010*, www.epbd-ca.eu.

Department for Communities & Local Government (DCLG) (2011) *Proposed Changes to the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007 (The EPB Regulations)*,
www.rics.org/site/download_feed.aspx?fileID=9371&fileExtension=PDF.

Department of Communications, Energy and Natural Resources (2011) *Better Energy: The National Upgrade Programme Factsheet 11 May 2011*, www.dcenr.gov.ie/NR/rdonlyres/3F8D2585-F2E1-46EA-BA30-50370A4F1D0F/0/2011_0511BetterEnergyLaunchFactsheet.pdf.

Deng, Y., Li, Z. and J.M. Quigley (2012) "Economic returns to energy-efficient investments in the housing market: Evidence from Singapore" in *Regional Science and Urban Economics* 42: 506-515.

Dinan, T.M. and J.A. Miranowski (1989) "Estimating the implicit price of energy efficiency improvements in the residential housing market: A hedonic approach" in *Journal of Urban Economics*, vol. 25, issue 1: 52-67.

Eichholtz, P., Nils, K. and J.M. Quigley (2008) *Doing Well by Doing Good? Green Office Buildings*, Program on housing and urban policy, Institute of Business and Economic Research, University of California, Berkeley, Working paper April 2008,
http://urbanpolicy.berkeley.edu/pdf/EKQ_Green_Buildings_040808.pdf.

- (2009) *Doing Well by Doing Good? An Analysis of the Financial Performance of Green Office Buildings in the USA*. RICS Research.

www.greenbiz.com/sites/default/files/document/DoingWellbyDoingGood.pdf.

- (2010a) *Doing Well by Doing Good? Green Office Buildings*, Program on housing and urban policy, Institute of Business and Economic Research, University of California, Berkeley, Working paper December 2010, http://urbanpolicy.berkeley.edu/pdf/AER_Revised_Proof_101910_wcover.pdf.

- (2010b) *Sustainability and the dynamics of green building: new evidence on the financial performance of green office buildings in the USA*, RICS Research, Maastricht University, October 2010, www.gbcsa.org.za/system/data/uploads/resource/106_res.pdf.

- (2011) *The Economics of Green Buildings*, Program on housing and urban policy, Institute of Business and Economic Research, University of California, Berkeley, Working paper April 2011, http://urbanpolicy.berkeley.edu/pdf/EKQ_041511_to_REStat_wcover.pdf.

ERA (2012) *Barometer study results*, www.era.be/fr/connaitre-ERA/les-news.aspx.

European Commission (EC) (2008) *Impact Assessment of the Recast of the Energy Performance Buildings Directive*, EC, Brussels.

- (2011a) *Energy Efficiency Plan 2011*, COM (2011) 109, Brussels 8.3.2011.

- (2011b) *Climate Change*, Special Eurobarometer 372, EC, Brussels, http://ec.europa.eu/public_opinion/archives/ebs/ebs_372_en.pdf.

European Council for an Energy Efficient Economy (eceee) (2009) *Successful EPC schemes in two Member States: An eceee case study*, eceee.

European Energy Network (2008) *Implementation of the EU Energy Performance of Buildings Directive – a snapshot report*.

Ferreira, J. and M. Pinheiro (2011) "In search of better energy performance in the Portuguese buildings – the case of the Portuguese regulation" in *Energy Policy* 39, 7 666-7 683.

Fonseca, P., Almeida, A. and U. Nunes (2011) *Research results and policy recommendations of the IDEAL EPBD project addressing effective EPBD implementation and the Energy Performance Certificate*, www.ideal-epbd.eu/download/pap/PT_findings_recommendations.pdf.

Fuerst, F. and P. McAllister (2011a) "The impact of energy performance certificates on the rental and capital values of commercial property assets" in *Energy Policy* (39):6608-6614.

- (2011b) "Green noise and green value? Measuring the effects of environmental certification on office values" in *Real Estate Economics* Vol.39 (1):45-49.

- (2011c) "Eco-labelling in commercial office markets: Do LEED and Energy Star offices obtain multiple premiums?" in *Ecological Economics* 70:1220-1230.

Fuerst, F., McAllister, P., van de Wetering, J. and P. Wyatt (2011) "Measuring the financial performance of green buildings in the UK commercial property market: addressing the data issues" in *Journal of Financial Management of Property and Construction*, Vol.16 No.2:163-185.

