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The Relevance of EPC Labels in the Spanish Residential Market: The Perspective of Real Estate Agents

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Abstract: Assessment regarding the impact of Energy Performance Certificates (EPC) on the residential market is largely inconclusive; while the majority of hedonic analyses have found EPC ratings to be correlated with prices, opinion-based research has found a negligible impact on prices and other marketing variables. Using the opinion of qualified real estate agents, this paper explores whether, in Spain, EPC labels play any role in housing marketing, as well as the policy changes required to foster efficient dwellings. The results reveal a large misunderstanding of the EPC labels, since they are seen as a global home-quality indicator, while their impact on residential marketing is quite poor. Apparently, both supply and demand place a small interest in energy performance, although it is slightly larger for sellers/buyers in relation to lenders/tenants. In any case, EPC labels are far from blurring the energy information asymmetry, since most of the buyers/tenants are informed of the EPC rating after having selected their home. Overall, the EPC scheme has a poor reputation exacerbated by inaccuracies, unintelligible units to express the financial and environmental implications of energy efficiency, and an apparent weak supervision. These findings stress the need to improve the scheme; in doing so, realtors suggest the need for some companion policies.

Keywords: EPC labels; energy efficiency; housing marketing; energy policy

1. Introduction

A number of barriers limiting the adoption of energy-efficient premises under the social optimal (i.e., “energy gap”) have been identified [1]. One such barrier is information asymmetry between future users and suppliers, which constraints the capacity of the former to take into consideration the potential benefits of energy-efficient technologies. Eventually, such an issue may lead to a “green-lemon-problem” [2] producing inefficient pricing, especially in the case of premises built before construction codes introduced minimum criteria for energy-efficiency in the late 1970s. In order to eliminate such a market failure, the European Commission designed the Energy Performance Certificates (EPC) in 2002 (EPBD 2002/91/EC) and, in 2010 (2010/31/UE) made it mandatory to include EPC labels in property marketing. EPC labels are intended to explain in an easy way (e.g., ratings) the financial and environmental implications of the energy performance of buildings certified by independent experts.

According to EPBD's hypothesis, potential benefits associated with efficient premises such as energy savings and environment conservation may capitalise on larger prices (i.e., green premiums) and preference for efficient premises [3]. In turn, green premiums and improved demand for efficient buildings would compensate for extra costs associated with efficient construction fostering efficient developments and retrofits [4]. Furthermore, Fuerst et al. [5] highlight the presence of other benefits, such as "signaling-values" driving up green-premiums. Thus, energy-efficient homes "have an additional signaling value attached to them that allows households to visually demonstrate their environmentally conscious values and behaviour to their peers" (p.7). In summary, efficient buildings may provide benefits in financial, environmental, and social realms [6].

Departing from hedonic analyses, a growing number of studies (reviewed in Section 2) have found a positive correlation between EPC ratings and housing prices, confirming the green-premium hypothesis. Such correlation is clearer after the EPBD expanded in 2010 the obligation to certify existing buildings and display this information in property advertisements [7]. Nevertheless, in some cases, such a correlation is small, reverted, or non-existent. Insufficient statistical control of structural and quality housing attributes correlated with EPC rating may be behind that contradiction. On the other hand, opinion-based studies centred upon both users and real estate experts (e.g., agents and valuers) have found a negligible impact on preferences and prices.

As discussed in Section 2, in Spain, the hedonic marginal price for housing EPC ratings is quite small in relation to Northern European countries. Moreover, there is evidence that such a marginal price may be incorrectly measuring housing quality instead of energy performance, while, opinion-based research is largely absent. Using surveys gathered from qualified real estate agents, this paper addresses this knowledge gap with the following aims: (i) identify the awareness level of EPC ratings and their perceived role; (ii) explore whether EPC ratings play any role in price formation and other marketing aspects, both in the selling and leasing markets; (iii) identify the main issues around the Spanish implementation of the EPC scheme; and (iv) ascertain the companion policies that, according to realtors, may help to foster the development and retrofit of efficient homes.

The Spanish case is doubly interesting: firstly, due to mild winters (chiefly, although not only, in the Mediterranean region), energy demand in housings is moderated, dwarfing the energy savings argument; secondly, due to the overnight 2010 EPBD transposition (see Section 2) and small diffusion due to public budget constraints, it is doubtful that such policy is meeting the European goal of fostering energy-efficient buildings.

The remainder of the paper is organised as follows: Section 2 contains a brief literature review depicting evidence on EPC impacts coming from hedonic and opinion-based research and the issues around the 2010 EPBD implementation in Spain; next, the methods and materials are explained; in the results section, the main findings are discussed, and finally, conclusions are placed in the context of extant literature.

2. Brief Literature Review and Issues around the EPBD Spanish Implementation

Empirical evidence on the impact of EPC labels on the residential market has appeared in the form of both observed and stated preferences. In the first field, studies have used hedonic analysis (HA) to identify whether EPC ratings appear correlated to prices (see a comprehensive review in Taltavull et al. [8] and in Warrens-Myers [9], Bruegge et al. [10] for other sustainability certifications) and opinion-based research addressed to users, property agents, and valuers so as to ascertain the relevance of such labels in property selection, price, and transactions.

Table 1 offers a selection of EPC studies based on HA; most of them use transaction prices or, in the absence of them, listing prices. EPC ratings are granted, in the majority of the cases, as a categorical attribute of energy-efficiency; however, some studies use technical units for energy consumption [11]. According to the reported semi-elasticities (i.e., the percent variation of the housing price corresponding to each of the ratings or kWh/m²/year), the effect on prices is as expected: the higher the energy performance, the larger the price after controlling for other structural and neighbourhood attributes

of houses. Within this context, the pioneering study by Brounen & Kok [12] analysed the effect of EPC ratings on residential prices in the Netherlands, although the data used comes from the period in which the buyer could exempt the seller for providing the EPC (i.e., before the 2010 EPBD). The results of this study found a positive correlation between top-rated dwellings and transaction prices. So, considering the intermediate rate “D” as the basis for comparison, they found that the marginal price moves from +10% for rate “A” to –5% for rate “G”, i.e., “market premiums” are formed above the reference situation, while below such threshold market penalties or “brown discounts” (i.e., price reductions) emerge. The study conducted by Hyland et al. [13], in different Irish cities, was the first to simultaneously compare the impact of EPCs on rental and sale listing prices. In general, they found that the impact of the energy labelling is higher in the sale market than in the rental market. For example, a dwelling for sale ranked as “A” (in relation to “D”) has a market premium of +9.30%, and only of +1.80% if it is in the rental market, holding everything else equal. Similarly, the “brown discount” for a home rated as class “F” or “G” (in relation to “D”) is significantly larger (–10.60%) than another one on the rental market (–3.20%). The larger impact of green labels on sales prices in relation to rental prices is a finding that had already been reported by previous work based on other certification schemes [14]. The work of Stanley et al. [15] carried out in Dublin found a large price gap between best and worst houses in terms of energy performance. The hedonic agenda of EPC ratings has also been researched in Spain. The pioneering work of Marmolejo [14] based on listing prices in the Metropolitan Area of Barcelona found a price gap equivalent to 5.11% for A/G homes if it is assumed that the EPC ladder is perceived as a continuous scale of energy performance; or 9.62% under the hypothesis that market agents assume that EPC ratings are a nominal measure of energy efficiency. In a further paper, Marmolejo & Chen [3] for the same city reported a price premium of 7.8% for the A/G gap. Taltavull et al. [8] in the Province of Alicante found a premium of 1.1% and 1.18% for the E/G and F/G gaps, respectively. Overall, the hedonic agenda of EPC ratings seems to be smaller in Spain regarding other EU countries.

