Energy efficiency in the residential market and implications for architecture education in Spain

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ABSTRACT: In this article, the authors have summarised the main findings of an empirical programme aimed at exploring the relevance of energy efficiency, as measured by the energy performance certificates (EPCs), in the Spanish housing market. The conclusions drawn from hedonic models, choice experiments, in depth interviews with housing experts and surveys of real estate agents were to provide the main implications for architecture education. The results suggest that despite directives to promote energy-efficient buildings, the impact on housing is far from effective. Furthermore, the way such directives have been implemented in Spain has led to the *banalisation* of the policy and even its incorrect comprehension. Architects can play a paramount role in the promotion of efficient homes, not only from the technical and design perspective, but also in acting as energy experts assessing both developers and final users on the benefits of energy efficiency on health, economy and comfort. This challenge requires a reconsideration of how architects are trained, both at undergraduate and postgraduate levels.

INTRODUCTION

In Europe, buildings are largely the source of both energy consumption and CO_2 emissions. This issue has significant environmental and geopolitical implications because of dependence on energy imports. However, opportunities also arise to promote a green economy, create employment and wealth, while preserving the environment and health. The Energy Performance of Buildings Directive (EPBD) fosters energy-informed real estate transactions by making it mandatory that an energy performance certificate (EPC) is obtained and to include - since its recast in 2010 - the EPC ranking in the property advertisement.

The rationale of such a policy lies in the idea that information asymmetries lead to suboptimal decisions. The performance of buildings results from a complex interaction of architectonic and design attributes. Therefore, it is necessary to *massage* this complexity into a comprehensible indicator, such as a ranking associated with unitary energy consumption and encapsulate emissions. Informed users may capitalise on future economic and environmental benefits implied by this ranking through an increased willingness to pay for efficient premises. As a consequence, increased prices may offset additional costs associated with sustainable construction, animating developers to produce efficient buildings, creating a virtuous cycle.

A growing number of studies based on the hedonic methodology have found that such a green market premium for efficient EPC rankings is actually present in large markets, including residential [1]. Nonetheless, this is not homogeneous across countries, possibly because of the impact of climate and energy costs on residential prices. In addition, there are diverse construction traditions and regulations, and, perhaps, divergent environmental concerns.

Intriguingly, the conclusions derived from expert-based studies have found that EPC rakings have a negligible impact on prices and the marketing of the property. All in all, this portrays an inconclusive scenario. In southern countries, led by Spain, the evidence for EPC impact on the residential market is even scarcer, despite Spain's dynamic housing market and residential tourism in coastal and mountain areas dominated by retirees from northern European countries.

To tackle the lack of knowledge regarding EPC impact, a comprehensive programme framed in the project, EnerValor, has been envisaged. The aims are:

1) To explore the relevance of energy efficiency in the residential market.
2) To learn whether market premiums for efficient houses are present.
3) To research the spatial and social implications of such premiums, if any.
4) To learn whether EPCs are understood as reliable, effective and relevant by stakeholders of the housing industry.

In this article, the authors have reviewed the main findings of the EnerValor project, to extract the implications for architects' education. Architects in countries, such as Spain play a monumental role in the residential sector since their competencies go beyond design and facultative management. In Spain, architects have professional competencies to design and calculate structures and buildings installations, as well as to perform real estate valuations. Their role in promoting efficient buildings can be upgraded if educational programmes include the competencies and knowledge on the economic, environmental, comfort and health implications.

The remainder of the article is organised as follows: first, the main findings from the EnerValor programme are reviewed; second, the implications of such findings for architecture education are discussed; and third, the concluding sections summarise the work done.

MAIN FINDINGS OF THE ENERVALOR PROJECT

Efficient Building Development in Spain

The EnerValor findings strongly suggest that the virtuous cycle of efficient building development discussed above is not manifest in Spain. Conversely, the analyses suggest that the vicious circle of inaction suggested by Cadman is well implemented [2]. Despite that, it was found - using a hedonic model - in Barcelona, there was a market premium for efficient buildings of 0.85% for each EPC rank [3]. Next, in the study of Marmolejo-Duarte and Chen, the authors found that, as time goes on, this premium increases for the most efficient homes [4]. This is an excellent conclusion for developers interested in carrying out efficient real estate projects. Although the Spanish green premium is smaller than that reported for other studies, ranging from -0.4% in Oxford up to 11% in Wien for each EPC rank.