Fuerst, F., McAllister, P., Nanda, A. and P. Wyatt (2013) "Is Energy Efficiency Priced in the Housing Market? Some Evidence from the United Kingdom". Working Paper Series, available at SSRN: <http://ssrn.com/abstract=2225270>.

- Fawcett, T. and B. Boardman (2009) "Housing Market Transformation" in *Proceedings of ECEEE Summer Study*, 1-6 June 2009 (La Colle sur Loup, France). European Council for an Energy-Efficient Economy.
- Gilmer, R.W. (1989) "Energy labels and economic research: An example from the residential real estate market" in *Energy Economics* (July 1989): 213-218.
- Gram-Hanssen, K., Bartiaux, F., Jensen, O.M. and M. Cantaert (2007) "Do home owners use energy labels? A comparison between Denmark and Belgium" in *Energy Policy*, 35(5), 2 879-2 888.
- Griffin, A., Kaufman, B. and S. Hamilton (2009) *Certified Home Performance: assessing the market Third Party Certification on Residential Properties*, May 2009, http://pacenow.org/documents/seattle_green_real_estate_premium.pdf.
- Guertler, P., Pett, J. and Z. Kaplan (2005) "Valuing low energy offices: the essential step for success of the Energy Performance of Buildings Directive" in *Proceedings of the 2005 ECEEE Summer Study*, Mandelieu, 30 May – 3 June, Stockholm.
- Guy, S. (2002) "Developing interests: environmental innovation and the social organisation of the property business" in *Development and Developers: Perspectives on Property*, Eds. S. Guy, J. Henneberry, Blackwell, Oxford, pp. 247-266.
- (2006) "Designing urban knowledge: competing perspectives on energy and buildings" in *Environment and Planning C: Government and Policy*, 24, pp. 264-282.
- Harris, M. and R. Halkett (2007) *Hidden innovation: how innovation happens in six 'low innovation' sectors*, National Endowment for Science, Technology and the Arts, London.
- Heckman, J. (1979) "Sample selection bias as a specification error" in *Econometrica* 47 (1): 153–61. doi:10.2307/1912352
- Hinnells, M. and B. Boardman (2008) "Market transformation: innovation theory and practice" in *Innovation for a Low Carbon Economy – economic, institutional and management approaches*, Eds. T. Foxon, J. Köehler and C. Oughton, Edward Elgar, pp. 203-229.
- HM Government (2008) *Improving the energy efficiency of our homes and buildings: Energy certificates and air-conditioning inspections for buildings*, DCLG, London, www.communities.gov.uk/documents/planningandbuilding/pdf/714826.pdf.
- Hovorka et al. (2012), *Note sur l'approche de la valeur verte*, Caisse des Dépôts et Consignations.
- Hüttler, W., Bienert, S., Schützenhofer, C., Leopoldsberger, G. and K. Leutgöb (2011) "Integrating energy efficiency and other sustainability aspects into property valuation – methodologies, barriers, impacts" in *Proceedings from the 2011 ECEEE Summer Study on Energy Efficiency in Buildings*, Stockholm, European Council for an Energy-Efficient Economy.
- Hyland, M., Lyons, R.C. and S. Lyons (2012) *The value of domestic building energy efficiency – evidence from Ireland*, Department of Economics Working Paper No. 614, University of Oxford, available at SSRN: <http://dx.doi.org/10.2139/ssrn.2096296>.
- Ifop (2007) *L'opinion des professionnels et du grand public à l'égard du DPE*, ADEME, www.developpement-durable.gouv.fr/IMG/spipwwwmedad/pdf/30.o8.o7_Sondage_IFOP_pour_ADEME_cle7111b2.pdf