Thus, the impact is divergent across different countries and even in different cities within the same country. Such divergence may be explained by large differences in climatic conditions, construction techniques/codes, housing typologies, energy to house prices and, perhaps, distinct concerns regarding environment conservation. A relatively reduced number of HA studies have found the correlation to be small, non-existent, or reversed. For example, in Oxford, the Bio Intelligence Service [16] found in the rental market an inverted relationship: for each increment in the EPC ladder, rents are reduced by 4%. As these authors recognise, poor control of location factors influencing residential prices leads to biased coefficients. In this case, the reversal of the coefficient is produced by the inclusion of old mansions, placed in exclusive central zones, boasting large prices but low energy-performance. A number of studies have found no correlation between EPC ranks and prices; an example is the work of Fregonara et al. [17] carried out in Turin, which found that EPC ratings do not have any impact on prices when quality attributes are controlled. In Spain, Marmolejo & Chen [3] have arrived at compatible conclusions, finding that in the multifamily segment of state-of-the-art apartments, EPC ratings have no effect on prices. They concluded that in the absence of quality attributes (i.e., air conditioning/heating, lift, kitchen quality, retrofit, and other common amenities), EPC ratings play an incorrect “global quality” role in price differentiation. The same conclusions are found in the study of Olaussen et al. [18] who compare the actual value of energy savings with the price premium for energy-efficient homes derived from a HA in Oslo: “we conclude that not only the energy label, but also the energy performance of dwellings in general, has little to no effect on transaction prices” (p. 1). However, as stated in the introduction, the energy premium can be driven, beyond energy-savings, by signalling values [5], as well as reputation, health, and well-being [19]. Interestingly, most of the studies contained in Table 1, reporting a green premium, perform a scarce control on architectural, construction quality, and micro-locative price drivers [20]. Examples of this issue are the use of postal-codes as a proxy of the residential location or quantitative and dichotomous variables related to the home configuration. Aspects such as material quality, design, aesthetics, orientation, natural light,

and conservation, whose assessment is a key element on price determination, are remotely taken into consideration. Table 1 contains the number of structural and quality control attributes for the selected studies; only three of them seem to carry out extensive control of such price drivers. However, in the Barcelona case, a close inspection suggests that attributes such as condition, orientation, natural light, or aesthetics are still missing; while in Alicante, some of them are present, this study fails to distinguish which attributes are relevant for each typology (e.g., lifts are relevant for apartments). Since EPC ratings are somehow correlated to architectonic features (e.g., orientation, window-to-wall ratio, etc.) as well as constructive quality [2], the incorrect control of such latter attributes, as well as other econometric issues (e.g., selection bias, outliers or spatial dependence), may render spurious coefficients for the former, as discussed by Wilhemsson [21]. In any case, no studies to this date have addressed the effect of such omitted variables, which deserves further research.

Findings from opinion-based research are even more inconclusive. Murphy [23] conducted a survey in the Netherlands in order to identify the impact of EPC information on price negotiation in the context of home purchasing. Her results suggest that “a higher EPC fails to have a direct influence during negotiation and decision making” (p. 666). In the U.K., Lainé [24] investigated a panel of 500 adults who had recently moved into a new dwelling. Her findings identified that only 18% of the respondents saw their decisions influenced by EPC’s information. In addition, such information was rarely used as part of price negotiation both in the rental and selling markets. The same conclusions were also drawn in Great Britain by Adjei et al. [25] since EPCs were not used as a negotiation instrument in the purchasing process. In the same country, Parkinson et al. [26] found, on surveying commercial office occupants, no correlation between EPC ratings and rental values. Their findings suggest that a facility’s aesthetic value is the main rental driver. In Germany, Amecke [27] surveyed owner-occupier households to assess whether EPC labels influenced their purchase decisions. His conclusions indicate that the effectiveness of EPCs is limited, due to the unhelpfulness in understanding the financial implications of energy efficiency; therefore, energy efficiency is only a minor purchasing criterion. Compatible evidence can be found in the study of Pascual et al. [28] based on surveys gathered from real estate agents in eight EU countries. According to their results, EPC ratings exert a negligible impact on housing prices. This conclusion is especially valid in the case of Spain, where only 15% of the surveyed agents confirmed the existence of a premium for efficient flats.

Similar conclusions are found in non-EU countries and considering not only energy-performance but also other sustainability attributes. Wong [29] surveying realtors in Australia found they hold greater importance to other housing attributes than sustainability ones. Furthermore, Moore & Hurst [30], after interviewing households in Melbourne, concluded that attributes such as location, affordability, and the number of bedrooms/bathrooms were the main considerations in house selection, while sustainability was seldom indicated. In Queensland, Bryant & Eves [31] using surveys applied to realtors, assessed whether sustainability features were important in the house purchase decision; they found that 96% of buyers do not consider such attributes important in their decision-making process. The same conclusions were drawn in the study of Eves & Kippes [32] based on surveys to home buyers in New Zealand; aspects such as location and price were the buyers’ main concerns, although energy-efficiency and green housing issues appeared as major concerns for the tier of younger and older buyers in the high-income brackets. Encinas & Aguirre [33] concluded that, in the absence of mandatory energy-labels, real estate developers used marketing strategies to “green-wash” developments, which have an uncertain contribution to sustainability performance. Such “sustainable” developments attract young highly educated households.

Table 1. Selected studies on EPC ratings marginal price.

Authorship	Study Cases	Type of Prices	Sample Size	Scale of EPC Ratings/Energy Consumption	EPC Performance (/Reference)	Marginal Impact of EPCs on Selling Price	Number of Structural & Quality Attributes controlled
[3]	Barcelona Metropolitan Area	listing price	3479	Categorical	A/G D/G	7.80% 3.30%	13
[7]	Denmark	transaction price before 1st July 2010 transaction price after 1st July 2010	72,326 45,157	Categorical	A,B,C/D,E,F,G A,B/D C/D E/D F/D G/D	2.40% 10.10% 6.20% 5.10% −5.40% −12.90% −24.30%	5
[8]	Alicante	valuation	8949	Continuous Categorical	KWh/sq-m (Electricity) Kg/sq-m (CO ₂ emissions) A,B,C/G E/G F/G	−0.03% −0.03% −6.30% 1.10% 1.18%	13
[11]	Sweden	transaction price	1073	kWh/m ² /year	continuous	4.4%	7
[12]	Netherlands	transaction price	31,993	Categorical	A/D B/D C/D E/D F/D G/D	10.00% 5.50% 2.00% −0.50% −2.50% −5.00%	7
[13]	Ireland	listing price	19743	Categorical	A/D B/D E/D F,G/D	9.30% 5.50% −10.60%	5
[15]	Dublin	listing price	2793	Continuous Categorical	step B1/C1 D2/C1 E2/C1 G/C1	1.00% −28.20% −4.60% −7.00% −12.80%	3
[16]	Vienna Lower Austria Brussels (Flanders) Brussels (Capital) Brussels (Wallonia) Lille Marseille Ireland (cities) Ireland (no cities) Oxford (United Kingdom)	listing price	1800 800 15,935 1222 1043 1946 1350 20,000 1344	Continuous	step step step step step step step step step	Between 10% & 11% Between 5% & 6% 4.30% 2.90% 5.40% 3.20% 4.30% 1.70% 3.80% 0.40%	3 4 13 8 4
[22]	United Kingdom	transaction price	500,000	Categorical	A,B/D C/D E,E/D G/D	5.00% 1.80% −1.00% −7.00%	4

Notes: Scale of EPC ratings is the statistical scale used in regression models; marginal impact of EPCs on selling price is expressed in semi-elasticities (i.e. price percent variation for each EPC rating or rating variation); structural variables include attributes such as typology (e.g. detached, apartment, etc.) area, number of bedrooms, bathrooms, age, while quality attributes include aspects such as maintenance, quality of building materials, HVAC systems, views, lift (when it applies), amenities (e.g. swimming pool). Source: Own elaboration.

From the perspective of property valuation, Michl et al. [34] found that only 2.2% of surveyed UK's RICS valuers collect and use energy performance information in their analyses, while this figure increased to 21.1% in Germany. The authors conclude that there is a perception among some professional groups that collecting and analysing sustainability-related data can be avoided until there is "enough" empirical evidence [on the price effect]. The lack of *useful* evidence to support property valuations on the relationship between sustainability and market value is also suggested in the review by Warren-Myers [9]. In Australia, Warren-Myers [35,36] found that valuers are not reporting on sustainability due to their knowledge deficiencies in the matter and choose to avoid the consideration of such attributes, rather than provide ill-informed judgments. However, as Sayce [37] observes, there is progress towards deeper knowledge and integration of sustainability attributes in property valuation. Examples are the integration of sustainability criteria in valuation standards (e.g., RICS' VIP 13 or EVS-2016) and educational requirements (e.g., TEGoVAS' MER). Such a trend is fostered by a growing concern for sustainability among citizens as well as private and institutional agencies [38].