The statistical findings presented by the authors contradict opinion-based research. Delgado et al after having interviewed in-depth 20 experts on housing design, development, banking, real estate valuation, certification and supervision, conclude that EPC rankings have no impact on their decision-making [5]. To ratify such conclusions, Spairani et al surveyed realtors, whose opinions are similar [6]. According to their experience EPC rankings have a negligible influence on the housing market: energy efficiency has little impact on prices, speed to market and price negotiations. Hence, there is a paradox: on the one hand, these hedonic analyses point to the existence of a market premium, and on the other hand, housing experts refute any influence from energy efficiency.

Marmolejo-Duarte and Chen have refined their hedonic analyses [1]. Such refinement consisted of segmenting the housing sample into submarkets and running separate hedonic models. The results suggested that EPC rankings have no impact on the segment of state-of-the-art apartments; conversely, in the case of poor housing boasting no amenities (i.e. no lift, heating, air conditioning, and so on), the impact of EPC rankings was enormous. So, EPC rankings play an incorrect role in price differentiation in absence of other quality attributes [7].

The same conclusions were drawn in Marmolejo-Duarte et al using a geographically weighted approach [8]. The authors discovered that the impact of EPC rankings is maximised in zones inhabited by poor people. That means the main equity of the most vulnerable population is depreciated by the *brown* discount of their inefficient homes. At the same time, such a low-income population has limited resources with which to carry out an energy retrofit. As a result, a well-intentioned environmental policy has unexpected social repercussions when public support is not present.

EPC Rankings are Misunderstood

Marmolejo-Duarte et al surveyed potential home users and found that the general population does not understand the aim and meaning of EPC labels, especially in the case of seniors and the low-income/low-educated [8]. They also do not understand the technical units (kWh/m^2/year and CO_2 tonnes) legally established for the energy and emissions implications of EPC rankings. Also, in this survey to realtors, worryingly, they failed in signalling the actual role of EPC labels, since they perceive them as comfort and general quality indicators, instead of energy consumption and CO_2 emission estimations. Too, they failed in recognising the architectonic attributes that drive energy efficiency.

This general unawareness has been produced by overnight implementation of the EPBD in Spain: there were only 47 days between the date of adoption of the RD 235/2013 and the date when it was mandatory to get an EPC to advertise a property. Furthermore, there was practically no information campaign because of the economic crisis.

Experts in real estate valuation also have a problem with energy consumption as it is expressed in an EPC label, since energy consumption refers to primary energy, and the translation into Euros is not easy. Therefore, it is not possible to use an EPC to develop a cash-flow model intended to assess the value of commercial property.

Moreover, the interview-based research has revealed that the relatively benign climate of the country (in relation to northern and continental climates) is a reason why the argument for energy savings is not compelling for Spanish households, and it is overshadowed by high house prices. Also, such an argument is spurious in the case of fuel poverty households unable to maintain the minimum temperature for comfort. Quite the contrary, the experts think that comfort and health implications should be featured in the marketing of efficient housing.

To explore whether households do give importance to energy efficiency when economic and environmental implications are explained in a comprehensive way, Marmolejo-Duarte and Bravi performed choice experiments [9]. These consisted of submitting a sample of potential house users to an experiment, where they are forced to choose the home they are willing to buy/lease from a set of alternatives. Each of the alternatives has different architectonic attributes, including EPC ranking. Further, choices are analysed through a random utility model, so as to identify, which attributes drove the choice. The results suggest that households do prefer efficient homes, even above other attributes associated with the general quality and layout.

This preference is increased when the potential house users are informed of the meaning of energy efficiency and the architectonic attributes driving such efficiency, as reported in Marmolejo and Ampudia [10]. On the other hand, using a contingent valuation approach, in the study of Marmolejo-Duarte, it was found that people increase their willingness to pay (WTP) for efficient homes when they believe their health and comfort will improve by living there and also when they correctly understand the meaning of energy efficiency [11]. In general, when people are informed in monetary terms how much they will save with an efficient home, they directly translate such savings into their WTP for such a dwelling. This trade-off has a large potential for the promotion of efficient homes.

Both real estate agents and other housing stakeholders believe that in Spain the EPC scheme has been trivialised and both consumers and suppliers see EPC labels as a mere bureaucratic requirement in real estate transactions. Also, there is high non-compliance with the obligation to include EPC rankings in property advertisements. As reported in Marmolejo-Duarte and Chen only 45% of housing advertisements include EPC rankings [12]. The suggestion in that paper is, that in some Spanish cities there are serious anomalies in the advertising of energy information since the correlation between listing prices and EPC rakings is reversed; i.e. the lower the performance, the larger the price after taking into consideration other attributes. Furthermore, the non-compliance is not homogeneous across the city; i.e. the proportion of non-informed advertisements is larger in low-income neighbourhoods. As a consequence, the population whose budgets can be most positively impacted by energy savings, is the least informed.