- (2010) Survey for FNAIM, www.ifop.com/media/poll/1223-1-study_file.pdf.
- International Energy Agency (2010) *IEA Policy Pathway: Energy Performance Certification of Buildings*, OECD/IEA, Paris, www.iea.org/papers/pathways/buildings_certification.pdf.
- Investment Property Forum (2007) *The Energy Performance of Buildings Directive and Commercial Property Investment: A Situation Review*, Investment Property Forum, London.
- Jaffee, D., Stanton, R. and N. Wallace (2011) *Energy factors, leasing structure and the market price of office buildings in the US*, Working paper, August 2011, <http://faculty.haas.berkeley.edu/jaffee/Papers/DOE1831.pdf>.
- Janda, K. B. and Y. Parag (2011) "A middle-out approach for improving energy efficiency in existing buildings" in *Proceedings of ECEEE Summer Study*, 6-11 June 2011, Belambra Presqu'île de Giens, France, European Council for an Energy-Efficient Economy.
- Joint Research Centre IPTS (JRC) (2011) *Development of European Ecolabel and Green Public Procurement Criteria for Office Buildings*, Draft Report, JRC IPTS, Seville, http://susproc.jrc.ec.europa.eu/buildings/docs/market_and_economic_analysis.pdf.
- Jones Lang LaSalle (2008) *Global Trends in Sustainable Real Estate: An Occupier's Perspective*, Jones Lang LaSalle, London.
- Keeping, M. (2000) *The Cutting Edge 2000: What about demand? Do investors want 'sustainable buildings'?*, RICS Research Foundation, Oxford Brookes University.
- Kholodolin, K.A. and A. Mense (2012) *Internet-Based Hedonic Indices of Rents and Prices for Flats: Example of Berlin*, DIW Berlin Discussion Paper No. 1191, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2013076.
- Killip, G. (2011a) "Can Market Transformation approaches apply to service markets? An investigation of innovation, learning, risk and reward in the case of low-carbon housing refurbishment in the UK" in *Proceedings of ECEEE Summer Study*, 6-11 June 2011, Belambra Presqu'île de Giens, France, European Council for an Energy-Efficient Economy.
- (2011b) *Implications of an 80% CO₂ emission reduction target for the UK housing refurbishment industry*, Doctoral thesis, University of Oxford.
- Kok, N. and M. Jennen (2012) *The impact of energy labels and accessibility on office rents*, BUILD UP Publication, www.buildup.eu/publications/24611.
- Kok, N. and M.E. Kahn (2012) *The Value of Green Labels in the California Housing Market: An Economic Analysis of the Impact of Green Labeling on the Sales Price of a Home*.
- Lainé, L. (2011a) *Room for improvement: The impact of EPCs on consumer decision-making*, Consumer Focus, London, www.consumerfocus.org.uk/files/2011/02/Room-for-improvement.pdf.
- (2011b) *As easy as EPC? Consumer views on the content and format of the energy performance certificate*, Consumer Focus, London, www.consumerfocus.org.uk/files/2011/06/Easy-as-EPC-WEB.pdf.
- Laquatra, J. (1986) "Housing market capitalization of thermal integrity" in *Energy Economics*, July 1986 : 134-138.

Lancaster, K. (1966) "A New Approach to Consumer Theory" in *Journal of Political Economy*, Vol. 74, No. 2, pp. 132-157.

- (1971) *Consumer Demand: A New Approach*, Columbia University Press, New York.

Lorenz, D. and T. Lützkendorf (2008a) "Next generation decision support instruments for the property industry – understand the financial implications of sustainable building" in *Proceedings at the World Sustainable Building Conference*, Melbourne, Australia, 21-25 September 2008.

- (2008b) "Sustainability in property valuation: theory and practice" in *Journal of Property Investment and Finance*, Vol. 26 No. 6:482-521.

Lützkendorf, T. and D. Lorenz (2011) "Capturing sustainability-related information for property valuation" in *Building Research and Information* 39 (3):256-273.

Lyons, R.C. (2012) *Inside a Bubble and Crash: Evidence from the Valuation of Amenities*, available at SSRN: <http://dx.doi.org/10.2139/ssrn.2007530>.

Lyons, R.C. (2013) *Price Signals and Bid-Ask Spreads in an Illiquid Market: The Case of Residential Property in Ireland, 2006-2011*, available at SSRN: <http://ssrn.com/abstract=2205742>.

McNamara, P. (2008) "Will Greener Buildings Bring Bigger Profits?" in *Professional Investor*, pp. 41:43,
www.prupim.com/upload/managerFile/3186_Will_greenier_buildings_bring_bigger_profits.pdf.

Miller, N., J. Spiver and A. Florance (2008) *Does Green pay off?*, Final draft: 12 July 2008,
www.usgbc.org/ShowFile.aspx?DocumentID=5537.

MillwardBrownUlster presentation "SEAI – 'BER' 2011 research".

Ministère de l'Écologie, du Développement durable, des Transports et du Logement (2011) *6 mesures pour améliorer le Diagnostic de Performance Énergétique (DPE)*, Communiqué de presse,
www.lesenr.fr/actualites/CPfiabilisationDPE_13-09-11.pdf.

Muldavin, S. (2008) *Quantifying "Green" value: assessing the applicability of the CoStar studies*, Green Building Finance Consortium, June 2008,
www.greenbuildingfc.com/Home/ViewResearchDoc.aspx?id=34.