Departing from such contradictory evidence, Olaussen et al. [39] carried out a peculiar quasi-natural experiment to identify whether omitted variables in model specifications can lead to spurious results. Their study, based on Oslo's residential market, consists of analysing the price of homes sold before and after July 2010 (when it became mandatory to include EPC labels in advertisements), in order to identify whether such labels actually produced a price effect. In doing so, they assigned the EPC rating to each home in the pre-2010 sample, according to the rating the same home had in the post-2010 sample. Their hedonic results show similar market premiums on EPC ratings for the pre- and post-2010 samples, allowing them to conclude that "price premium of the energy labels clearly captures something else than an effect to the labels themselves" (p. 251).

2.1. Implementation of the EPC Scheme in Spain

In Spain, the 2010 EPBD transposition occurred in extremely adverse conditions: (1) the Spanish Government hurried to implement the new labelling system due to the threat to taking it to the European Court for having not transposed the recast of the EPBD in time [40]; (2) the large deficit of public finances did not allow to make the necessary diffusion of the new EPC. As a matter of fact, when EPC labels became mandatory, most of the Spanish regions had not implemented the public register where EPC must be recorded [41]. Overall, this situation produced large turmoil among owners, users, and even property assessors. To make things worse, the epicentre of the economic crisis was centred on the property market after years of uncontrolled production. As a consequence, unemployment among building professionals (e.g., surveyors and architects) was large. As a result, becoming an energy performance certifier was seen as a new source of income. Since non-specific training, additional to technical building professions, was required, a large number of certifiers appeared. Quickly, the price for a conventional dwelling certification dropped in parallel to the quality of the services, aggravated by Groupon-like discounts [42]. As a result, EPCs lost reputation in the building industry and were seen as ineffective by some property professionals [43]. Not surprisingly, the scarce hedonic-based studies implemented in some Spanish cities found the impact of EPC ratings to be relatively small in relation to other North European countries [14,44]. Furthermore, it has been pointed out that in some cases, such ratings play an incorrect role as general quality proxies, as discussed before [45]. Whether this problematic situation persists after five years of the Spanish transposition of EPBD is explored below.

3. Methods and Materials

According to the Ministry of Public Works, in Spain each year, around 500,000 homes are sold and 72% of households own their home (National Institute of Statistics—INE in Spanish-), thus, sellers and buyers largely correspond to owner-users. For that reason, both existing and new housing is largely sold/leased using the services of real estate agents. Thus, agents have a wide perspective on the aspects

that both users and owners take into consideration when transacting a dwelling. No official statistics are provided for rental transactions.

Since 2003, real estate brokerage has been liberalised, which means that it is not necessary to have specific education nor professional accreditation (except in Catalonia) to work as a realtor. This fact prevents having official statistics on the total number of realtors in the country. Only those called “agentes de la propiedad inmobiliaria” are required to be associated and to accomplish educational requirements; in total, there are around 5600 of them [46]. This paper is drawn from the opinion of these “qualified” professionals—the impact of EPC labels on the residential market—and the companion policies that, according to their opinion, may succeed in promoting efficient buildings. The method consists of four steps.

3.1. Design of the Survey

While the primary aim of the research is focused on exploring the influence of energy efficiency in the marketing process, the survey goes beyond this remit to extract the opinion of real estate agents on a number of policies that could foster efficient buildings. It also investigates the knowledge realtors have on the EPC scheme. The survey consisted of 37 questions (most of them using a Likert scale; see technical details in Table 2), structured as follows:

The perceived role of EPC ratings and knowledge regarding the EPC scheme. This section analyses the role that the realtors assume EPC ranks play and their knowledge on the EPC scheme. In doing so, it explores whether EPC ratings are understood as indicators of energy consumption and CO₂ emissions (what they actually are), or as indicators of the global quality of homes and their thermic comfort. Also, realtors are required to indicate if they believe that EPC labels come from actual monitoring or model estimations, as well as the architectonic/building attributes they believe do impact EPC ratings.

Influence of EPC ratings on housing marketing. In this section, realtors are required to express, according to their professional expertise, the impact that EPC ratings have in speed to market, and determine and negotiate prices; as well as the importance that both users (i.e., buyers and tenants) pay to EPC ratings when acquiring or selling a home. Also, the survey investigates the moment when consumers are informed of the EPC rating.

Perceived impact of companion policies aimed to foster efficient homes. This section is intended to study the expected impact of the possible implementation of a number of public policies aimed to promote efficient homes. Such policies range, from information campaigns, intended to address the general population in order to disseminate the aim of the EPC scheme and the economic and environmental implications of energy efficiency, to active policies with financial implications coming from private markets (e.g., green mortgages) and public bodies (e.g., subsidies and fiscal exceptions).

Concluding section. The last section includes an open-format text to allow realtors to express their opinions on the failures of the current scheme, as well as render their ideas in order to improve the efficacy of the EPC scheme. It also requires an indication of the province where most of their business is based. In order to gain responses, no personal nor professional data was gathered.

3.2. Survey Validity and Reliability

The validity of the survey is concerned with the accuracy of the questions. It depends on asking questions that truly gauge what is supposed to be measured. For that reason, the survey was discussed in a focus group formed of experts from the property market and in the fields of architecture, energy efficiency, and policy-making. The idea was to collate common knowledge stemming from real estate marketing, technical, and political realms around energy efficiency. The draft of the survey was tested in a restricted sample of agents in order to identify and solve any communication issues. Reliability referred to the survey’s internal consistency; for example, for questions that use the Likert scale, Cronbach’s alpha was used. In our case, a number of questions use different items (i.e., sub-questions) in order to figure out aspects, such as the realtors’ knowledge regarding the EPC scheme, the effect of EPC ratings on housing marketing or the effect of potential policies aimed at fostering efficient homes.

Thus, in order to learn whether such items use a scale that is reliable, the aforementioned test was used, as reported in Table 2. The average of the test was 0.871, which implies that the questions are consistent (i.e., reliable).

Table 2. Survey’s technical details and structure.

Qualitative Study Technical Data Sheet		Structural of the Online Survey Application	Items (Sub-Question)	Answer Format	Reliability Statistics (Cronbach’s Alpha)
Universe:	national	1. What is your agreement level with the following statements regarding the Energy Performance Certificate labels	4	Closed, Likert scale	0.848
Type of study:	descriptive qualitative primary study	2. Depending on your experience in the rental and selling markets ...	3	Closed, Likert scale	0.805
Research technique:	online survey	3. Indicate the importance that demands pay to the EPC ratings at home when...	2	Closed, Likert scale	0.852
Cohort to consider:	experienced real estate agents using only Professional Associations	4. Indicate the importance that suppliers pay to the EPC ratings at home when ...	2	Closed, Likert scale	0.889
Data collection instrument:	online survey using six closed answer questions with the Likert scale, two closed answer questions with unique choice, two closed answer questions with multiple choice and one answer question with free text response	5. At what point do tenants or sellers usually learn about the EPC rating?	1	Closed unique choice	na
Sampling online survey type:	Consecutive not stratified, in order to be accessible and inclusive for the cohort of the study	6. Indicate your agreement with the statements below, in the case of a campaign to explain what the Energy Performance Certificates are, how they are calculated and their economic impact	6	Closed, Likert scale	0.928
Sample online survey size:	548 valid cases have been compiled, in 17 Regions (i.e. Autonomous Communities) in Spain, which represents a response rate of 13%	7. Indicate the impact that the following policies would have no the effectiveness of Energy Performance Certificates in the promotion of efficient homes ...	7	Closed, Likert scale	0.907
Online survey error level:	< 5% for global data, in the assumed simple random sampling, at 95% confidence level, and p-q-0.5	8. What elements do you think are taken into account to determine the housing EPC rating?	9	Closed multiple choice	na
Data collection period:	June 2017 to October 2018	9. How do you think the EPC rating is determined?	1	Closed multiple choice	na
Conducting research:	EnerValor project researchers	10. Please point out the main issues around the EPC policy and suggestions to improve it	1	Free text	na
		11. Please indicate the provinces where you deliver your intermediation services	1	Closed multiple choice	na

Source: Own elaboration.