Hence, the evidence suggests that EPC labels are not acting as good information sources for future tenants and owners, and are not driving housing choice from the perspective of energy efficiency. The results of the survey of real estate agents confirm this conclusion: 56% of surveyed realtors confirm that consumers are informed on the performance of the selected home only at contract signing or even later. So, EPC rankings cannot play a significant role in house buying decisions. There is also evidence that in some cases the certification process is far from rigorous, since some certificates are issued without visits to the property: the certifier asks the owner to take pictures and complete a checklist questionnaire. For that reason, in Spain the EPC scheme is far from being respected by investors and developers.

Despite the above, there is, in Spain, hope for the promotion of efficient buildings. Some interviewed experts have indicated the existence of a market niche interested in developing and using efficient homes. It is comprised of expatriates from northern and central European countries, where energy efficiency has been long developed. Also, the younger, higher educated and more wealthy population familiar with high-tech devices are part of such demand. Housing co-operatives and private cohousers interested in environment conservation also look to develop sustainable buildings and play an important role in the architectonic design process.

The advice of interviewed experts and the research findings are synthesised thus:

1) Redesign EPC labels, so as to express economic and environmental impacts in a comprehensible way.
2) Produce an integral communication programme to create awareness of energy efficiency in homes; the repercussions and relationship with architectonic attributes and user behaviour.
3) Public administrations must oversight the compliance of EPBD and the technical rigour of the certification process.
4) In the marketing of energy efficiency new arguments related to comfort and health should be introduced.
5) Real estate agents should be trained to improve their advice in terms of energy efficiency.
6) Real estate managers should be aware of the potential for retrofitting managed buildings.
7) Take advantage of the imminent green labels with interest rates inversely correlated to the energy efficiency.
8) Fiscal aids and subsidies should be EPC companion policies.
9) Since investment amortisation in efficient technologies requires a long time, it is necessary to research how to reduce uncertainty as a way of risk mitigation.

How architects should be educated, so as to participate in such a transition is discussed in the next section.

IMPLICATIONS FOR ARCHITECTURE EDUCATION

Sagarra, the former dean of the Barcelona School of Architecture (ETSAB), summarised the main challenges that education in architecture faces as globalisation, reorganisation and externalisation of labour markets, rapid technological change, processes in industry (e.g. Industry 4.0) and digital imagery [13]. These jeopardise the traditional education model. Spiridonidis and Voyatzaki stress pressure from the financial sector and political factors [14]. Furthermore, contemporary students are digital natives, not used to reading or writing, but rather to seeing, listening,

posting and texting. It is evident, they cannot be taught in the *traditional* way [15]. Such challenges imply that knowledge is becoming more sophisticated and diversified, which, in turn requires a transversal approach across other subjects around architecture education. In Spain, as in many other countries, the organisation of faculties into departments certainly *hampers transversal reflexions on the studio praxis* [13]. On the other hand, in the past decades, tenured professors with no parallel professional practice have occupied most of the permanent positions.

This situation has been exacerbated by research production goals required not only to gain such positions, but to progress in an academic career. As a result, architecture professors, isolated in their respective departments, are also separated from the rich and intrinsically multidisciplinary professional experience. Concurrently, the labour market has produced a *de facto* specialisation of practising architects. Puig-Pey identifies three profiles for architects: designers, managers and advisors, and claims the actual architecture programmes in Spain unsuccessfully train students as managers and advisors [16]. Education is organised at the Bachelor level lasting five years + one year professional-awarding Master, and specialisation requires one or two additional years.

This discouraging prospect did not change during the adaptation of the European higher education area (EHEA); hence, reducing the attractiveness to international students of Spanish schools. Such a structure fails to produce managers and advisors, and reinforces the ancient role of architects as designers and project supervisors.

Education for the Promotion of Efficient Buildings

The need to improve energy efficiency and, more generally, sustainability and resilience in architecture is global in origin. While the pressure to reduce energy usage in buildings started with the Oil Crisis of the 1970s, architectural programmes did not reflect a reaction until some decades later [17]. Architecture, as a profession, only endorsed sustainability after the 1992 Earth Summit, through the Declaration of Interdependence for a Sustainable Future agreed in the 1993 World UIA Congress (*Union Internationale des Architectes* or International Union of Architects). At the start, education for sustainability was concentrated in postgraduate programmes basically because legal requirements, new technologies and demand expectations were quite new and needed to be learnt by experience. There are many examples of such programmes, most of them conjointly operated with industry, to train professionals to be awarded as energy efficiency/sustainability advisors/assessors by public or private organisations [18].