National Home Energy Rating (NHER) (2009) *Commercial Property EPCs – Compliance in the High Street*, research report by the NHER scheme, part of National Energy Services (NER), June 2009, NER, Milton Keynes,
www.diag.org.uk/media/255423/epc%20compliance%20ofinal%205june09.pdf.

Nösperger, S., G. Killip and K. B. Janda (2011) "Building Expertise: A System of Professions Approach to Low-Carbon Refurbishment in the UK and France" in *Proceedings of ECEEE Summer Study*, Belambra Presqu'île de Giens, France, 6-11 June 2011.

Pett, J. and L. Ramsay (2003) "Energy efficiency in commercial offices: who can transform the market" in *Proceedings of ECEEE Summer Study*, St. Raphaël, France, 2-7 June 2011, European Council for an Energy-Efficient Economy.

Pivo, G. and J.D. Fisher (2010) "Income, value, and returns in socially responsible office properties" in *The Journal of Real Estate Research*, Vol. 32, No. 3:243-270.

Reichardt, A., Fuerst, F., Rottke, N.B. and J. Zietz (forthcoming) "Sustainable Building Certification and the Rent Premium: A Panel Data Approach" in *Sustainable Real Estate Journal*, <http://aux.zicklin.baruch.cuny.edu/jrer/papers/pdf/forth/accepted/Sustainable%20Building%20Certification%20and%20the%20Rent%20Premium.pdf>.

RICS (2010) *Energy Efficiency and Value Project*, RICS and the Department of Communities and Local Government.

Salvi, M., Horehájová, A. and R. Müri (2008) *Der Nachhaltigkeit von Immobilien einen finanziellen Wert geben- Minergie macht sich bezahlt*, University of Zurich, Center for Corporate Responsibility and Sustainability, November 2008.

Salvi, M., Horehájová, A. and J. Neeser (2010) *Der Nachhaltigkeit von Immobilien einen finanziellen Wert geben- Der Minergie- Boom unter der Lupe*, University of Zurich, Center for Corporate Responsibility and Sustainability, March 2010.

Sayce, S., Sundberg, A. and B. Clements (2010) *Is sustainability reflected in commercial property prices: an analysis of the evidence base*, RICS Research, School of Surveying and Planning, Kingston University, January 2010, <http://eprints.kingston.ac.uk/15747/1/Sayce-S-15747.pdf>.

Schiellerup, P. and J. Gwilliam (2009) "Social production of desirable space: an exploration of the practice and role of property agents in the UK commercial property market" in *Environment and Planning C: Government and Policy*, Vol. 27, 801-814.

Soriano, F. (2008) *Energy efficiency rating and house price in the ACT: Modelling the relationship of energy efficiency attributes to house price: the case of detached houses sold in the Australian Capital Territory in 2005 and 2006*, Department of the Environment, Water, Heritage and Arts, www.nathers.gov.au/about/publications/pubs/eeer-house-price-act.pdf.

Tigchelaar, C., Backhaus, J. and M. de Best-Waldhober (2011) *Consumer response to energy labels in buildings, Recommendations to improve the Energy Performance Certificate and the Energy Performance of Buildings Directive based on research findings in 10 EU countries*, Deliverable 6 of the IDEAL EPBD project, European project on consumer response to energy labels in buildings.

Ürge-Vorsatz, D., Novikova, A. and M. Sharmina (2009) "Counting Good: quantifying the co-benefit of improved efficiency in buildings" in *Proceedings of ECEEE Summer Study*, 1-6 June 2009 (La Colle sur Loup, France), European Council for an Energy-Efficient Economy.

Wiley, J.A., Benefield, J.D. and K.H. Johnson (2010) "Green design and the market for commercial office space" in *Journal of Real Estate Financial Economics* 41:228-243.

Winward, J., Schiellerup, P. and B. Boardman (1998) *Cool Labels: The First Three Years of the European Energy Label*, *Environmental Change Institute*, University of Oxford.

Yoshida, J. and A. Sugiura (2011) *Which "Greenness" is valued? Evidence from green condominiums in Tokyo*, paper presented at Green Building Finance and Investments: Practice, Policy and Research, Maastricht University, March 2011, http://mpra.ub.uni-muenchen.de/23124/1/Yoshida-Sugiura_2010_Tokyo_Green_Condominiums.pdf.



19 April 2013

20-22 Villa Deshayes
75014 Paris

+ 33 (0) 1 53 90 11 80

www.biois.com