3.3. Survey Distribution, Data Collection, Spatial Coverage, and Representativeness

The final survey was conducted using an online system. This format allows respondents to freely express their opinion without moral or political constraints. For the same reason, the survey is anonymous and no information regarding the IP was saved. In order to disseminate the survey among experienced realtors, we only used professional associations that distributed the survey, thus legally protecting personal data. Replies were gathered between June 2017 and October 2018 and all of the Spanish regions were included.

The response statistics are as follows: from the 4,245 e-mails sent, 92% were correctly received, 23% opened the email, and 13% successfully completed all the questions contained in the survey. In this paper, the final sample contained 548 surveys; data cleansing consisted eliminated those with five or more unanswered questions. Only 7 surveys were eliminated, which means that the survey was

comprehensible and valid. There was a large degree of heterogeneity regarding knowledge about the EPC scheme, indicating that the respondents did not provide biased answers (discussed in the next section). This sample represents an error equivalent to 3.91% at 95% confidence and is significantly smaller than the 68 surveys analysed in the ZEBRA 2020 Project, which aimed at assessing the relevance of EPC labels on property prices and consumer preferences in Spain [47]. We consider this response rate valid and reliable, since it comes from qualified experts in real estate transactions. This conclusion is reinforced by the fact that realtors were not economically compensated for the time they invested in answering the survey. Despite this, the results require to be understood as exploratory trends and further research with cross-sectional analyses is required.

3.4. Data Segmentation and Analysis

While all the 17 Spanish autonomous regions are included in the sample, there is not enough information to provide a statistically significant stratified analysis at the province or regional levels. Thus, the information is analysed as a whole, but in some cases, it is split into two groups. Following the rationale of Bio Intelligence Service [16] regarding the possible economic factors affecting the impact of energy efficiency on prices, such groups were identified as follows: (1) First, information on households' general and energy-related expenditure (largely depending on climatic conditions and housing typology) and housing prices was retrieved from the INE (2); next, a multivariate analysis was performed using the percentage of energy bills in family budgets, energy expenditure to housing price ratio, and unitary housing prices. Principal component analysis (to eliminate redundant information) followed by K-media cluster analysis using principal components was done. According to Table 3, Group A included the autonomous regions, where energy bills represent a small proportion of households' budgets, the energy expenditure to housing price ratio is small, and housing is expensive. Conversely, Group B contains zones where energy bills represent a larger proportion of households' budgets, energy expenditure to housing price ratio is larger, and housing is cheaper. In summary, this segmentation considers differences in income, energy consumption, and property dynamism. Demographic data was deliberately not introduced due to the fact that the analysis was conducted at a regional level where differences are small.

Table 3. Grouping of regions.

Group of Regions	Number of valid Responses	Energy Expenditure as a Percent of Household Expenditure	Year Energy Expenditure/Housing Price per m ²	Housing Price (Euro/m ²)
Group of regions "A"	294	3.46%	0.61%	1827
Group of regions "B"	182	4.31%	1.09%	1097

Regions in group "A": Andalusia, Balearic Islands, Canarias, Cantabria, Catalonia, Basque Country, Madrid
Regions in group "B": Aragon, Castille & Leon, Castille La Mancha, Navarra, Extremadura, La Rioja, Asturias, Valencia, Galicia, Murcia

Source: Own elaboration based on information from the National Institute of Statistics (INE).

In order to ascertain whether realtors' knowledge of the EPC scheme influenced their responses, they were classified into two groups. The realtors were asked to state, on a Likert scale (null, low, medium, high) their agreement with the affirmations considering EPCs as indicators of: (a) energy savings, (b) environmental impact, (c) global quality, and (d) comfort. The larger their agreement on "a" and "b", the larger their knowledge on the EPC scheme; the larger their agreement on "c" and "d", the larger their unawareness. To produce these groups, the responses were re-codified as follows: null = 1, low = 2, medium = 3, and high = 4; positive for "a" and "b", and negative for "c" and "d". The sum of the recoded responses from "a" to "c" produced an integrated score; those above the median

were categorised as having “high EPC knowledge”. In brief, “low EPC knowledge” realtors were likely to fail in identifying the aim of the EPC scheme.

The data was analysed using descriptive statistics; significant differences between regions and realtors on their EPC knowledge were identified by means the Chi-squared test. Table S1, in the supplementary file, offers a complementary multivariate analysis that identifies concomitant relations among different answers. It consisted of extracting principal components by means of factor analysis, as described in the aforesaid Table S1.

4. Results

Figure 1 shows the agents’ awareness regarding the aim of EPC ratings. Interestingly, there is a misperception regarding the role of EPC ratings, since most realtors agreed that such labels were about the general quality of the homes and thermal comfort. By definition, according to the Spanish EPBD transposition, EPC ratings measure (for the same comfort level) energy expenditure and CO₂ emissions. Thus, it seems that there is a large confusion on the actual role of EPC labels, which is not surprising due to the 2010 EPBD overnight transposition, as discussed earlier in the paper.

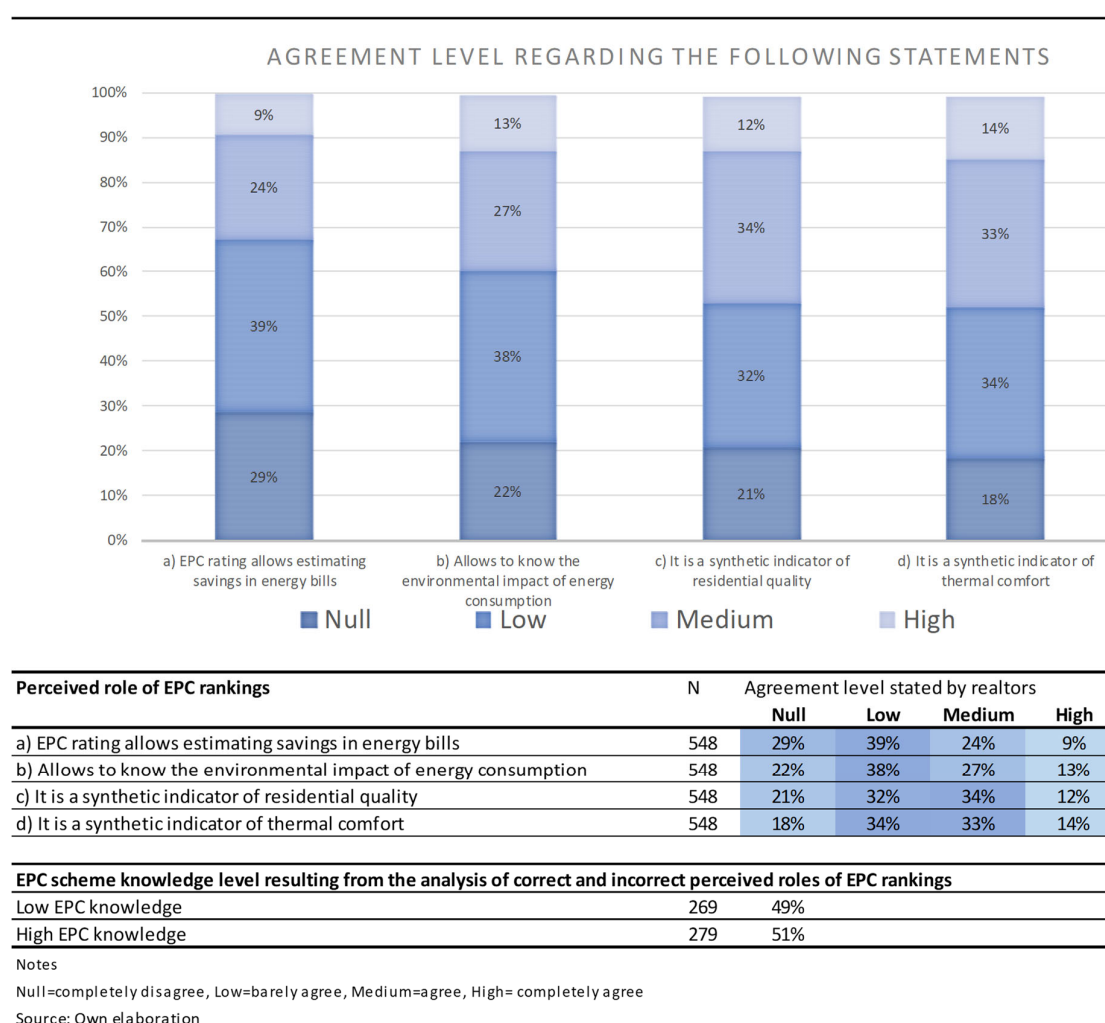


Figure 1. Realtors’ perceptions and knowledge of EPC ratings.