Such skills progressively have been included in undergraduate studies, and this is important for the promotion of efficient buildings in countries such as Spain, where a BArch is completed in six years. Most scholars agree that energy efficiency needs to be embedded in design studios inherited from the *atelier* model pioneered by École des Beaux-Arts. Two main virtues of this model have been highlighted: a design studio is student-centred and it is based on a problem-solving paradigm. The Design Education Unit College has shown that the design, by itself, promotes learning [13]. So, what is the best way to incorporate sustainability criteria into the design studio? The responses of the world are diverse.

In Thailand, the acquisition of knowledge and skills to integrate sustainability aspects into design include a workshop at the final stage of the BArch [19]. Promoted by this methodology are the qualities of self-evaluation, self-criticism and self-awareness. Schneider-Skalska thinks that sustainability criteria should be included at the very beginning of the academic programme and explains that at Cracow University of Technology they are embedded in lectures with design classes assisted by lecturers from a range of disciplines [20].

Jagiełło-Kowalczyk opines the need to take advantage of digitalisation not only as drawing and visualisation, but also using business information modelling (BIM) to estimate the impacts over energy performance and comfort produced by designs [21]. At the Slovak University of Technology in Bratislava, Pifko uses specialised software to simulate climatic conditions and performance (for example PHVP, MCHD or CESBA) with an experimental physical module [22]. Included in the module is a 6 x 6 x 6 m model, where students can measure the impact of their design decisions in terms of orientation, window size/distribution and even location within the city. In this regard, the experience is relevant of the second school of architecture in Barcelona (ETSAV or Vallès School of Architecture).

The School is the only one selected three consecutive times to participate in the Solar Decathlon initiative. It has promoted the creation of a permanent 1:1 scale laboratory RESSÒ (a regeneration strategy and tool for teaching), in co-operation with industry, to improve comfort conditions at the highest level. It facilitates explaining to the local community how to improve the performance of their homes. All this suggests that the design studio is the natural place to incorporate sustainability criteria, from the beginning of the education, assisted by recent advances in model simulation and also physical models.

Nevertheless, even when a transversal approach is followed, the exposure to multidisciplinary contributions is limited. The RMIT University, Australia, has designed a disruptive PhD model that ties research in architecture to professional offices. The effect of this model is to allow experienced architects to develop their dissertation related to their professional experience. Two modalities are distinguished by this model. The first is intended for practitioners with experience centred on projects and technologies. The second is for senior architects in the *sunset* of their professional career; it is intended to provide a critical perspective of their professional *trajectory*. Burry explains that this model

emulates the nurturing experience in the physicians-hospital relationship [15]. By using architects' own design experience as a research subject, the programme tries to capture tacit knowledge, from different disciplines, that normally occurs in architects' offices.

Upgrading the Role of Architects According to EnerValor

Architects, as specialists in energy performance, can act as advisors to owners of households, who are willing to retrofit their homes. This advice requires not only technical knowledge, which is nowadays available in most undergraduate programmes, but also managerial and economic analytical skills, to deliver services on legal aspects, financing, public grants and amortisation of investments. To succeed in this, architects must expand their knowledge on the implications of sustainable attributes and energy performance on health.

Research, as a way to identify reliable evidence, has great potential. As a consequence, a more compelling discourse might be developed to convince other stakeholders. Interestingly, contemporary building certifications have started to incorporate aspects that, beyond comfort, impact on quality of life and wellness. The WELL certificate (International WELL Building Institute (IWBI) is a public benefit corporation) is an example of such a trend. Departing from a holistic knowledge on energy efficiency implications, architects would be in the position to train other professionals from the real estate industry, such as realtors and facility managers, to expand their work scope.

Following the 2015 Paris Agreement to expand green finances, it is necessary to explore the implications of energy efficiency on investment risk mitigation. Architects can contribute by showing that efficient premises are a way to reduce uncertainty since they are resilient. They can also explain implications to professionals from other disciplines, such as finance. In countries such as Spain and Latin American, where real estate valuations are performed by architects, it is necessary to advance toward green valuations. That will train valuers, so as to incorporate the implications of energy conservation, building life cycle and marketability into valuations.

CONCLUSIONS

As Schneider-Skalska has pointed out, effective teaching of sustainable design requires consideration of politics, market, property development, production and education [20]. Architects interact in a context dominated by communities, decision-makers and investors. It is necessary to distinguish the culture of producing sustainable premises from the marketing approach, to pursue certification as a means of promoting development. While such approaches do not exclude each other, their implications are quite different. From a social perspective, architects should encourage the educating of a society towards a more sustainable lifestyle. Education that results in sustainable societies requires a position regarding the global system, because education is based on values, which are not neutral. It requires a broad approach that is not only centred on universities [23].

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