While the *role* of the EPC scheme seems to be chiefly misunderstood, the *way how* EPC ratings are determined seems to be clear (Table 4); only 12% of the realtors say that these ratings come from energy monitoring. Thus, realtors are aware of the process that certifiers follow when issuing an EPC,

since agents generally instruct certifiers on behalf of the owners: only 10% failed in signalling that the buildings' attributes affect ratings. The main failures are linked to lighting, water-saving devices, and energy consumed in construction, which, according to the EPBD Spanish transposition, do not affect the housing "A-G" rating.

Table 4. Realtors' knowledge of the attributes affecting EPC ratings.

	Total Answers (N)	Incorrect Answer (N)	Incorrect Answer (%)
Realtors that think lighting is included in EPC estimation	548	214	39%
Realtors that think water economising devices are included in EPC estimation	548	194	35%
Realtors that think energy consumed in construction is included in EPC estimation	548	77	14%
General number of attributes inquired	4932	485	10%
Realtors that think EPC comes from energy monitoring	548	68	12%

Source: Own elaboration.

According to Figure 2, most of the respondents indicated that the effect of EPC ratings on the marketing process is negligible: 94% said it is null or minute during the price negotiation process, 92% for price fixing, and 88% for marketing. Therefore, in Spain, the EPBD hypothesis discussed in the introductory section remains largely unverified. Surprisingly, there are no statistically significant differences in the opinions coming from regions where energy expenditure is relevant, both in terms of household budgets and in relation to housing prices (Group B) in relation to the opposite situation.

However, according to the Chi sq. test (at 90% confidence), realtors with more knowledge of the role of the EPC scheme think that efficient EPC ratings do have a positive impact on marketing time.

Figure 3 shows that owners, buyers, and tenants pay little attention to EPC energy ratings in relation to other structural and location attributes. Nonetheless, households willing to buy as well as owners willing to sell do pay more attention to energy performance in relation to households willing to rent and owners willing to lease. Similar conclusions can be found in the work of Wong [29]. It is necessary to recall that in Spain most of the households own their house. Leasehold is seen as a temporary regime; therefore, energy efficiency in rental homes seems to be an irrelevant attribute. Furthermore, the EPC awareness level of realtors does make a difference in the assessment of this item, albeit it is only significant (at 90% confidence) in the case of owners wanting to sell.

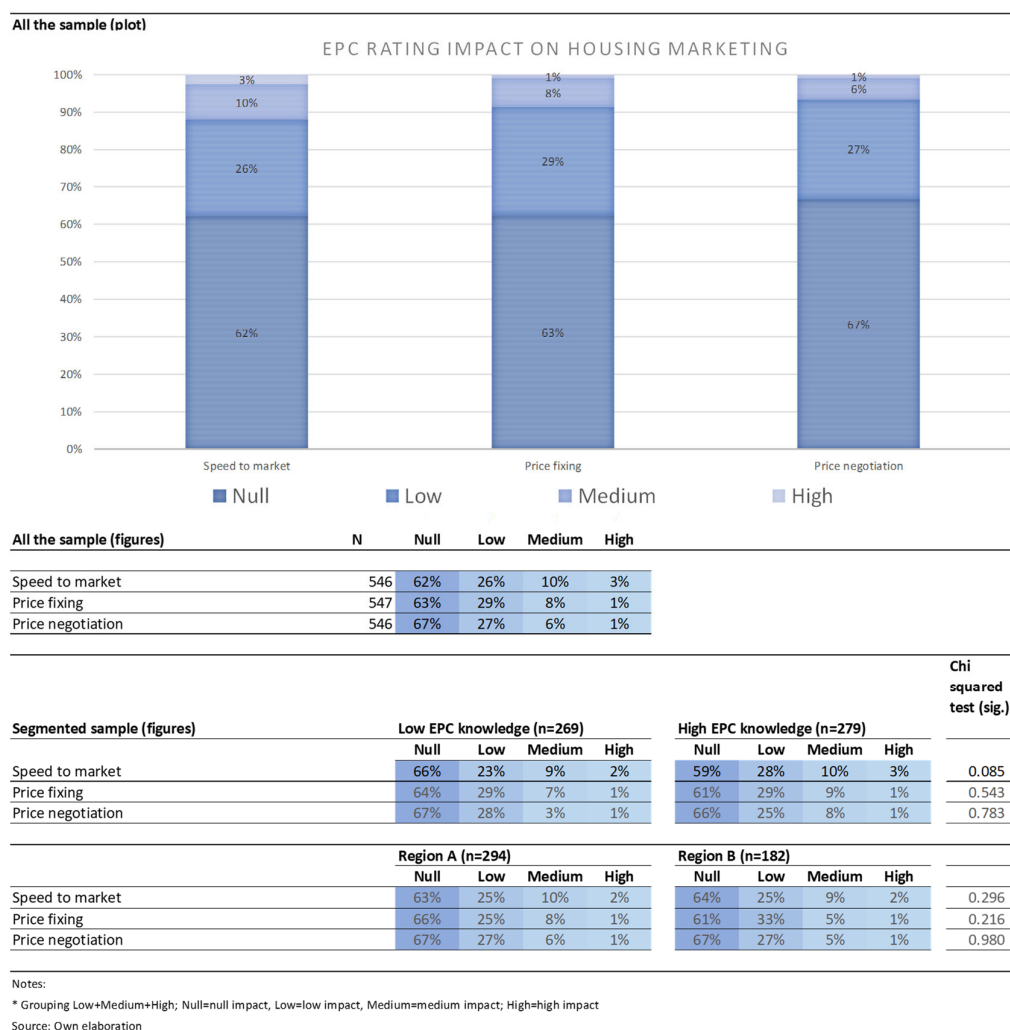


Figure 2. Impact of EPC ratings on the housing market.

As earlier discussed, the main aim of EPC labels is to eliminate energy-efficiency asymmetries in property markets. Thus, by providing useful information, property users can make energy-informed transactions. For that reason, the 2010 EPBD introduced the obligation to include such labels in property advertisements. In Spain, the 8/2013 Act on Land Regime set a sanction system that regional administrations are required to follow when supervising the application of the EPC scheme. Nonetheless, according to Marmolejo [14] the potential benefits to owners for omitting low EPC ratings are larger than the fines they get from this violation. As a consequence, in dynamic residential markets, such as Metropolitan Barcelona, only 12% of the listed homes disclosed EPC information in 2014 [14] and 15% in 2016 [45]. The results of our survey (see Figure 4) confirm a huge lack of transparency on energy performance in the residential market. Only 27% of the surveyed realtors said EPC ratings were disclosed in property advertisements, and a mere 15% said potential buyers/tenants were informed when asking for more information or visiting the property. Thus, 58% of the transactions are energy uninformed, although all of them must include an EPC as part of the mandatory documentation to formalise the transaction. Therefore, EPCs are largely fulfilling a bureaucratic role in home transactions.

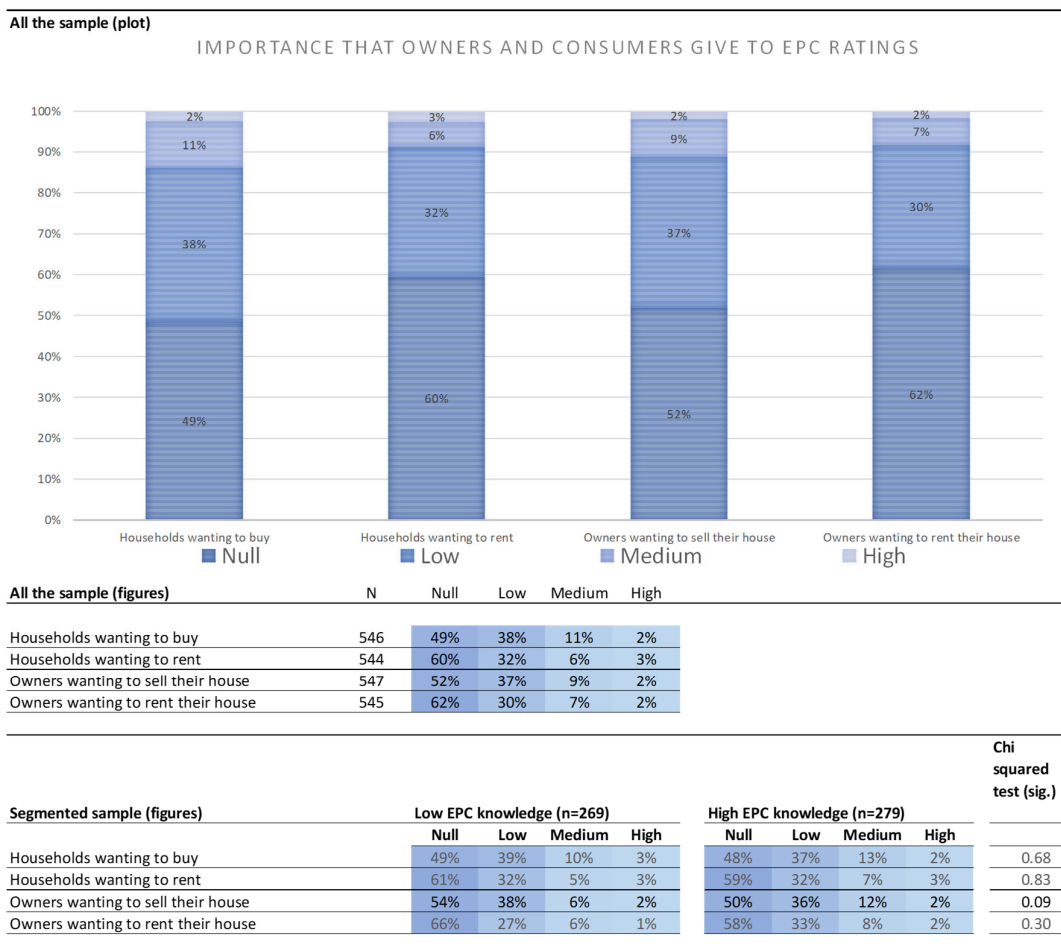
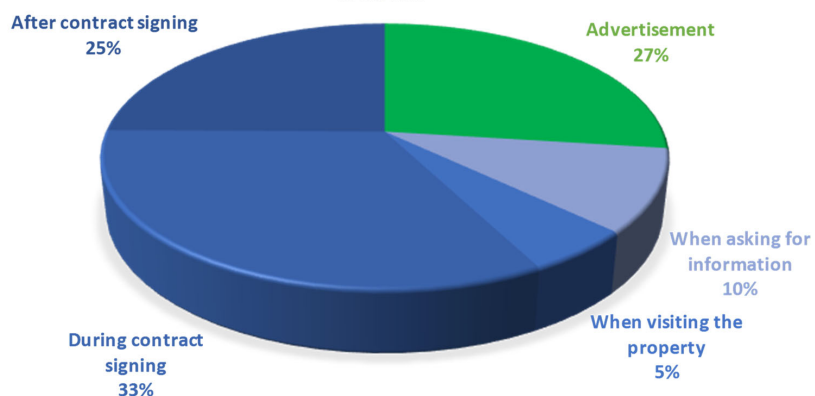


Figure 3. Perceived importance of EPC ratings for owners and users.

In order to understand which aspects are behind the apparent failure of the Spanish implementation of the scheme, realtors were asked to freely express the main issues. Figure 5 details the categorisation of the reasons expressed. The two main reasons can be categorised as “communication” and “reputation” issues. In the first category, realtors stressed the absence of a campaign explaining what the EPC scheme is intended for; what energy efficiency is; its repercussions on health, environment and family budgets; and which architectonic attributes account for energy performance. Also, the fact that technical units used to express energy consumption and CO₂ emissions contribute poorly to understanding the financial implications (i.e., energy savings) on household budgets and environmental repercussions. In the second category, agents perceive that lack of supervision in EPC disclosure, how the certificates are issued, and a generalised confusion has tarnished the scheme’s reputation. Furthermore, EPCs are seen as a mere formality, a fiscal imposition, or a work source to employ certifiers. The agents said that accuracy in energy performance certification is far from optimal; some even commented that in some cases, certificates are made in “desktop mode”, where owners fill a questionnaire, take pictures, and email information to certifiers who have never visited the property.

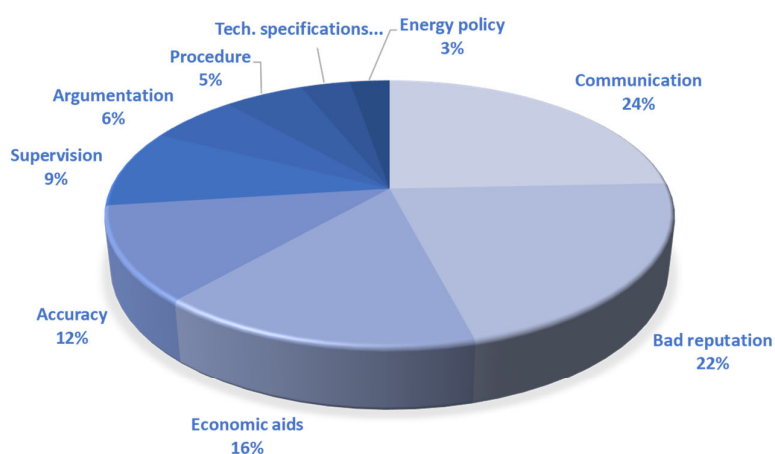
MOMENT WHEN PROSPECTIVE TENANTS AND BUYERS ARE INFORMED ON EPC RATINGS



	N	(%)
Advertisement	148	27%
When asking for information	55	10%
When visiting the property	29	5%
During contract signing	180	33%
After contract signing	136	25%
N	548	

Source: Own elaboration

Figure 4. Moment of disclosure of EPCs in residential transactions.



	N	(%)	Low EPC knowledge	High EPC knowledge
Communication	36	24%	58%	42%
Bad reputation	32	22%	75%	25%
Economic aids	23	16%	48%	52%
Accuracy	17	11%	41%	59%
Supervision	14	9%	64%	36%
Argumentation	9	6%		
Procedure	8	5%		
Tech. specifications	5	3%		
Energy policy	4	3%		
	148			

Source: Own elaboration

Figure 5. Perceived issues on implementation of the EPC scheme in Spain.

Finally, it is worth saying that in the opinion of the respondents, the main argument on energy efficiency being related to energy savings is not valid in regions where climatic conditions have a poor influence on homes' energy demands or when large property prices dwarf possible energy savings.

Again, the awareness level of respondents regarding the EPC scheme seems to be correlated with aspects that are seen as the main issues behind the diffusion of the scheme in Spain.

Despite the efforts of the Institute for the Energetic Diversification (Industry Ministry), the obligation to disclose EPC in property transactions arrived practically without any informative campaign. Agents were thus asked in the survey to state their opinion on the potential effectiveness an information campaign might have on energy-efficient home marketing. Figure 6 shows that such a campaign could improve the advice realtors give when marketing a home; it would also help consolidate energy efficiency as a sales argument. Nonetheless, the surveyed agents showed reluctance to accept a relevant influence on willingness to pay, reduce marketing times, and price negotiation. Clearly, agents with a clear knowledge of EPC are more optimistic about the positive impact of such a campaign in bringing energy-efficiency to the forefront, as well to the creation of a market premium for efficient homes, reducing marketing time, and improving price negotiation and energy advice.

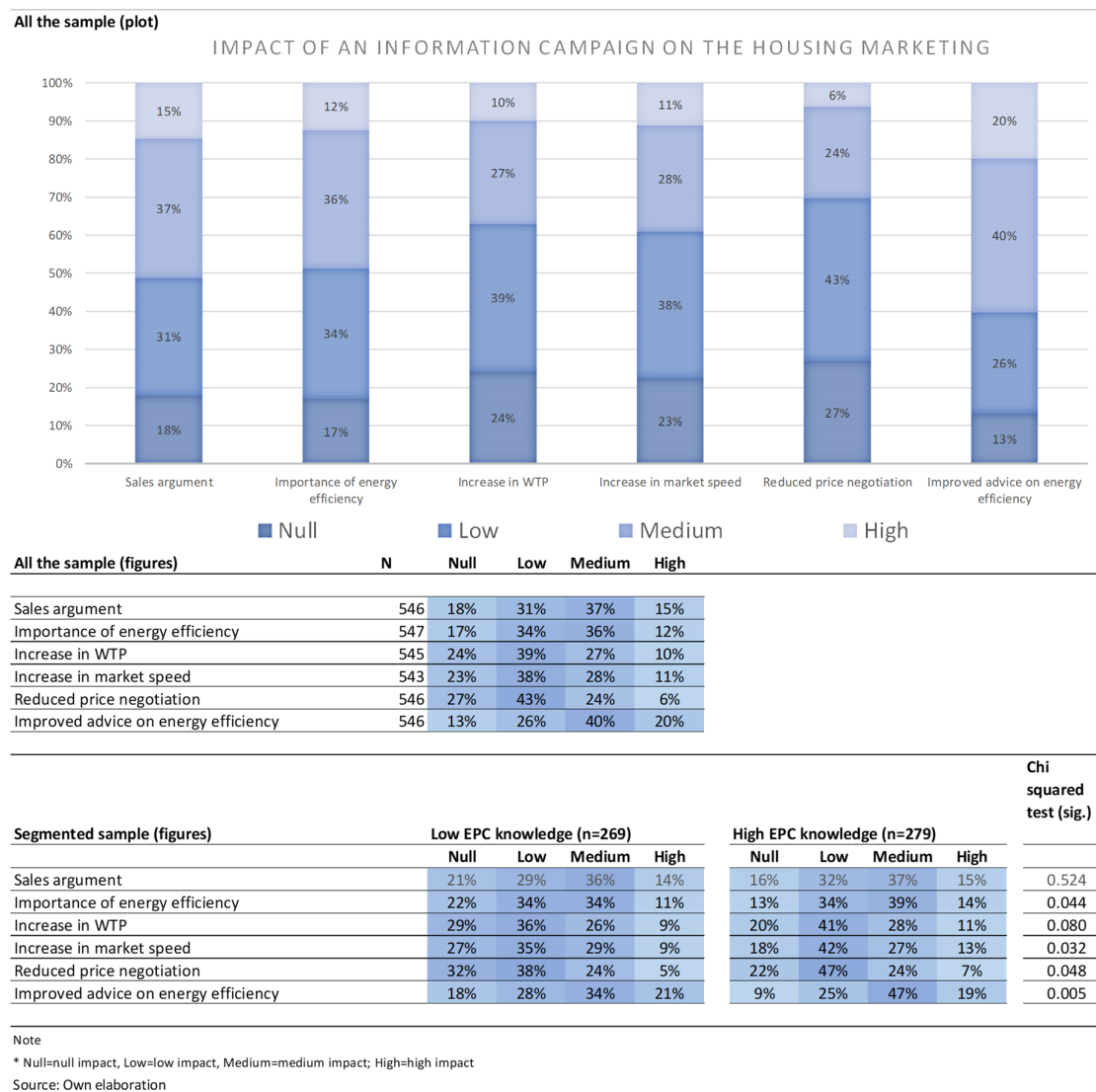


Figure 6. Perceived potential impact of an EPC information campaign.

The respondents gave their opinions on the potential effectiveness of companion policies based on financial incentives and specific information campaigns aimed to promote efficient homes. According to Figure 7, policies with financial implications are seen as more effective than purely information-based ones. Eighty-four percent of the respondents think that valued added tax and property tax rebates for efficient homes have a medium/high potential to foster demand for energy-efficient dwellings. In 2016,

the General National Budget included a proposal to allow municipalities to discount up to 20% of property tax for “A” rated permanent dwellings. Despite such a policy being favourably perceived by agents and developers, the adverse deficit scenario throttled this proposal. Other policies attracting private capital to finance efficient homes, such as “green mortgages”, are also perceived as potentially effective. Albeit in Spain, Triodos Bank introduced a kind of home financing where the interest rate is inversely correlated with energy ratings; its impact remains anecdotic. Nevertheless, this panorama is changing, since large banks (e.g., BBVA or UCI) do participate in the Energy Efficient Mortgage Action Plan, a European project aimed at generating a harmonised scheme to foster this kind of green financing by attracting securitised bonds based on energy-efficient collaterals. Conversely, experts were not enthusiastic about the effectiveness of information-based policies, especially regarding the diffusion of passive attributes. This latter finding stresses the unawareness of such kind of sustainable architectural attributes in Spain, even in the case of realtors exposed to a wide variety of dwellings. However, agents that better understand the EPC scheme did give more relevance to policies on its passive attributes.

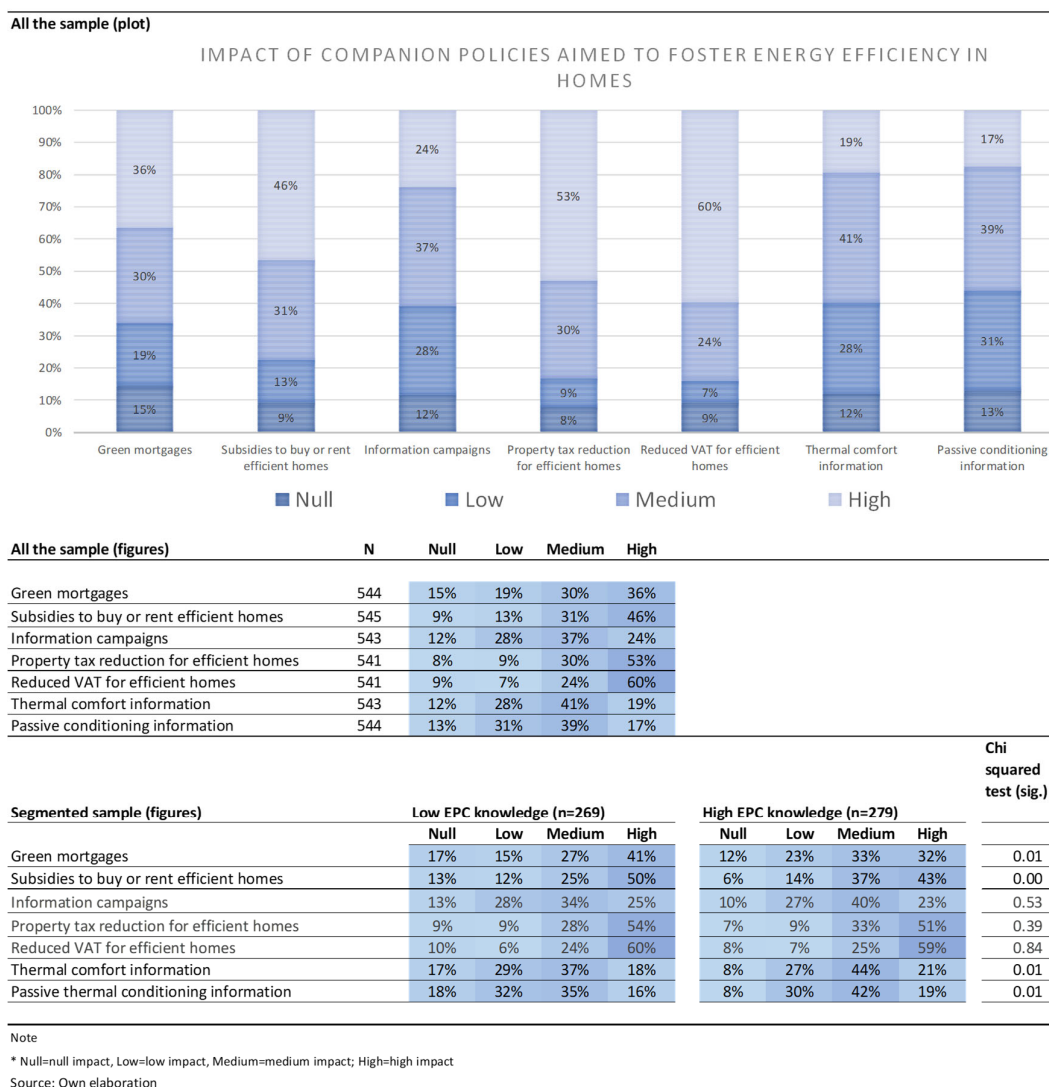


Figure 7. Perceived effectiveness of EPC companion policies aimed to foster efficient homes.

Finally, Table S1, as has been explained in Section 4, contains a multivariate analysis aimed at finding correlations between some of the previously analysed questions. The findings of such an analysis largely ratify the findings of this section. It also highlights some interesting facts, for example,

there is an inverse correlation between the realtors' awareness of the EPC scheme and the region where they deliver their services. Interestingly, EPC-knowledgeable realtors deliver their services in regions where housing prices are expensive, and energy repercussions in family budgets and the ratio of energy expenditure to housing prices are small. This finding has paramount consequences in energy policy spatial diffusion and stresses the need to reinforce it in less dynamic real estate regions, which, in turn, are the regions where energy bills have more importance in family budgets.

5. Conclusions

In order to bring energy transparency to the property market, the EC designed within the Energy Performance of Buildings Directive (EPBD) in 2002 the Energy Performance Certificates (EPC). The derived "energy labels" became almost universally mandatory when advertising a property, both in the rental and selling markets in 2010. The rationale of such a directive was to allow prospective users to learn about the financial and environmental benefits of efficient premises. Eventually, such benefits (i.e., energy savings, environment conservation, and sociological rewards) could capitalise on a larger willingness to pay and increased preference for efficient buildings [48]. Such increased interest might offset any additional production costs, resulting in more development and redevelopment of high-performance premises. In the literature, (see Section 2), inconclusive evidence was found regarding the existence of a market premium for high-rated dwellings. On the one hand, hedonic-based research has mostly reported positive semi-elasticities for EPC ratings, although a marginal number of studies found the impact of such ratings to be null or even reverted. On the other hand, opinion-based research has concluded that the effect of EPC ratings on prices and home selection is negligible. In Spain, the few existing hedonic studies found a small premium for efficient homes in relation to other EU countries, while opinion-based research is largely absent. There were a number of concerns about the overnight transposition of the 2010 EPBD, as discussed in Section 2.1. This paper sought to identify if these issues were solved or not.

This study tries to fill the gap by gathering the opinions of qualified experts in property intermediation by means of four objectives: (i) to identify the awareness level of EPC ratings and its perceived role; (ii) to explore whether EPC ratings play any role in price formation and other marketing aspects, both in the selling and leasing markets; (iii) to identify the main issues surrounding the Spanish transposition of the EPC scheme; and (iv) to ascertain companion policies that, according to realtors, may help foster the development and retrofit of efficient homes. To do so, an online survey form was given to qualified real estate agents across the country. The main findings can be summarised as follows:

- (1) There is a generalised misperception on the aim of EPC ratings, since they are largely understood as a comfort and general architectonic quality indicator, instead of energy consumption and CO₂ emissions markers.
- (2) EPC ratings play a negligible role in housing marketing (price determination, speed to market, and price negotiation). However, the agents that were more aware of the EPC scheme showed a slightly optimistic perspective. Interestingly, it seems that energy performance is somehow more relevant in the selling market than the leasing scenario.
- (3) Energy opacity remains the main issue; most of the agents confirmed that EPC information is largely disclosed to prospective users after the leasing or buying decision has already been taken.
- (4) The scheme is riddled with a bad reputation and communication problems.

A number of issues account for this situation. Communication issues rank as the main problematic aspect. In the absence of an informative public campaign explaining what the scheme is actually all about, the scheme throws at people unintelligible units that describe the financial and environmental implications of energy efficiency. The labels were designed to discuss the technical outputs of the certification process, but little advice was presented on its impact on family budgets. Our respondents also highlighted problems in the supervision of both the certification process and the obligation to

disclose EPC information, right from the advertisement stage. For these reasons, some of them found the EPCs to be inaccurate and unreliable. As a result, the issuing of EPCs has become paperwork necessity to formalise property transactions.

Discussion, Study Limitations, and Further Research

As has been seen, the EPC scheme, as implemented in Spain, is far from meeting the EPBD's goal to promote efficient buildings by means of bringing energy information to the real estate market. However, according to our results, energy performance is largely disclosed to prospective users after they have already made a decision. This issue may derivate in a "lemon-market-problem", producing an inefficient price differential for efficient premises delivering social, environmental and economic benefits [2,6], and consequently in a sub-optimal market diffusion of such buildings.

On the other hand, the extant literature has shown the relevance of correctly informing market agents on the benefits of energy efficiency (see Ramos et al. [49]). In our case, besides the absence of informative campaigns to raise public awareness, the use of odd units to express economic implications is another issue identified by our respondents. The EPBD's Spanish transposition uses kWh/sq.m.p.a. of primary non-renewable energy to express energy consumption. This is quite difficult, even for a specialist, to translate into monetary units in countries where energy prices vary across regions. This issue is also detrimental to other property professions, such as real estate valuation, since it makes integration of this information into valuation techniques difficult (e.g., income approach), as pointed out by Warrens-Myers [9]. Remarkably, this issue has also been reported in other EU countries, which suggests the need for policy action at the European level [24,27]. Furthermore, as suggested by Marmolejo et al. [50], the promotion of efficient buildings should also be supported in communicating the co-benefits for comfort and health.

The need for good reputation and accuracy of EPCs, as pointed out by Sayce [19], is a prerequisite to be taken into consideration by property professionals. The adverse scenario in which the 2010 EPBD was transposed in Spain has resulted in the EPC scheme gaining a bad reputation, as confirmed by our respondents. Thus, it is necessary that public authorities with jurisdiction in terms of supervision assure that EPCs are properly disclosed and the issuance procedure is audited.

It is also necessary to improve property professionals' training regarding energy-efficiency. Hurst & Halvitigala [51] have found that "real estate agents' engagement with house energy-efficient technologies is restricted by their limited understanding of these" (p. 1). Our results confirm this, as agents correctly informed on the role of EPC scheme are more optimistic about its relevance in housing marketing and confident of information-based policies. Wong et al. [52] have pointed out that the perspective of property professionals (realtors, valuers, and financiers) on sustainability features is not trivial, since they can influence the demand for sustainable housing by providing complete information and assessment. In that regard, the Spanish International Realty Alliance is introducing the Green SIRA Realtor Recognition, aimed at training and certify realtors' competences in the environmental, financial and regulatory implications of sustainable homes.

However, as said in the introductory paragraph, information asymmetry is only one of the many market failures explaining the "energy-gap". Gillingham & Palmer [1] have also pointed to the following: the split incentive issue (i.e., principal-agent), which is largely absent in Spain since most of the homes are owned by their users; learning-by-using, which implies a learning curve that fosters the use of efficient premises by future users; and large upfront investments. In this latter aspect, Allcot & Taubinsky [53] suggest that when the regulation becomes insufficient, it should be complemented by public aids. The opinion of our experts largely conveys such an argument: the policies related to the diffusion of the EPC scheme throughout information campaigns are seen as insufficient in relation to these based on financial stimulus. According to our respondents, policies aimed at discounting fiscal pressure related to property transactions (e.g., VAT) or tenure (e.g., property tax) might raise the interest of prospective users and bring to the forefront energy performance of dwellings. However, besides public money, innovative financial initiatives such as "green mortgages" offering interest rates

inversely correlated to energy performance could also pave the road for a new generation of efficient homes. As stated by Murphy [23], EPC acts as a launchpad for more sophisticated mechanisms to drive energy performance improvements (p. 671).

Despite the large efforts to raise the interest of agents to respond to our survey, we received a sample that could be enlarged by future studies to allow in-depth cross-sectional and longitudinal analyses. Subsequently, the conclusions laid in this study should be understood as exploratory. Also, as said in Section 2, it is necessary to fully review the conclusions drawn by hedonic models, and inspect whether the positive market premium for energy efficiency holds when other quality attributes affecting the price and correlated with energy performance are fully controlled.

Supplementary Materials: The following are available online at <http://www.mdpi.com/2075-5309/10/2/27/s1>, Table S1: Multivariate response analysis.

Author Contributions: C.M.-D. and S.S.B. have designed the survey, gathered the sample, analysed the information and produced this paper; C.D.M.-Á. and L.D.M. have aided in shaping the survey and gathered respondents. All authors have read and agreed to the published version of the manuscript.

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